Health Information and Quality Authority

An tÚdarás Um Fhaisnéis agus Cáilíocht Sláinte

Draft health technology assessment of teledermatology to support the management of primary care referrals

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Foreword

Demand for outpatient dermatology services has increased in recent years, driven largely by Ireland's ageing population, the rising incidence of skin cancer, and improvements in the treatments and technologies available for the management of chronic skin conditions. Demand has increased faster than capacity, contributing to long waiting lists for access to dermatology services. In light of these lengthy waiting lists, strategies to improve access to specialist services are needed.

Teledermatology enables the use of static images or live videoconferencing technology to support triage, diagnosis or monitoring of skin conditions without the patient being physically present. A teledermatology-supported referral management system could be introduced in Ireland to augment the current referral pathway in by including static images alongside a referral letter or through live videoconferencing after a referral letter is received. With both of these methods and with the ranking of patients based on clinical need, there is the option to discharge patients back to primary care if a face-to-face dermatology appointment is not considered necessary.

The aim of this HTA was to evaluate the efficiency, safety, clinical effectiveness and economic impact of using teledermatology to support the management of patient referrals from primary care to secondary care dermatology services. Italso assessed the organisational, social, legal and ethical issues associated with such a decision.

Work on the HTA was undertaken by an Evaluation Team from the HTA Directorate in HIQA. A multidisciplinary Expert Advisory Group was convened to advise the Evaluation Team during the course of the HTA. HIQA would like to thank the Evaluation Team, the members of the Expert Advisory Group and all who contributed to the preparation of this report.

Dr Máirín Ryan

Deputy Chief Executive & Director of Health Technology Assessment

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The membership of the EAG was as follows:

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Note: *Consultant dermatologists were nominated by the HSE to participate.

Organisations and individuals that assisted HIQA in providing information, in writing or through meetings, included:

- National Cancer Control Programme
- National Treatment Purchase Fund
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Conflicts of Interest

None reported.

Executive Summary

1 Background

Demand for outpatient dermatology services in Ireland has risen due to an ageing population, increasing skin cancer rates, and advances in treatment for chronic skin conditions. Demand exceeds capacity, resulting in long waiting lists. The HSE Model of Care for Dermatology identifies teledermatology as a potential strategy to improve access to care, pending the outcome of further assessment. Teledermatology involves the use of static images or live videoconferencing technology by dermatologists to support the diagnosis, management, or monitoring of skin conditions without the patient being physically present. Teledermatology-supported referral management involves a dermatologist using images, videos, or live interactive video in addition to the clinical information provided as part of the referral from primary care to make an initial management decision, and prioritise patients identified to require in-person consultation or a procedure.

An aim of the HSE Model of Care for Dermatology is to increase dermatologists' capacity to triage referrals effectively. A teledermatology-supported referral management service has the potential to support timely and appropriate care, improve resource efficiency, and expand access. However, its economic impact and effects on care quality must also be evaluated.

The HSE requested HIQA to carry out a health technology assessment (HTA) evaluating the clinical effectiveness and economic impact of teledermatology-supported referral management for adult and paediatric patients.

2 Description of the technology

Many patients with dermatological conditions can be managed in primary care. However, some patients require referral to specialist dermatology services due to an inadequate treatment response, complex or rare diseases, diagnostic uncertainty, or suspected malignancy.

Teledermatology enables the use of static images or live videoconferencing technology to support triage, diagnosis or monitoring of skin conditions without the patient being physically present. There are two main types of teledermatology:

- store-and-forward (asynchronous): typically involves capturing digital images of skin conditions and transmitting them with relevant clinical information to dermatologists for later assessment. There are different technologies used to capture the images ranging from basic digital cameras to specialised imaging

devices, such as dermatoscopes and devices that offer both macro and micro magnifications.
- live interactive (synchronous): uses live videoconferencing for real-time consultations between patients and dermatologists.

Access to specialist dermatology services is currently facilitated through a referral letter sent from the general practitioner (GP) to a dermatology service. In Ireland, this can be sent electronically through Healthlink, or alternatively by post, fax, or secure email (HealthMail). On receipt of the referral letter, it is sent for clinical prioritisation, also known as clinical triage or triage. The referral will be either accepted and assigned a Clinical Prioritisation Category (urgent, semi-urgent, or non-urgent), redirected, or rejected. Once triaged, the patient is placed on a waiting list for a face-to-face (FTF) appointment in secondary or tertiary care dermatology services.

A teledermatology-supported referral management system could be introduced in Ireland to augment the current referral pathway in several ways, either through store-and-forward or live-interactive technology. With store-and-forward, images could be provided alongside the referral letter from primary care with the images used to triage the patient based on clinical need. With live-interactive, an initial live interactive appointment in a location convenient for the patient could replace the first FTF appointment offered to patients, at which point the patient would be triaged. Both approaches, as well as ranking patients based on clinical need, allow for the option of a dermatologist to discharge patients back to primary care with advice when a FTF appointment is not considered clinically necessary.

Internationally, teledermatology has seen significant growth over the past decade, with 21 of 23 countries examined implementing teledermatology nationally, regionally, or through pilot studies. The global trend favours store-and-forward models, supported by dedicated electronic referral management platforms.

3 Epidemiology and burden of disease

Skin conditions form a large and heterogeneous group of conditions which affect between 30 to 70% of people globally, and approximately 54% of the Irish population each year. Skin cancer accounts for over one third of invasive cancers in Ireland, with incidence rates on the rise. The age-standardised incidence rate of melanoma increased by 33% among women and 140% among men between 2002 and 2022. The age-standardised incidence rate of non-melanoma skin cancer (NMSC) rose by 28% among women and 32% among men between 2002 and 2021.

It is projected that both melanoma and NMSC rates will increase in the coming years.

In addition to skin cancer, inflammatory and infectious skin conditions contribute toward demand for dermatology healthcare services. Skin conditions are a common reason for a GP visit, although without a national registry or database, it is difficult to quantify the true burden of skin conditions in primary care. Approximately 21.3 million GP consultations occur each year in Ireland with studies estimating that between 7.6 and 8.6% of these relate to a skin complaint. This results in potentially 1.6 to 1.8 million GP consultations each year associated with a skin condition.

Demand for outpatient dermatology services has continuously increased in recent years. While the number of whole-time equivalent (WTE) consultant dermatologists has steadily increased, demand has outpaced capacity. The number of referrals to dermatology outpatient departments (OPDs) rose by 55% between 2019 (n=64,220) and 2024 (n=99,994). Over the same period, the number of new patients seen increased by only 21%. A proportion of suspected pigmented lesion referrals are sent to plastic surgery and while it was not possible to quantify this number, it suggests that demand for dermatology services is likely greater than reported here.

At the end of January 2025, 60,821 patients were waiting for a dermatology OPD appointment; 51.7% had been on the waiting list for 0-6 months, 26.0% for 6-12 months, 11.2% for 12-18 months, 7.9% for 18-36 months, and 3.2% for over 36 months.

Lower-acuity referrals make up the majority of dermatology outpatient referrals; however, most appointment slots are allocated to urgent cases due to necessary clinical prioritisation. Despite this, only a small proportion of urgent cases are seen within recommended timeframes. Delays in accessing specialist dermatology services can worsen health outcomes including reduced survival for cancers diagnosed at later stages and increased physical and mental burden in chronic inflammatory conditions.

4 Clinical efficacy, effectiveness, healthcare service utilisation, and safety

A systematic review was undertaken of the clinical efficacy, effectiveness, impact on service utilisation, and safety of teledermatology-supported management of primary care referrals compared with traditional direct referral to FTF dermatology.

Overall, 120 studies across 141 publications were included, of which 10 were randomised controlled trials. To assess the certainty of evidence, GRADE was

conducted on the key outcomes of percentage of appointments avoided, diagnostic concordance, risk of incorrect diagnosis, and safety. Most studies evaluated store-and-forward (SAF) teledermatology, and mainly acquired images at the primary care appointment rather than at a specialised imaging clinic.

Concordance between teledermatology and usual referral pathways was assessed using multiple measures across various clinical outcomes:

- Teledermatology demonstrated moderate to high triage concordance with usual care referral pathways.
- Percentage concordance with primary diagnosis between teledermatology and FTF or histology varied by indication. For the suspected melanoma population, it ranged between 75% and 91%. For inflammatory and or infectious conditions, it ranged between 62% and 70%. Pooled estimates were 75% (95% CI: 68% to 81%) in a suspected cancer (mixed) population and 78% (95% CI: 74% to 81%) in a mixed dermatology population. For all analyses there was significant heterogeneity across studies.
- For suspected cancer (mixed), the risk of incorrect diagnosis was higher for teledermatology compared with FTF evaluation (risk ratio: 1.27 (95% CI: 1.15 to 1.40)). The risk ratio (RR) was 1.51 in a NMSC population, and ranged from 0.67 to 0.77 in a suspected melanoma population, and from 0.85 to 1.43 in a mixed dermatology population; although these results were not statistically significant.
- Including differential diagnoses improved concordance estimates, suggesting that teledermatology aligns well with FTF in clinical reasoning.
- Diagnostic concordance was positively influenced by higher image quality and also by the confidence of the teledermatologist in their diagnosis as well as their years of teledermatology experience.

Management recommendations made by teledermatology within a suspected melanoma population appeared comparable to FTF evaluation. In a suspected cancer (mixed) population, recommendations also tended to align with those made through traditional FTF consultation. In a mixed dermatology population, teledermatology showed high agreement for surgical and biopsy-related decisions and moderate concordance for recommendations relating to general medical management and diagnostic requirements. Overall, management concordance tended to exceed diagnostic concordance, supporting the reliability of teledermatology in guiding management decisions within a broader referral management pathway.

Evidence on the clinical course of disease following teledermatology assessment compared with usual care assessment was limited. Of the six studies assessing this outcome, none demonstrated a significant difference between teledermatology assessment and FTF evaluation.

Safety was reported in the context of incidental detection rates, misdiagnosis frequencies and the clinical impact of incorrect diagnoses. Across studies, the direction of effect was generally consistent, with no major safety issues unique to teledermatology identified. Occasional diagnostic or management inaccuracies were reported, underscoring that while teledermatology can support referral management, it does not eliminate the inherent risk of error in clinical assessments.

Compared with routine referral to FTF dermatology consultation in both mixed dermatology and indication-specific populations, there is evidence that teledermatology-supported referral management reduces times to definitive treatment, biopsy and consultations; averts the need for FTF specialist dermatology consultation in 13 to 94% of cases; and has a lower risk of missed appointments.

GRADE certainty of evidence ranged across indication subgroups from very low to low for percentage appointments avoided; low to moderate for percentage concordance; very low to moderate for risk of incorrect diagnosis; and low to moderate for safety.

While there is a large body of evidence assessing the use of teledermatology-supported referral management, studies were heterogeneous in the type of intervention used, how outcomes were measured, and often included relatively small sample sizes. Despite the limitations, the direction of effect across most studies was similar and supported the use of teledermatology. As teledermatology is now widely implemented internationally, further large, high-quality RCTs are unlikely, and the existing evidence base is therefore likely to represent the best available to inform decision-making. The evidence should be considered collectively in the context of a complete care pathway as individual outcomes captures reflect only one element of the process; interpretation of outcomes in isolation may give an incomplete picture of the overall impact of teledermatology.

5 Systematic review of economic evaluations

A systematic review was undertaken to identify, synthesise, and critically appraise the international evidence on the cost effectiveness of teledermatology for the management of patient referrals from primary care to consultant-led dermatology services in secondary and or tertiary care versus conventional referral pathways.

The review included 20 studies. From these, three were full economic evaluations (cost-effectiveness analysis, cost-utility analysis), while the remaining studies only considered cost outcomes (cost-consequence analysis, cost-minimisation analyses, costing analyses). Eleven were from Europe, six from North America, two from New Zealand and one from Australia. With one exception, studies were limited to adult populations.

Eighteen economic studies compared SAF teledermatology with conventional FTF consultations. Three studies considered cost-effectiveness or cost-utility, two of which reported reduced costs associated with SAF teledermatology, and one reported teledermatology to be cost effective. Of 15 studies that only considered cost outcomes, 12 reported reduced costs associated with teledermatology.

Two studies compared live-interactive (LI) teledermatology with conventional FTF for triage of referrals. One study reported reduced costs with the use of teledermatology, while the second study reported additional costs with its use.

The included studies were considered to be of low to moderate quality largely due to concerns regarding the adequacy of cost considerations, sensitivity analysis, and potential conflicts of interest. The available evidence suggests that teledermatology for managing primary care referrals is likely to be a cost-saving intervention compared to usual care. Although there was variability in the degree of effect, almost all studies on SAF teledermatology reported cost savings, mainly due to the reduction in FTF appointments.

6 Budget impact analysis and resource implications

Demand for outpatient dermatology services is increasing, with 43,500 more referrals in 2024 than there was capacity to see face-to-face. Assuming that referral rates for new patient dermatology appointments rise in line with population growth and demographic changes, referrals will grow by a predicted 1.7% each year, reaching over 120,000 new referrals each year by 2035. The ability of the current dermatology pathway to deal with new outpatient referrals is related to consultant capacity. It is estimated that, on average, a consultant dermatologist within the HSE has capacity for approximately 900 new patient appointments each year.

Budget impact and resource implication analyses were undertaken of teledermatology to support the management of primary care referrals within a SAF model, in which images are captured during the GP appointment and subsequently reviewed alongside standard referral information by a consultant dermatologist. For the main analysis, it was assumed that dermatologist capacity is expanded by an

additional five whole-time equivalent (WTE) consultant posts each year. Secondary analyses assumed maintaining current dermatology capacity, and increasing capacity immediately to meet new referral demand, respectively. The capacity increases were assumed to apply for both the current care and teledermatology pathways. If consultant capacity were to increase by an additional five WTE consultant posts each year, the estimated 10-year incremental budget impact of a teledermatology pathway would be almost €2.7 million. This would comprise €9.8 million primary care costs, approximately €0.25 million in secondary care equipment costs, and a reduced consultant workforce requirement to meet demand, reducing the overall spend by over €7 million relative to the current pathway workforce spend. In this scenario, a TD pathway would enable an additional 270,000 patients to be managed over 10 years, compared with the current pathway. TD would begin reducing the waiting list backlog from year nine, while it would still be increasing with the current pathway.

The budget impact of delivering teledermatology within the capacity currently available for dermatology, that is, 63.6 WTE consultants, would have a similar incremental budget impact of €9.9 million over 10 years. Capacity constraints in this scenario would mean that waiting lists would continue to grow rapidly. Despite this, teledermatology would have a positive impact on removing people off the waiting list and the cumulative waiting list by year 10.

If consultant capacity were to increase to immediately meet new referral demand, most of the recruitment would be required in year one: 45 consultant posts in the current pathway and 37 with teledermatology, representing the current demand-capacity gap. Reduced consultant requirements would mean that the cost of implementing teledermatology would be completely offset by reduced salary costs relative to the current pathway. Both pathways would see positive impacts on waiting list numbers and numbers of patients removed from the waiting list. However, a teledermatology pathway would reduce the number of patients needing to be seen face-to-face and DNAs compared to the current pathway, potentially freeing up capacity in outpatient department clinic spaces.

Results of the analyses were sensitive to changes in the proportion of patients returned to their GP without a FTF appointment. Setting key teledermatology-specific parameters at their lowest efficiency simultaneously, would eliminate the positive impact on waiting lists. If a teledermatology pathway were to be introduced, consideration should be given to what contingencies could be put in place to ensure the service could maintain efficiencies. The main analysis assumed adding five dermatologists per annum, which could prove challenging to achieve in practice.

While it was assumed that demand will increase in line with an ageing and increasing population, there may also be currently unmet demand that will only become apparent as capacity expands. Increases in demand above what has been estimated here would place an additional burden on the service.

7 Organisational considerations

If implemented, consideration of the type of teledermatology model used would be important. A SAF model with images captured during the primary care consultation that are subsequently reviewed by a consultant dermatologist, who may either provide advice to the GP if a FTF appointment is not clinically necessary or triage the patient for a FTF appointment, would likely be the most feasible option to integrate teledermatology into the existing referral pathways.

Teledermatology-supported referral management would introduce additional steps in clinic workflow; implementation would need to be carefully planned to ensure that these changes ultimately lead to greater efficiency in the referral process. Referrals through teledermatology would require more time from GPs to capture and attach images to the referral and could result in more follow-up appointments when patients are managed in primary care with advice. Introduction of teledermatology would redistribute consultant dermatologist capacity — patients triaged via teledermatology who are ultimately seen FTF require more consultant time compared with current practice, while those managed in primary care following teledermatology triage and advice would overall require less time, offering potential for efficiency gains.

Healthlink, the national e-referral system, allows the attachment of images to referrals and could be leveraged to support SAF teledermatology-supported referral management. Effective implementation would depend on key organisational and IT practices, including the universal adoption of electronic referrals via Healthlink across all referring GPs, replacing any use of post, email, and fax referrals. Additionally, it would require the activation of image attachment capability for Healthlink referrals across all hospitals, along with the consistent addition of images by GPs to appropriate dermatology referrals. Digital review, triage, and management of referrals by consultant dermatologists would be necessary, replacing the paper-based workflow currently used in many dermatology departments.

Appropriate equipment would be required to facilitate a SAF teledermatology-supported referral management pathway. General practices would need access to suitable imaging devices capable of producing high-quality photographs, and consultant dermatologists would require appropriate digital infrastructure to

efficiently review referrals and associated images. Consideration would need to be given to the development of teledermatology guidance and training to support standardisation and quality across the pathway.

8 Patient, social, ethics and legal considerations

Skin conditions are associated with a broad range of patient symptoms that present a significant physical, psychological and economic burden. Access and equity of dermatology care may improve using teledermatology for those with suspected non-cancer skin conditions who may currently be waiting longest for dermatology consultations, through faster and more comprehensive triage and management of cases. Teledermatology may also improve care for those living in underserved areas with higher burdens in terms of travel, time and costs to attend appointments in secondary and or tertiary care dermatology centres.

For GPs or GP practices that are not digitally mature or lack access to high-quality broadband, teledermatology could be challenging to utilise. Support may be required to identify and mitigate barriers to use of electronic referrals and teledermatology to ensure patients are not disadvantaged.

Clear communication with patients prior to teledermatology consultations is essential to enable informed consent and to allow for appropriate management of patient expectations regarding potential benefits or harms of using teledermatology, along with explanation of data protection and privacy safeguards. Clear communication is required regarding the patient cohorts that may require initial FTF rather than teledermatology consultations. The autonomy of patients to optionally choose teledermatology should be respected, but risks low uptake of the service. Benefits from teledermatology may be reduced if suitable patient cohorts are not targeted appropriately.

Replacing some FTF consultations with teledermatology consultations may challenge clinician autonomy by altering responsibilities for GPs and dermatologists regarding patient triage and management. Guidance should be developed based on current best practices that clearly define and communicate GP and dermatologist roles and responsibilities in a collaborative teledermatology triage and management process.

Imaging equipment such as dermatoscopes or digital dermatoscopy used as part of a teledermatology solution are subject to and must be compliant with current EU and Health Protection Regulatory Agency medical device regulations.

Current legislation exists to manage clinician liability in a teledermatology process. The risk of misdiagnosis is already present in the current system of referral to FTF

consultations. Any legal risks to GPs and dermatologists associated with potential misdiagnosis can be mitigated through the implementation of teledermatology processes that are governed according to best practice standards integrated into clinical pathways.

9 Discussion

There is a significant burden on secondary and tertiary care dermatology services in Ireland, evident from the large waiting lists. Unmet need will continue to increase over time unless action is taken to increase capacity in dermatology. Without intervention, it is predicted that there will be more than 500,000 people on dermatology waiting lists in 10 years' time. Teledermatology-supported referral management could help reduce the unmet need in Irish dermatology services by improving efficiency. However, other actions will be needed to fully address capacity shortages in this area, potentially including recruitment of more clinical staff, and insourcing and outsourcing initiatives. More consultant dermatologists are required, although recruiting suitably qualified doctors is a persistent challenge. As teledermatology can be adopted into current referral-management systems with relative ease, it could potentially be considered the starting point of a range of actions to target the demand-capacity gap in dermatology services.

Plain language summary

What did we look at?

A dermatologist is a doctor who diagnoses and treats skin conditions. We looked at whether it would help if a GP included photos when sending a referral letter for their patient to a dermatologist. The dermatologist would use the photos alongside the referral letter to help decide how urgently they need to see the patient. In some cases, the dermatologist might not need to see the patient in person. Instead, when it is safe to do so, they could provide advice to their GP on how to manage the patient's condition.

What challenges does dermatology care currently face?

There has been a rise in demand for hospital dermatology care in Ireland. There are many reasons for this, including Ireland's population getting older, an increase in the number of people getting skin cancer, and new treatments to manage skin conditions. Skin conditions can cause a lot of different symptoms and can have a significant physical, psychological and economic impact on patients and their carers.

In 2024, nearly 100,000 people were referred to hospital dermatology services in Ireland. This number is expected to increase each year. However, there are not enough dermatologists to see everyone, which has caused long waiting lists and delays in getting appointments. Waiting times are long for all patients, but appointments are mostly allocated to patients who need to be seen more urgently. This means that patients who need a less urgent appointment may have to wait up to three years. The HSE target is for these patients to be seen within 26 weeks. Delays in accessing care increases the impact on patients and their carers.

What did we find?

We found that in the context of an overall care pathway where a dermatologist always has the option to see a patient in person if they need to, teledermatology is a safe and effective way to help manage referrals to dermatologists. With teledermatology, some patients do not need to be seen in-person, or can be safely treated by their GP with advice from a dermatologist. That means these patients will have faster access to expert advice to help manage their condition. Using teledermatology will mean fewer patients need to have in-person appointments. This means that patients who the dermatologist wants to see in person will have shorter wait times. With some simple changes, teledermatology can easily be added to the existing electronic referral system used by GPs. The estimated additional cost to the

Health Service Executive is around €2.7 million over 10 years. It is important to know that teledermatology alone cannot meet the growing demand for dermatology services. More dermatologists are also needed to reduce waiting times.

List of abbreviations used in this report

2WW	Two-week wait pathway
A&G	Advice and Guidance
AD	Atopic dermatitis
AE	Adverse event
AI	Artificial intelligence
ANP	Advanced nurse practitioner
BAD	British association dermatologists
BCC	Basal cell carcinoma
BIA	Budget impact analysis
BIU	Business Intelligence Unit
BSA	Body Surface Area
CBD	Cross-Border Directive
CEA	Cost-effectiveness analysis
CI	Confidence interval
CHEC	Consensus on Health Economics Criteria
CHI	Children's Health Ireland
CMA	Cost-minimisation analysis
CROs	Central referral offices
CRT	Clinically recommended timeframe
CSCST	Certificate of Satisfactory Completion of Specialist Training
CSO	Central Statistics Office
CUA	Cost-utility analysis
DLQI	Dermatology Life Quality Index
DNA	Did-not-attend
DPIA	Data privacy impact assessment
EAG	Expert Advisory Group
ED	Emergency department

EHRs	Electronic health records
EQ VAS	EuroQol Visual Analogue Scale
EQ-5D-5L	5-level EuroQol-5 Dimensions index
e-RS	e-Referral Service
EU	European Union
EUnetHTA	European network of health technology assessment
FTF	Face-to-face
FTF_DSC	Face-to-face evaluation with dermatoscopy
FTF_DSC_histo	Face-to-face evaluation with dermatoscopy and histology
FTF_histo	Face-to-face evaluation with histology
FTF_post	Face-to-face evaluation post-intervention
FTF_pre	Face-to-face evaluation pre-intervention
GBD	Global Burden of Disease
GDPR	General Data Protection Regulation
GP	General practitioner
GRADE	Grading of Recommendations Assessment, Development and Evaluation
GS-PEQ	Generic Short Patient Experiences Questionnaire
HCCQ	Healthcare Communication Questionnaire
HIQA	Health Information and Quality Authority
Histo	Histology
HPRA	Health Products Regulatory Agency
HRQoL	Health-related quality of life
HS	Hidradenitis suppurativa
HSE	Health Service Executive (Ireland)
HTA	Health Technology Assessment
iPMS	Integrated Patient Management System
ICD	International Classification of Disease
ICER	Incremental Cost-Effectiveness Ratio

ICGP	Irish College of General Practitioners
ICT	Information and communication technology
IGEES	Irish Government Economic and Evaluation Service
IH	Infantile haemangioma
ISPOR	International Society for Pharmacoeconomics and Outcomes Research
JVBC	The Joint Vascular Birthmark Clinic
LI	Live-interactive
MDR	Medical Device Regulation
MM	Malignant melanoma
MSC	Macroscopy
NCCP	National Cancer Control Programme
NCRI	National Cancer Registry Ireland
NHS	National Health Service
NICE	National Institute for Health and Care Excellence (UK)
NIPHS	Northern Ireland Planned Healthcare Scheme
NMB	Net monetary benefit
NMSC	Non-melanoma skin cancer
NR	Not reported
NTPF	National Treatment Purchase Fund
OECD	Organisation for Economic Co-operation and Development
OOP	Out-of-pocket
OPD	Outpatient department
OR	Odds ratio
OWSA	One-way sensitivity analysis
PASI	Psoriasis Area and Severity Index
PCSA	Primary Care Surgical Association
PCP	Primary care provider
PCRS	Primary Care Reimbursement Service

PtGA	Patient Global Assessment
PHQ-9	Patient Health Questionnaire
PICOS	Population, Intervention, Comparator, Outcomes, and Study Design
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PSA	Probabilistic sensitivity analysis
QALY	Quality-adjusted life year
RCT	Randomised controlled trial
RE-AIM	Reach, Effectiveness, Adoption, Implementation, and Maintenance
RHA	Regional Health Authority
RoB2	Risk-of-bias tool
ROBINS-I	The Risk of Bias in Non-randomised Studies of Interventions
RR	Risk Ratio
SAF	Store-and-forward
SAF_DSC	SAF with the addition of dermatoscopic images
SAF_DSC_alone	SAF with dermatoscopic images without standard clinical images
SAF_DSC_post	SAF with dermatoscopy post-intervention
SAF_DSC_pre	SAF with dermatoscopy pre-intervention
SAF_DSC without notes	SAF with dermatoscopic images without clinical notes
SAF_imageclinic	SAF conducted at imaging clinic
SAF_imageclinic_DSC	SAF conducted at imaging clinic with dermatoscopy
SAF_imageclinic_DSC_MSC	SAF conducted at imaging clinic with dermatoscopy and macroscopic images
SAF_LI	Store-and-forward with live interactive
SAF_MSC	SAF with macroscopic images

SAF_MSC_DSC	SAF with macroscopic and dermatoscopic images
SAFvideo	SAF with video attachment
SAF_withoutnotes	SAF without clinical notes
SCC	Squamous cell carcinoma
SHTG	Scottish Health Technologies Group
SD	Standard deviation
SE	Standard error
SSC	Suspected skin cancer
TAS	Treatment Abroad Scheme
TD	Teledermatology
TTO	Time trade-off
WLAP	Waiting List Action Plan
WHO	World Health Organization
WTE	Whole-time equivalent
WTP	Willingness to pay

1 Introduction

1.1 Background to the request

Demand for outpatient dermatology services has increased in recent years, driven largely by Ireland's ageing population, the rising incidence of skin cancer, and improvements in the treatments and technologies available for the management of chronic skin conditions. The increased demand has contributed to long waiting lists for access to dermatology services.[1] In light of these lengthy waiting lists, strategies to improve access to specialist services are needed.

According to the Health Service Executive (HSE) National Clinical Programme in Dermatology Model of Care (hereafter referred to as the HSE Model of Care for Dermatology), the use of technology initiatives, including teledermatology (TD), could be used to improve access to care, pending the outcome of further assessment.[1] TD involves the use of static images or live videoconferencing technology by dermatologists to support the diagnosis, management, or monitoring of skin conditions without the patient being physically present.[2]

TD-supported referral management involves a dermatologist using images, videos, or live interactive video in addition to the clinical information provided as part of the referral from primary care to:

- Make an initial management decision, which may include:
  - referral to in-person consultation
  - redirecting to other specialities
  - direct booking for a procedure
  - provision of advice for the GP on patient management in primary care where the dermatologist deems it clinically appropriate that FTF review is not required.
- Prioritise patients who require in-person consultation or a procedure.

An aim of the HSE Model of Care for Dermatology is to increase capacity for dermatologists to engage in effective triage of referrals to secondary and or tertiary care. A TD-supported referral management service has the potential to support the delivery of timely and appropriate dermatology care and manage demand for specialist dermatology services.[1] Use of TD may be associated with advantages in terms of resource efficiency and access to healthcare. However, it is important that the potential economic impact of such services and the impact on the quality of care are also considered.

The HSE requested HIQA to undertake a HTA to establish the clinical effectiveness and economic implications of using TD to support the management of GP referrals of adult and paediatric patients to specialist dermatology services.

1.2 Draft terms of reference

The purpose of the HTA is to provide evidence-based advice to inform a decision by the Minister for Health and the HSE on the use of TD to support the management of referrals from primary care to specialist dermatology services. With regard to dermatology services in secondary care, the draft terms of reference for this HTA are to:

- Describe the current referral pathway in Ireland including the use of teledermatology in relation to referrals from primary care
- Describe the current and projected demand
- Review the current evidence of the safety, clinical effectiveness, impact on waiting lists, resource use, and cost effectiveness of using teledermatology for referrals
- Assess the budget impact of implementing teledermatology to support the management of referrals from primary care
- Consider any potential organisational and resource implications of providing teledermatology to support the management of referrals from primary care
- Consider any patient and social implications that providing teledermatology to support the management of referrals from primary care may have for patients, the general public or the healthcare system in Ireland
- Consider any ethical and or legal implications of providing teledermatology to support the management of referrals from primary care
- Based on the evidence in this assessment, provide advice to the Minister for Health and the HSE to support a decision on whether to provide teledermatology to support the management of referrals from primary care.

1.3 Overall approach

Following an initial scoping of the available evidence, the terms of reference of this assessment were agreed between HIQA and the HSE.

HIQA convened an Expert Advisory Group (EAG) comprising representation from relevant stakeholders including patients, decision-makers, and clinical experts. The role of the EAG is to inform and guide the process, provide expert advice and information, and to provide access to data where appropriate.

The terms of reference for the EAG are to:

- contribute to the provision of high-quality and considered advice by HIQA to the Minister for Health and HSE
- contribute fully to the work, debate and decision-making processes of the group by providing expert guidance, as appropriate
- be prepared to provide expert advice on relevant issues outside of group meetings, as requested
- provide advice to HIQA regarding the scope of the analysis
- support the Evaluation Team led by HIQA during the assessment process by providing expert opinion and access to pertinent data, as appropriate
- review the project plan outline and advise on priorities, as required
- review the draft report from the Evaluation Team and recommend amendments, as appropriate
- contribute to HIQA's development of its approach to HTA by participating in an evaluation of the process on the conclusion of the assessment.

The terms of reference of the HTA were reviewed by the EAG at its first meeting on 16 January 2025 and considered final. Draft versions of the protocol and the report were circulated for review by the EAG at its meetings and amended, as appropriate, before a final draft report was prepared for public consultation. At its first meeting, the EAG reviewed two draft chapters (description of technology; clinical efficacy, safety, and health service utilisation). Considerations regarding the remaining domains of the HTA were discussed at the second meeting of the group. After the public consultation, a final draft version of the report and the advice to the Minister for Health and HSE will be circulated for review by the EAG. The report will be submitted to the Board of HIQA for approval. Subject to this, the completed

assessment will be submitted to the Minister for Health and the HSE as advice, and published on the HIQA website.

2 Description of the technology

Key points

- Many patients with dermatological conditions can be managed at a primary care level. However, some patients that have an inadequate response to treatments, have complex disease, diagnostic uncertainty, rare conditions, or suspected malignancy, require onward referral to specialist dermatology services.
- Access to specialist dermatology services is facilitated through a referral letter sent from the GP to a dermatology service. In Ireland, this can be sent electronically through the Healthlink messaging platform, although post, fax, or secure email (HealthMail) are also used as alternatives.
- Once the dermatology service receives the referral letter, it is sent for clinical prioritisation, also known as triage or clinical triage. The referral will be either accepted and assigned a Clinical Prioritisation Category, redirected, or rejected. The Clinical Prioritisation Category is the level of urgency that a clinician assigns to a referral. These categories are urgent, semi-urgent, or non-urgent. Once triaged, the patient is placed on a waiting list for a face-to-face (FTF) appointment in secondary or tertiary care dermatology services.
- Teledermatology (TD) enables the use of static images or live videoconferencing technology to support triage, diagnosis or monitoring of skin conditions without the patient being physically present. There are two main types of TD:
  - store-and-forward (asynchronous) typically involves capturing digital images of skin conditions and transmitting them with relevant clinical information to dermatologists for later assessment. There are different technologies used to capture the images ranging from basic digital cameras to specialised imaging devices, such as dermatoscopes and devices that offer both macro and micro magnifications.
  - live interactive (synchronous) uses live videoconferencing for real-time consultations between patients and dermatologists, allowing interactive discussions, immediate feedback, and dynamic assessment of skin conditions.
- A TD-supported referral management system could be introduced in Ireland to augment the current referral pathway in several ways:

  - Store-and-forward: images could be provided alongside the referral letter from primary care. These images could be used to triage the patient based on clinical need.
  - Live-interactive: an initial live interactive appointment in a location convenient for the patient could replace the first FTF appointment offered to patients, at which point the patient would be triaged.
  - With both of these methods and with the ranking of patients based on clinical need, there is the option to discharge patients back to primary care if a FTF dermatology appointment is not considered necessary. Referrals that are discharged back to primary care will likely be accompanied by advice.
- The international use of TD has seen significant growth over the past decade. TD is widely utilised across the countries described in this chapter to improve access to dermatological care and reduce waiting times. Of the 23 countries examined, 21 countries have implemented TD nationally, regionally or have conducted feasibility and pilot studies. Internationally, TD has been shifting away from live-interactive methods in favour of store-and-forward models. Dedicated TD management platforms provide an electronic system for the management of referrals and are widely used internationally.

2.1 Introduction

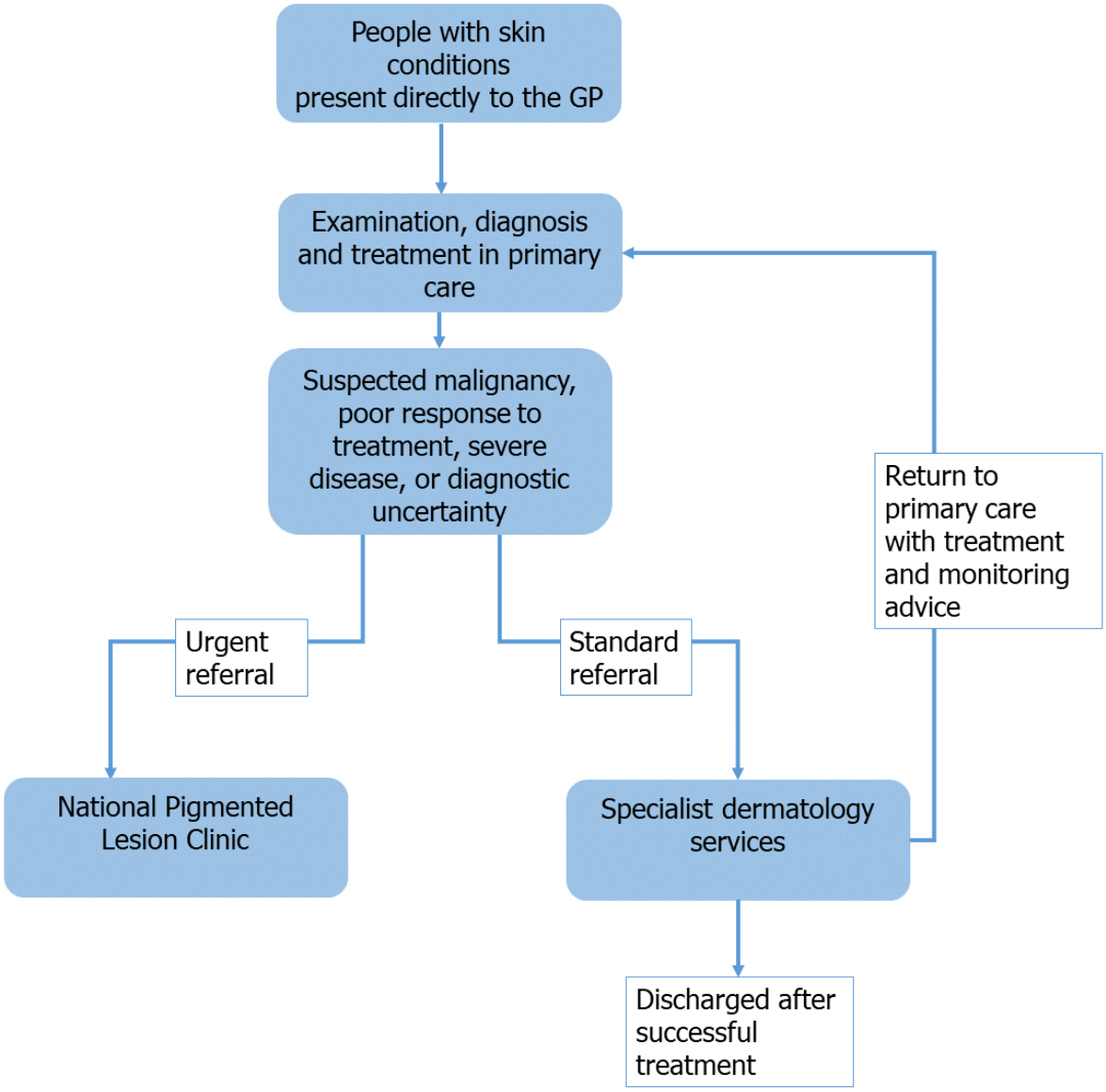
According to the Health Service Executive (HSE) Model of Care for Dermatology for Ireland, technology initiatives, including teledermatology (TD), could be used to improve access to care, pending the outcome of further assessment.[1] TD involves the use of static images or live videoconferencing technology by dermatologists to support triage, diagnosis or monitoring skin conditions without the patient being physically present.[2] Use of TD may be associated with advantages in terms of resource efficiency and access to healthcare. However, it is important that the potential impact of such services on the quality of care is considered.

This chapter provides an overview of the current options for accessing publicly-funded specialist dermatology services in Ireland. Additionally, it explores the use of TD services internationally for the management of primary care referrals.

2.2 Current management of referrals from primary care

The management of dermatological conditions in primary care involves a multi-faceted approach that includes assessment, diagnosis, medical management, and patient education. Figure 2.1 provides a visual for the dermatology pathway in Ireland. General practitioners (GPs) play a critical role in managing the majority of dermatology cases, supported by evidence-based clinical pathways and referral criteria to ensure appropriate care and resource allocation.[1] The detailed process of managing routine dermatological conditions and referrals in primary care, as outlined in the HSE Model of Care for Dermatology, includes several key steps. Initially, GPs assess patients presenting with dermatological conditions using clinical guidelines and diagnostic tools. Based on the diagnosis, GPs initiate appropriate treatments, which may include topical or systemic medications, lifestyle advice, and patient education. Many patients with dermatological conditions, such as acne, psoriasis and eczema can be managed at a primary care level. However, some patients that have an inadequate response to treatments, have complex disease, rare conditions, suspected malignancy, or in cases of diagnostic uncertainty, require onward referral to specialist dermatology services and regular follow-ups to monitor and adjust treatments. Clear referral criteria are established by the HSE in conjunction with the National Cancer Control Programme (NCCP) for the management of melanoma.[3] The most common conditions in dermatology outpatient care are melanoma, basal cell carcinoma, squamous cell carcinoma, psoriasis, acne, eczema (dermatitis), hidradenitis suppurativa, vascular lesions, rosacea, and skin infections.[1]

Figure 2.1 Dermatology Pathway in Ireland



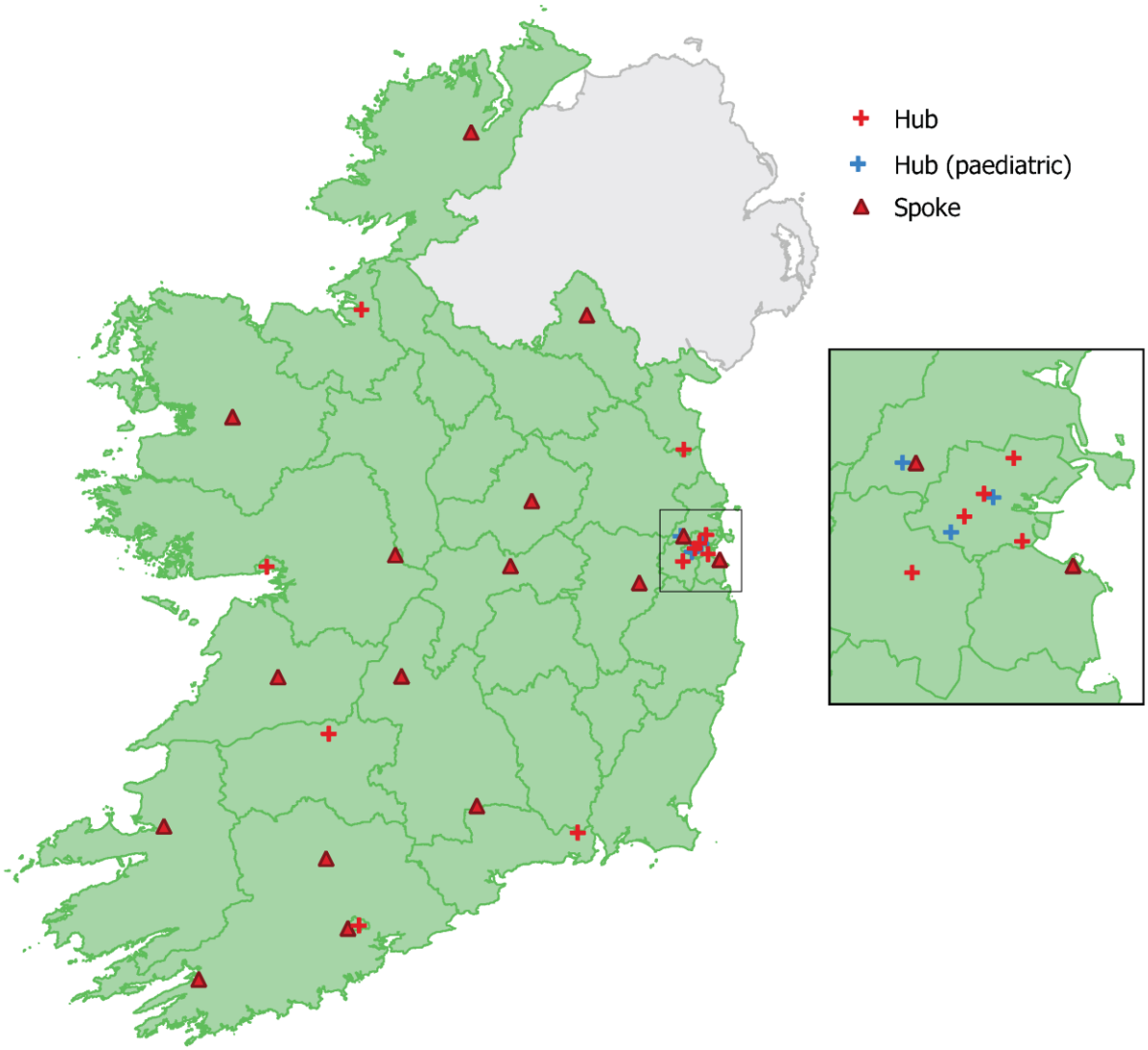
Key: GP – General Practitioner; NCCP – National Cancer Control Programme.

2.2.1 Referrals

Patients presenting to primary care with suspected non-melanoma skin cancer or who have non-malignant conditions and poor response to appropriate treatments or severe disease may be referred to one of 14 dermatology departments (hub), three of which are dedicated paediatric hospitals or 16 peripheral clinics (spoke) (Figure 2.2).[1] Alongside the adult dermatology pathway, the paediatric model of care emphasises the unique needs of children.[4] Similar to adults, paediatric dermatology often involves multidisciplinary teams, family-centred care, and specialised facilities. Children with complex or rare skin conditions are referred to specialised paediatric

dermatology services, ensuring their care is tailored to developmental needs and psychological support. In addition to the paediatric dermatology services delivered by the Children's Hospital Group across the three paediatric hospitals in Dublin, paediatric patients are also seen regionally in Galway, Drogheda (Our Lady of Lourdes), Cork (South Infirmary Victoria University Hospital), Limerick and Waterford with very small numbers in other centres.[1]

Figure 2.2 Locations of Dermatology Services in Ireland



The introduction of electronic referral systems has simplified the referral process, allowing GPs to submit referrals more efficiently and securely.[1] While these systems have improved communication between primary and secondary care and facilitated the triaging of referrals by experienced dermatology clinicians, they have not

necessarily resulted in significant reductions in wait times or fully addressed existing challenges in the system. After the specialist consultation, feedback is provided to the GP to ensure continuity of care, including treatment plans, recommendations for further management, and instructions for follow-up. GPs continue to play a role in monitoring and supporting the patient's ongoing care.

Healthlink is a platform used by many GPs for electronic referrals in Ireland, although some GPs still rely on post, fax, or secure email (HealthMail) as alternatives. Healthlink provides a web-based messaging service which allows the secure transmission of clinical patient information between hospitals and medical practitioners. Healthlink is funded by the HSE and all services are free of charge to GPs.[5]

2.2.2 Triage

An aim of the HSE Model of Care for Dermatology is that there will be an increased capacity for dermatologists to engage in effective triage of referrals to secondary and or tertiary care. The outpatient waiting list management protocol provides guidance to ensure that there is a consistent and standardised approach to the triage, active management, and scheduling of patients on outpatient waiting lists within each public hospital and across hospital groups.[6] When a new outpatient referral is received by a hospital, it is sent for clinical prioritisation, also known as clinical triage or triage. When a clinician assesses a new referral they decide if the referral will be either accepted and assigned a Clinical Prioritisation Category, redirected, or rejected. A referral letter is expected to be reviewed within five working days from the date the referral letter was received. The Clinical Prioritisation Category is the level of urgency that a clinician assigns to a referral. These categories are urgent, semi-urgent or non-urgent. Each category of clinical prioritisation is accompanied by a clinically recommended timeframe, a description of the categories and timeframes is given in Table 2.1. The clinically recommended timeframe to consultation is based on minimising risk and or achieving best clinical outcomes.

Table 2.1 Referral Clinical Prioritisation Category Definitions and Clinically Recommended Time-Frames

Clinical Prioritisation Category	Clinical characteristics/outcomes of conditions within category	Clinically recommended timeframe (CRT)
Urgent	• Risk of permanent damage to organ system if treatment is delayed beyond CRT • Major functional impairment • Suspected malignant neoplastic disease • Rapidly progressing dysfunction (over a period of days or weeks) in established conditions	≤ 28 days
Semi-urgent	• Risk of damage to organ system if treatment is delayed beyond CRT • Moderate functional impairment or progressive loss of function over a period of months or years • Benign neoplastic disease • Significant restriction of economic • Activity - inability to work/support self and or dependants	≤ 13 weeks
Non-Urgent	• Minimal risk of damage to organ system if treatment is delayed beyond 13 weeks • Moderate functional impairment • Significant restriction of social activity • Management issues in established conditions • Reassessment of stable/chronic conditions that meet the criteria for review	≤ 26 weeks
Excluded	• Conditions that have no impact on physical well-being, such as work assessments, cosmetic surgery	

Clinical Prioritisation Category	Clinical characteristics/outcomes of conditions within category	Clinically recommended timeframe (CRT)
	• Sub-acute or minor conditions/complaints that will be safely diagnosed and/or managed in primary care • Specialties can decide on specific conditions/complaints, based on literature and or international best practice, taking account of Irish health system's structure	

Source: Outpatient (OP) Waiting List Management Protocol 2022.[6]

2.2.3 Melanoma

Melanoma, a severe form of skin cancer, requires early detection and management to improve patient outcomes. The pathway for managing melanoma referrals is distinct and well-defined due to the severity and urgency of the condition. The HSE in conjunction with the NCCP offer a referral guideline for GPs suspecting melanoma, the National Melanoma GP Referral Guidelines.[3] If the lesion appears suspicious for melanoma, the GP proceeds with an urgent referral using the NCCP National Pigmented Lesion GP Referral Form.[7] The referral form includes details about the lesion, its characteristics, and any other relevant patient information.

The completed referral form is sent to a consultant dermatologist or consultant plastic surgeon at one of 14 National Pigmented Lesion Clinics located across the country.[1] These rapid access clinics are designed to prioritise and expedite the evaluation of patients with potentially serious conditions. This pathway is overseen by the NCCP. Rapid access clinics are held on a weekly or fortnightly basis and many of these clinics function as 'see and treat' services, with lesions removed at initial presentation.

2.2.4 Skin cancer

Non-melanoma skin cancer (NMSC) account for 90% of total skin cancer rates in Ireland.[8] Basal cell carcinoma (BCC) and squamous cell carcinoma (SCC) were almost exclusively the main subtypes. GPs play a crucial role in the first line management and the early detection of these cancers. During initial consultations, GPs assess suspicious skin lesions. For lesions suspected to be NMSC, GPs typically refer patients to dermatology services, following a less urgent but still structured pathway compared to melanoma. Referrals are usually made to dermatologists or

plastic surgeons, particularly in cases where the lesion is in a cosmetically sensitive area or if the patient is at higher risk, such as those with immunosuppression. Additionally, in areas with limited access to consultant-led dermatology, such as in the North West Region of the country, referrals may also be directed to a plastic surgeon. The HSE Model of Care for Dermatology outlines that non-urgent cases can be managed with routine referrals. These referrals are increasingly managed through electronic systems, which streamline the process, enhance communication between primary, secondary, and tertiary care, and facilitate appropriate triage. Unlike melanoma, which requires a broad and aggressive treatment approach, NMSC is often managed with localised treatments such as surgical excision, cryotherapy, or topical therapies. Multidisciplinary involvement is less common unless the NMSC is advanced or located in a challenging area.

In July 2024, the NCCP launched a skin cancer pilot with the Mater Misericordiae University Hospital which allows GPs to refer patients with suspected high risk SCC through Healthlink using a new option on the existing pigmented lesion referral form for suspected melanoma.[9] The pilot aims to establish if the newly developed GP guideline will help GPs identify patients with symptoms suspicious of high risk SCC requiring referral to secondary and or tertiary care, using an electronic referral form.[10]

2.2.5 Others

In Ireland, dermatologists treat a wide range of skin conditions. Common conditions include acne, eczema, psoriasis, rosacea, alopecia, skin cancer and dermatitis. A full list including a description of the mentioned conditions is available on the Irish Skin Foundation website.[11] Some systemic treatments, which are recommended when a patient has failed earlier lines of treatment, are only available through specialist dermatology services.[12]

The HSE has introduced an exclusion letter for benign lesions that will not be treated or seen in secondary or tertiary care.[1] GPs can manage many cases effectively within primary care, reserving referrals for cases requiring specialist input or when treatments fail to resolve the issue. The goal is to manage these conditions efficiently in primary care to reduce the burden on secondary and tertiary care services, allowing dermatologists to focus on more complex or urgent cases. These conditions include viral warts, skin tags, keratoses, dermatofibromas, spider naevi, epidermal cysts, sebaceous cysts, lipomas, tattoos, xanthelasma, melasma, and physiological male balding.[1]

2.2.6 Alternative pathways to treatment

There is an ongoing strain on dermatology services across the country. This is evidenced by data from the National Treatment Purchase Fund (NTPF) which showed that as of June 2025 there were over 56,000 adults waiting for a dermatology appointment, with wait times exceeding six months for 47% of those on the list, and with 11% waiting for 18 months or longer.[13] There is also pressure on paediatric dermatology services. As of June 2025 there were over 10,783 children waiting for a dermatology appointment in Ireland, with 57% waiting longer than six months for an appointment and 16% waiting 18 months or longer.[13]

To address ongoing challenges with long waiting lists, waiting list action plans have been funded and implemented annually since 2022. These plans allocate funding to the HSE and NTPF to reduce wait times for public patients. For 2025, €190 million has been designated for the HSE and €230 million for the NTPF.[14] Public patients waiting over three months for treatments on the NTPF's waiting list may be eligible and contacted for care through a combination of insourcing (funding temporary additional capacity within the public system) and outsourcing (utilising capacity in the private system) initiatives.[15] Skin lesion surgery is currently among the eligible treatments.

Patients may also access treatment outside of Ireland through HSE-funded schemes. The Cross Border Directive and the Northern Ireland Planned Healthcare Scheme allow patients to receive healthcare in EU countries and Northern Ireland. A referral letter from a GP or consultant is required, and patients must pay for their treatment themselves before applying for reimbursement from the HSE, subject to meeting the scheme's criteria.[16, 17] Reimbursement is capped at the lower of two amounts: the cost of healthcare received abroad or the equivalent cost within Ireland's public healthcare system. The HSE are also responsible for the administration of the Treatment Abroad Scheme which allows patients to seek treatment outside the country if a particular treatment is not available in Ireland, or if it is not available in a reasonable timeframe.[18, 19] Patients must be referred by a consultant in order to qualify for treatment under this scheme and prior approval is required.

2.3 Teledermatology

Telemedicine is a healthcare practice using interactive audio, visual and data communications. TD, a term used to describe the aspects of dermatological care delivered through information and communication technology, is a subset of telemedicine.[20, 21] TD involves the transmission of images and clinical information from patients to dermatologists for assessment and consultation.[22] TD provides an

alternative means for primary care clinicians to access expert opinion compared with standard referral processes from primary to specialist care.[20, 23] TD may be used as a triage tool to assess the need for onward referral and care, or as an alternative to a face-to-face (FTF) consultation. The most appropriate model of care will depend on the aims and needs of the service.

There are two main types of TD: store-and-forward (asynchronous) and live interactive (synchronous).[24] Store-and-forward (SAF) involves capturing digital images, or in some cases videos, of skin conditions and transmitting them with relevant clinical information to dermatologists for later assessment.[24, 25] There are different technologies used to capture the images, ranging from basic digital cameras to specialised imaging devices that offer both macro and micro magnifications. Other methods include dermatoscopes, 3D imaging and artificial intelligence-assisted imaging.[20] There is variability regarding the number of images required for adequate diagnostic accuracy. Some studies recommend capturing at least three images, for example two from a distance and one close-up, to ensure the best diagnostic result.[26-29] The images can be digital photographic images, or can be magnified dermoscopic images taken using a dermatoscope, with the latter referred to as teledermoscopy.[20] A dermatoscope is a device that contains an integral light source and typically a 10x magnification lens and is used to examine skin structure and patterns at a microscopic level.[30] A dermatoscope acts to magnify a lesion and reduce the interference of light reflection from the skin's surface, to allow pigmented and vascular structures in the deep epidermis and superficial dermis to be visualised.[31] There are three main types: a dermatoscope connected to a camera, a dermatoscope connected to a viewing device, or a hand-held dermatoscope.[32] Images may be captured by GPs, patients, or, in some systems, by patients attending imaging centres. Once the image is captured, there is variability across the literature in how these images are transmitted to secondary and or tertiary care. Some primary care centres use telehealth apps while others upload images to e-referral systems. One of the benefits of SAF TD is increased efficiency, as it allows dermatologists to manage their workload flexibly, potentially reducing backlogs and consultation wait times.[33] As SAF removes the need for a dermatologist and patient to interact simultaneously, it can reduce travel and volumes of people moving through hospitals.[25] It can also improve accessibility to specialist care for patients in remote or underserved areas.[34] However, challenges include image quality, where diagnostic accuracy depends on the clarity and quality of the images, and delayed interaction, which might limit immediate feedback or follow-up questions from patients.[22, 35] Furthermore, SAF dermatology is dependent on the information provided in the GP referral. If key information is missing, it will

impact on triaging and may require follow-up, reducing the benefits of quicker diagnosis.
In contrast, the live-interactive model of TD uses live videoconferencing for real-time consultations between patients and dermatologists, allowing interactive discussions, immediate feedback, and dynamic assessment of skin conditions.[21, 25] Virtual dermatology outpatient appointments are currently delivered using live interactive (LI) TD in Ireland.[1] Benefits include interactive diagnoses, allowing thorough examination, including patient history and visual assessment [36], and immediate care, providing instant advice and reassurance, potentially reducing patient anxiety and improving satisfaction.[24] Challenges include technical requirements and image resolution, as a reliable internet connection and appropriate technology are essential for smooth operations.[37] Additionally, LI TD requires synchronised availability of both parties, which might limit flexibility compared to the store-and-forward method.[22] The clinician and patient are separated by space, but not by time.[24] Moreover, variability exists in the level of training and resources provided to healthcare professionals using TD. The NHS, for instance, stresses the need to maintain continuous training across professional groups and care settings to ensure high-quality and consistent care.[38]

TD-supported referral management involves a dermatologist using images, videos, or live interactive video in addition to the clinical information provided as part of the referral from primary care to:

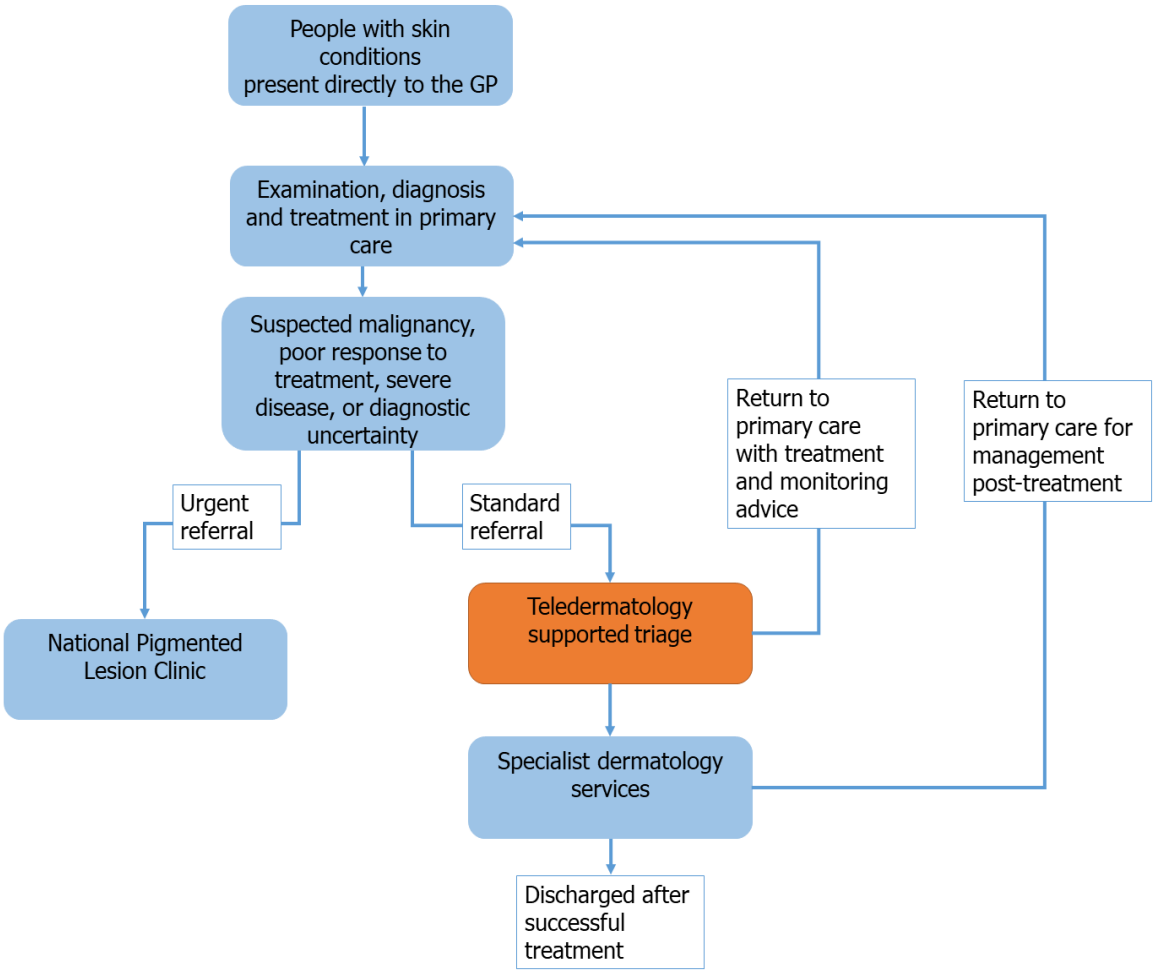
- Make an initial management decision, which may include:
  - referral to in-person consultation
  - redirecting to other specialities
  - direct booking for a procedure
  - provision of advice for the GP on patient management in primary care where the dermatologist deems it clinically appropriate that FTF review is not required.
- Prioritise patients identified to require in-person consultation or a procedure.

In the context of this HTA, advice within a TD-supported referral management system is provided as part of the current referral pathway and service – the aim is to facilitate timely access to dermatology review and is not a separate service for GPs to request advice for patients that they would not otherwise refer for FTF consulation.

Figure 2.3 shows how a TD-supported pathway could be incorporated into the primary care referral system for standard dermatological referrals in Ireland. Urgent

referrals for suspected melanoma would continue to follow the current pathway as shown in Figure 2.1.

Figure 2.3 Teledermatology-supported triage pathway



Key: GP – General Practitioner; NCCP – National Cancer Control Programme; LI – Live Interactive; SAF – Store and Forward.
Note: This diagram assumes that referrals to both national pigmented lesion clinics and general dermatology services would come through the same pathway. This design issue would need consideration before the implementation of a TD-supported referral management service.

2.4 Use of teledermatology in Ireland

TD is increasingly becoming a potentially valuable tool in Ireland's healthcare system, which may offer a solution to the challenges of access to dermatological care, especially in rural and underserved areas. In 2023, the HSE published a telehealth roadmap for 2024-2027.[39] The roadmap outlines six key principles to guide the seamless integration of telehealth into business-as-usual within the healthcare service. While TD is not explicitly mentioned in this work, the roadmap in

indicative of the HSE's plans to integrate telehealth into the Irish health system. TD provides an alternative means for primary care clinicians to access expert opinion compared with standard referral processes from primary to specialist care.[20, 23] TD has not traditionally been used by specialist dermatology services in public hospitals in Ireland. However, during the COVID-19 pandemic, scheduled virtual live-interactive outpatient appointments for both initial and follow-up visits were held via HSE-approved platforms to maintain access to care, where possible, in line with HSE procedures.[1, 40] A study conducted in Cork demonstrated positive results in a pilot on the use of electronic photo triage for infantile haemangiomas.[1] The project included GPs using a dedicated HSE email address to send anonymous photographs of infantile haemangiomas for dermatologist review within 5 working days. There was a rapid adoption to the methods by Irish GPs, especially in Western and Southern seaboards. These areas are considered geographically disadvantaged in terms of access to paediatric dermatology services. Additionally, Roscommon University Hospital's plastic surgery department launched a photo triage service for suspected skin cancer referrals in the summer of 2023. The service processes approximately 600 referrals per month from a large catchment area. Together, a triage nurse and the consultant assess referrals based on images and clinical information submitted by GPs. Suspected cancer cases are prioritised for an appointment with the surgeon, with high-risk patients seen within two days and treatment received at the same appointment. In the first 12 months, 25% of referrals were successfully managed by GPs without a FTF appointment.[41]

Private TD services, through imaging clinics, are also operating in the Irish healthcare system, with the HSE and NTPF availing of the services for outsourced dermatology capacity.

2.5 Use of teledermatology for referrals from primary care internationally

A targeted grey literature search of government-funded health organisations and websites of governmental departments of countries was conducted to provide an overview of current international practice regarding the use of TD for triage of primary care referrals. The countries included are: England, Scotland, Wales, Northern Ireland, Spain, Portugal, France, Netherlands, Germany, Belgium, Luxembourg, Austria, Switzerland, Italy, Norway, Sweden, Denmark, Finland, Iceland, Estonia, Canada, Australia and New Zealand. The information presented is current up to July 2025. An overview of the international countries utilising TD is presented in Table 2.2. Luxembourg and Iceland are the only countries for which no information was available on their utilisation of TD. National TD services are

available in 10 countries: England, Scotland, Northern Ireland, Netherlands, France, Portugal, Estonia, Norway, Sweden and Australia. Well established regional programmes are in place in six countries: Wales, Spain, Denmark, Italy, New Zealand and Canada. Feasibility or pilot programmes have been carried out in five countries: Germany, Finland, Belgium, Austria, Switzerland.

Table 2.2 Table of international dermatology overview

Country	TD for referrals from primary care to secondary care	Live interactive (LI) or Store and Forward (SAF)	Who takes the image and where?	Who carries out the TD triage?	National/ Regional	Conditions[Y]	Separate suspected cancer or melanoma pathway?	TD management platform?
Australia[42-49]	✓	Both	GPs capture images using smartphones, digital cameras or dermatoscopes	Dermatologists	National with regional variations	Various dermatological conditions, including NMSC and melanoma	No	Yes
Austria[50]	Emerging-pilot and feasibility studies	SAF	GPs capture images using smartphones or dermatoscopes	Dermatologists	Regional pilot and feasibility studies	Various dermatological conditions including NMSC and melanoma	No	Not reported
Belgium[51, 52]	Emerging-pilot studies	SAF	GPs capture images using smartphones or digital cameras	Dermatologists	Regional pilot studies	Various dermatological conditions	No	Yes
Canada[53-57]	✓	Both	GPs capture images using smartphone or digital camera	Dermatologists	Regional	Various dermatological conditions, including NMSC and melanoma	No	Yes

Country	TD for referrals from primary care to secondary care	Live interactive (LI) or Store and Forward (SAF)	Who takes the image and where?	Who carries out the TD triage?	National/ Regional	Conditions[Y]	Separate suspected cancer or melanoma pathway?	TD management platform?
Denmark[58-60]	✓	Both	GPs capture images using dermatoscopes. The Faroe Islands also offer live interactive consultations	Dermatologists	Regional	Various dermatological conditions, including NMSC and melanoma	No, but in-person clinics are prioritised for patients needing physical intervention, for example, dermatosurgery, or more complex diagnosis and treatment	Yes
England[38]	✓	Both	GPs capture images using smartphones, digital camera or dermatoscopes. In some regions, patients can capture the image and the submission is integrated with their GP referral	Dermatologists GPs with extended roles GPs with a special interest Private outsourced providers	National with regional variations	Various dermatological conditions including suspected skin cancers	Urgent suspected cancer pathway – (previously known as two week wait referral)	Yes
Estonia[61]	✓	SAF	GPs capture images using smartphones,	Dermatologists	National	Various dermatological	No	Yes

Country	TD for referrals from primary care to secondary care	Live interactive (LI) or Store and Forward (SAF)	Who takes the image and where?	Who carries out the TD triage?	National/ Regional	Conditions[Y]	Separate suspected cancer or melanoma pathway?	TD management platform?
			digital camera or dermatoscopes			conditions, including NMSC and melanoma		
Finland[62]	Emerging-feasibility study	Both	GPs capture images using digital camera and dermatoscopes along with live-interactive consultations	Dermatologists	Regional feasibility study	Various dermatological conditions	No	Not reported
France[63]	✓	Both	GPs capture images using smartphones, digital camera or dermatoscopes	Dermatologists Dermatology Nurses	National	Various dermatological conditions	No	Yes

Country	TD for referrals from primary care to secondary care	Live interactive (LI) or Store and Forward (SAF)	Who takes the image and where?	Who carries out the TD triage?	National/ Regional	Conditions[Y]	Separate suspected cancer or melanoma pathway?	TD management platform?
Germany[64, 65]	Emerging – pilot studies	SAF	GPs capture images using digital camera or dermatoscopes. Patients can submit smartphone images directly to dermatologists	Dermatologists	Regional pilot programmes	Various dermatological conditions	No	Yes
Iceland	X							
Italy[66-69]	✓	Both	GPs capture images	Dermatologists	Regional	Various dermatological conditions	No	Not reported
Luxembourg	X							
Netherlands[35]	✓	SAF	GPs capture images using camera, smartphone and dermatoscope	GPs can initially triage	National	Various dermatological conditions	No	Yes

Country	TD for referrals from primary care to secondary care	Live interactive (LI) or Store and Forward (SAF)	Who takes the image and where?	Who carries out the TD triage?	National/ Regional	Conditions[Y]	Separate suspected cancer or melanoma pathway?	TD management platform?
			attachment. Patients can also capture the image and the submission is integrated with their GP referral	directly with patient GPs can forward referrals for triage by Dermatologists				
New Zealand[70, 71]	✓	SAF	GPs using digital cameras for Suspected Skin Cancer (SSC) referrals. Nurses or trained nurses (melanographers) capture images using dermatoscopes where patient is referred to a Virtual Lesion Clinic	Dermatologists	Regional	Various dermatological conditions, including NMSC and melanoma	Suspected skin cancer pathway introduced in Waikato in 2017	No

Country	TD for referrals from primary care to secondary care	Live interactive (LI) or Store and Forward (SAF)	Who takes the image and where?	Who carries out the TD triage?	National/ Regional	Conditions[Y]	Separate suspected cancer or melanoma pathway?	TD management platform?
			medical imaging clinic					
Northern Ireland[72]	✓	SAF	GPs capture images using dermatoscopes	Dermatologists	National	Various dermatological conditions including skin cancer screening	Red Flag referral (melanoma) Red Flag referral (squamous cell carcinomas)	Yes
Norway[73, 74]	✓	Both	GPs capture images using dermatoscopes	Dermatologists	National	Various dermatological conditions including NMSC and melanoma	No	Not reported
Portugal[75]	✓	SAF	GPs capture images.	Dermatologists	National	Various dermatological conditions, including NMSC and melanoma	No	Not reported

Country	TD for referrals from primary care to secondary care	Live interactive (LI) or Store and Forward (SAF)	Who takes the image and where?	Who carries out the TD triage?	National/ Regional	Conditions[Y]	Separate suspected cancer or melanoma pathway?	TD management platform?
Scotland[76, 77]	✓	SAF	GPs capture images. In some regions, patients can capture the image	Dermatologists	Regional with national service roll-out started November 2024	Various dermatological conditions, skin lesions	Suspected Cancer Referral Guidelines	Yes
Spain[78, 79]	✓	Both	GPs capture images using smartphones, digital camera or dermatoscopes	Dermatologists	Regional	Various dermatological conditions, skin cancer	No	Yes
Sweden[80]	✓	SAF	GPs capture images using smartphones and dermatoscope attachments	Dermatologists	National	Various dermatological conditions including NMSC and melanoma	No	Yes
Switzerland[81]	Emerging-pilot and	SAF	GPs capture images using digital camera	Dermatologists	Regional feasibility study	Various dermatological conditions,	No	No – data managed as part of study

Country	TD for referrals from primary care to secondary care	Live interactive (LI) or Store and Forward (SAF)	Who takes the image and where?	Who carries out the TD triage?	National/ Regional	Conditions[Y]	Separate suspected cancer or melanoma pathway?	TD management platform?
	feasibility studies					including NMSC and melanoma		
Wales[82-87]	✓	SAF	GPs capture images or patient is referred to a designated medical illustration department	Dermatologists	Regional	Various dermatological conditions	Suspected Cancer Pathway	Yes

Key: GP – general practitioner; SAF – store and forward; LI – live interactive; NMSC – Non-Melanoma Skin Cancer

[Y] Definitive list of conditions included or excluded not reported by most countries. Column notes suspected skin cancers or melanoma where it has been specifically mentioned for that country.

In 2009, the World Health Organization (WHO) conducted a global survey on eHealth, which found that 38% of 114 responding countries had implemented TD services in the form of pilots, informal or established models.[88] In the 2015 follow up survey, this figure increased to 46% of 125 countries.[89] According to published data, TD is more widespread in Europe and North America. Countries such as the UK, the Netherlands, and Spain, which have among the lowest number of dermatologists per million inhabitants and whose dermatologists are mostly based in the public sector rather than in private practice, have extensive experience of TD and have developed significant mature digital health services.[78, 90, 91]

2.5.1 The United Kingdom

The UK National Health Service (NHS) has utilised TD for the past two decades.[92] In the UK, national surveys indicate an upward trend in participation in TD by dermatologists from 17% in 2006 to 48% in 2016. Additionally, the proportion of dermatologists with any experience in TD increased significantly, rising from 27% to 82% during the same period.[93]

In England, the NHS developed a National Teledermatology Roadmap, published in 2023, that supports the implementation of safe and effective TD triage pathways and processes. This roadmap supports systems to accelerate the roll out of TD to help manage demand and reduce unnecessary outpatient attendances.[38] Several TD-based innovations have been introduced, including TD triage for both urgent suspected cancer pathway referrals (previously known as two week wait pathway) and general referrals. An e-Referral Service (e-RS) that also supports a rapid Advice and Guidance (A&G) service has been implemented.[94] GPs can utilise the A&G service to seek specialist advice and guidance regarding patient management before, or instead of, making a full referral. The A&G service is integrated as part of the e-RS service and the decision to upgrade a case to a full referral is still available to the GP based on any initial A&G received.[95] GPs can capture images using a smartphone, digital camera or dermatoscope, with regional variations in availability. GPs can share clinical data and images, and these A&G requests can be converted to routine, urgent, or rapid skin cancer referral or appointments by the dermatology team.[96] By facilitating access to specialist opinions, e-RS assists GPs in managing patients within the community, thereby reducing unnecessary referrals.[97] Since 2018, the NHS have advocated the use of the pre-referral specialist advice, such as the NHS e-RS A&G, as the main referral pathway for access to specialist dermatology services, with the exception of the two-week wait suspected skin cancer pathway.[98] The two-week wait pathway for skin cancer (now called urgent suspected cancer pathway) refers to a streamlined process designed to ensure timely assessment and diagnosis for individuals with suspected skin cancer. When a

GP suspects a patient may have skin cancer based on their symptoms or examination, they can refer them to a specialist for further assessment within two weeks.[99]

There are some regional variations of TD services in England; for example, dermatology services in the South East of England have adopted a patient-centred mobile TD application to manage referrals and provide advice and guidance to GPs and their patients. The app enables patients to take and upload images of their skin condition along with pertinent information. This submission is integrated with their GP referral and medical summary into the dermatologist's electronic record system. The dermatologist evaluates the case, providing a diagnosis and treatment plan to both the patient and their GP.[100]

The Scottish digital dermatology appointment service was originally implemented across three Scottish health boards as a pilot project to support dermatology services during COVID. It operated a SAF virtual dermatology clinic, in which patients can upload images of their skin condition, along with answers to specific questions, after being referred to dermatology by their GP.[76, 77] All health boards in Scotland were scheduled to adopt a new digital dermatology pathway by March 2025 for patients who are referred from primary care to dermatology secondary care services.[101] Through an app, consultants can review images taken by GPs with their phone and triage patients with three possible outcomes: refer patient to a FTF appointment, refer to the most suitable service, or discharge from dermatology service with advice on condition management.[102-104]

NHS Wales is planning to implement teledermoscopy services in health boards across Wales. Under this initiative, patients who are referred to secondary care participate in a clinical photography appointment, during which high-quality dermoscopic images are captured. These images are then remotely reviewed by a consultant dermatologists, enabling appropriate signposting for each patient.[82] TD pilots and established services have been operational in Wales for the past decade, albeit with regional differences.[84-86] The University Hospital of Wales now requires all GP referrals to be in the form of TD.[87] Referrals are reviewed by a dermatologist within two to three days and may be accepted for a consultation or returned with a diagnosis and treatment advice.[87] The TD service offered by the Aneurin Bevan University Health Board involves the capture of diagnostic images of skin lesions/skin complaints via GP referrals at designated medical illustration departments.[83]

In Northern Ireland, the Dermatology Photo Triage Pathway was launched in 2018[31, 72] and 96% of GP practices signed up to provide this service by 2023.[105] Digital images are taken in the GP practice and sent directly to a dermatologist in a hospital, who then decides if the patient needs further assessment. The GP captures

the images with a dermatoscope attached to a smartphone preloaded with an app and the images are sent via the app to the dermatologist. If the skin complaint is suspected of being cancerous or requires other urgent treatment, the patient will be managed through the urgent cancer red flag pathway instead. Depending on the assessment by the dermatologist, patients may receive advice and guidance for managing non-harmful skin irregularities within their GP practice, eliminating the need for hospital intervention. Alternatively, they may be scheduled for a detailed examination by the dermatology team to further assess the condition. In cases requiring intervention, patients are provided with appointments for procedures such as biopsy or removal of the irregularity to diagnose and treat the condition promptly. Furthermore, if deemed necessary, patients may be referred to specialists in plastic surgery for further treatment.[72]

2.5.2 Netherlands

The Dutch government actively encourages the use of digital applications for healthcare and support.[106] In the Netherlands, TD is fully reimbursed and integrated into the national healthcare system (the Netherlands healthcare system requires all to enrol in insurance plans).[35] Ksyos, a private healthcare organisation in the Netherlands, began integrating TD into the existing healthcare infrastructure from 2005 onwards and health insurers began reimbursing TD services, which led to a further increase of its use.[35, 107] During TD consultations in primary care, the GP takes an overview, detailed, and dermatoscopic image of the suspicious lesion. These along with relevant patient details are sent via the Ksyos digital health record system to a dermatologist. The dermatologist assesses the consultation and provides a diagnosis. The Ksyos platform offers other TD services including a quick consultation advice service for the GP whereby the GP uploads the image, and the dermatologist assesses the skin complaint and answers the GP's question within 15 minutes.[108] Home consultation services are also provided in which the GP sends the patient a secure email link from the platform; the patient uploads their own images which the GP sends directly to a dermatologist for diagnosis and advice, with the GP receiving results from the dermatologist within three days.[109]

2.5.3 Spain

Spain has one of the highest frequencies of publications on TD; several regions have well-established TD services.[110] A study carried out to determine the frequency of TD consultations in Spain showed TD was most frequently used in the regions of Galicia, Catalonia, and Andalusia, although Madrid is the community with the highest number of services utilising TD.[78, 79] Two surveys were conducted in 2009 and 2014 to analyse TD models in clinical practice in Spain.[78] In 2009, there were 25 centres identified that used TD, increasing to 70 in 2014. All centres that used TD belonged

to the Spanish national health system and most were university hospitals (57%). The SAF TD model was adopted by 67% centres in 2009, rising to 83% in 2014. Conversely, the utilisation of live-interactive TD decreased from 24% in 2009 to 12% in 2014. In 2014, 62% of centres had integrated TD into the treatment of various skin conditions, whereas 25% solely utilised it for addressing skin cancer cases (a decrease from 38% in 2009). In 2014, 40% of the centres had the capability to directly schedule surgical appointments without requiring a pre-surgical clinical appointment.[78]

2.5.4 Other European countries

TD referral from primary care to secondary care is also widely utilised in countries such as France, Portugal, Norway, Sweden, Estonia and Denmark. TD was integrated into the French healthcare system in 2012 to extend access and decrease waiting times for dermatological care.[63] TD has been reimbursed within the French healthcare system from 2019. According to a 2019 survey of dermatologists, 55% reported informal TD practice, 19% reported regular use of TD, while 13% were planning to adopt the technology.[111]

In Portugal, primary care physicians are required to include images of skin lesions when referring patients for their initial dermatology consultation. This practice has contributed to the widespread adoption of TD across Portugal.[75] Currently, they utilise TD to enhance skin cancer exploration and streamline dermatology surgery triage.[112, 113]

In 1996, Norway became the first national health system to reimburse telemedicine services. Since 2002, the Norwegian Centre for Telemedicine (NST) has been a WHO Collaboration Centre for Telemedicine.[73] The NST is government funded and provides LI and SAF TD services.[73] A more recent pilot study has examined the use of a smartphone app to facilitate primary care providers in referring patients to dermatology services.[74] In Sweden, smartphone apps are used in TD, the app provides a digital referral system that transfers relevant clinical information along with digital dermoscopic images from primary care to a dermatologist for review.[80] In 2013, a country-wide TD-service database was incorporated into Estonia's National Health Information System. In this service a GP uses a dermatoscope to acquire an image of a suspected melanoma. This service was used by over 100 different GPs and 11 dermatologists and has evaluated over 11,000 dermatology referrals from primary care by 2019.[61]

Italy experienced a surge in TD utilisation during the COVID-19 pandemic due to restricted access to hospitals and travel.[66, 67] Since the COVID-19 pandemic, the Italian government have taken several actions to promote the adoption of

telemedicine; in 2020 the national guidelines for the provision of telemedicine services was published.[68, 69]

TD has proven valuable for triaging and managing complex dermatological conditions in a geographically-challenged area like the Faroe Islands. The Faroe Islands are a medically underserved area in Denmark and have employed TD alongside FTF consultations since 2003.[58-60] TD pilot programmes and feasibility studies have been conducted in Finland[62], Belgium[51, 52], Switzerland[81], Austria[50, 114], and Germany.[64, 65] No information on TD services available in Iceland and Luxembourg was found.

2.5.5 Australia

In Australia, most telehealth services receive funding from either the state or federal government.[42, 115, 116] To encourage adoption among dermatologists and promote best practices, the University of Queensland's Centre for Online Health has developed guidelines for TD.[117] There is a strong focus on TD to enhance access to specialised care in rural areas. Tele-Derm National is provided to registered medical practitioners affiliated with the Australian College of Rural and Remote Medicine. Operating through the Rural and Remote Medical Education Online platform since 2003, this service employs a SAF approach to provide specialist dermatologist advice and guidance within 24 hours.[42] The Princess Alexandra Hospital Skin Emergency Telemedicine Service, established in 2008, handles external TD referrals for clinics located 600–1,200 km away from dermatology services.[43] Similar TD programs operate in Broken Hill, New South Wales, emphasising TD's role in providing dermatologic care for remote Australian communities.[44] During the COVID-19 pandemic, TD utilisation increased in Australia. SAF and LI models are used by four hospitals[43, 45-49], one skin cancer centre[44] and the Australian College of Rural and Remote Medicine.[42]

2.5.6 New Zealand

New Zealand has implemented several regional TD programmes. In Hamilton, New Zealand, a TD service was established in 2010 between a public hospital and private teledermatoscopy company. Through this service, patients are referred from primary care to an imaging clinic for assessment of one to five skin lesions. Dermoscopic images along with clinical information are taken for later remote diagnosis by a teledermatologist.[70] Between 2010 and 2019, over 6,000 patients attended the teledermatoscopy clinic. A publicly-funded TD service called the Virtual Lesion Clinic was established in 2010. At the Virtual Lesion Clinic, a nurse takes dermatoscopic images of the skin lesions along with a targeted medical history for dermatology referrals. While this service allows for faster management of skin cancers, it has

drawbacks including extended waiting times for imaging, the need for patients to travel to imaging centres and a lack of integration with GP and hospital medical centres.[71] To address access gaps and prioritise skin cancer diagnosis and treatment, Waikato public dermatologists introduced the suspected skin cancer (SSC) service in 2017. GPs using the SSC pathway are required to attach dermatoscopic images of up to five lesions with the referral, SSC referral and responses are documented in patients' medical records. A consultant dermatologist reviews the referral and chooses a diagnosis from a menu of ICD-11 codes and provides advice. Treatment recommendations may include no action, excision, diagnostic biopsy, medication prescription, cryotherapy, referral to plastic surgical services, re-referral to the SSC service with improved images or after an interval of time, or referral to the nurse-led teledermatoscopy service for expert imaging. The referrer remains responsible for patient care.[71]

2.5.7 Canada

In 2015, the Canadian Dermatology Association issued a position statement supporting the expansion of TD.[53] There is a scarcity of dermatologists relative to demand, with a striking disparity in dermatologist density between urban and rural areas.[118] The implementation of TD was shown to be helpful in providing care to remote populations.[119] Government support of telehealth initiatives promises development and throughout the country several TD services are available, although variations in practice exist due to regulatory and policy differences across the provinces.[54] The Ontario eConsult programme, which is part of Ontario's publicly-funded healthcare system, allows GPs and nurses access to dermatology specialist advice within an average of five days, often eliminating the need for an in-person referral.[55] The Shared Care TD programme operates in Alberta, British Columbia, Northwest Territories, and Prince Edward Island.[56] The GP captures images of the skin condition using their smartphone or digital camera and sends them, along with patient history, to a dermatologist for review. In July 2022, Quebec launched its own TD programme in which the GP sends images and clinical information to a dermatologist who performs a review within 14 days. This programme aims to improve access to care for the general population and the quality of care for rural Indigenous communities.[57]

2.5.8 Use of centralised teledermatology management software platforms

As previously described, Healthlink is currently the primary electronic mechanism for supporting electronic referrals using interoperable formats between GPs and hospital consultants, including dermatologists, in Ireland. Across countries it can be seen that dedicated centralised TD management platforms are widely used for the

implementation of national services. Of the 21 countries reviewed, 14 were using a TD software management platform. These systems provide a dedicated online TD software application platform to enable ongoing interactive communication between GPs and dermatologists with central management of all images.

2.6 Discussion

In Ireland, the management of dermatological referrals from primary to secondary and tertiary care is a structured and multi-faceted process. GPs play a crucial role in the initial assessment and management of dermatological conditions, utilising clinical guidelines and diagnostic tools to evaluate patients presenting with common skin conditions. Many conditions can be effectively managed at the primary care level. However, when patients present with more complex or severe conditions, or when there is a suspicion of malignancy, GPs refer them to specialist dermatology services.

As of June 2025 there are over 66,000 people waiting for a dermatology appointment in Ireland.[13] The demand for dermatology services continues to outpace supply, leading to ongoing challenges in managing patient flow and ensuring timely access to care. New technologies, such as TD, may impact waiting lists and times and improve access and quality of care delivery for Irish dermatology patients. The HSE Model of Care for Dermatology recommends strategic investment in piloting specific TD initiatives.[1]

TD uses interactive audio, visual, and data communications to deliver dermatological care. It involves transmitting patient's images and clinical information from the GP to dermatologists for assessment and consultation, providing an alternative to traditional referral processes. There are two main types: store-and-forward, which involves sending digital images for later assessment, and live interactive, which uses live videoconferencing for immediate consultations. Store-and-forward TD increases efficiency and accessibility, especially for remote areas, but may suffer from issues like low image quality and delayed interaction. Live-interactive TD allows for interactive diagnoses and immediate care but requires reliable internet and synchronised availability of both parties. Both methods offer unique benefits and challenges, with the choice depending on the specific needs and aims of the service. TD is becoming a more commonly-used tool in Ireland's healthcare system. Adoption surged during the COVID-19 pandemic with virtual live-interactive outpatient appointments via HSE-approved platforms.[1, 40] A successful pilot in Cork demonstrated the effectiveness of electronic photo triage for infantile haemangiomas.[1] Additionally, private services providing TD are available in Ireland.

The international use of TD has seen significant growth over the past decade.[120] TD is widely utilised across the countries described in this chapter to improve access to

dermatological care and reduce waiting times. Of the 23 countries examined, 21 countries have implemented TD nationally, regionally or have conducted feasibility and pilot studies. Internationally, TD has been shifting away from live-interactive methods in favour of SAF models, possibly due its low cost, higher image quality, and the fact that an SAF approach allows for better organisation, resource management, efficiency and improved documentation. TD has been introduced in rural areas of Australia and Canada to improve access to services. In contrast, other countries utilised TD primarily in urban areas; for instance, most TD centres in Spain are concentrated in larger cities (Seville, Madrid and Barcelona).[78]

This chapter only describes the international triage and, advice and guidance TD models that are currently being used, as the follow-up and direct-care models are out of the scope of this HTA. Some of the countries listed in this chapter also utilise follow-up models and direct-care models, in which private companies provide direct patient access to a dermatologist without a referral from a GP. In the countries discussed in this chapter, many individual GPs practice TD informally. Therefore, it's important to note that this overview of TD is not exhaustive but aims to illustrate the wide breath of TD utilisation. Additionally, an international survey on TD utilisation found that the published literature does not fully reflect the extent of TD use.[120]

This international review of evidence also searched for published TD guidelines for each country. A limited number of countries have published guidelines for TD. Australia has developed guidelines for TD.[117] International and national societies such as American Academy of Dermatology Association and the British Association of Dermatology have published standards and guidance on teledermatological practice.[23, 121] A publication by the German Dermatological Society also proposed guidelines for TD in Germany.[122] It was not possible to assess how those guidelines were being actually being implemented and followed in practice.

3 Epidemiology and burden of disease

Key points

- Skin conditions form a large and heterogeneous group of conditions which affect between 30 to 70% of people globally, and approximately 54% of the Irish population each year.
- Skin cancer accounts for over one third of invasive cancers in Ireland with incidence rates on the rise:
  - The age-standardised incidence rate of melanoma increased by 33% among women and 140% among men between 2002 and 2022.
  - The age-standardised incidence rate of non-melanoma skin cancer (NMSC) rose by 28% among women and 32% among men between 2002 and 2021.
  - Projections indicate that both melanoma and NMSC rates will increase in the coming years.
- In addition to skin cancer, inflammatory and infection skin conditions contribute toward demand for dermatology healthcare services.
- Skin conditions are a common reason for a general practitioner (GP) visit. However, without a national registry or database, it is difficult to quantify the true burden of skin conditions in primary care.
  - Approximately 21.35 million GP consultations occur each year in Ireland with studies estimating that between 7.6 and 8.6% of these relate to a skin complaint. This results in potentially 1.62 to 1.84 million GP consultations each year associated with a skin condition.
- Demand for outpatient dermatology services has continuously increased in recent years:
  - The number of referrals to dermatology outpatient departments (OPDs) rose by 55% between 2019 (n=64,220) and 2024 (n=99,994).
  - The number of whole-time equivalent (WTE) consultant dermatologists has steadily increased, but demand has outpaced capacity. Between 2019 and 2024, while new patient referrals rose significantly, the number of new patients seen increased by only 21%.

- There is an increasing trend in the number of patients waiting for a dermatology OPD appointment:
  - At the end of January 2025, 60,821 patients were waiting for an appointment; 51.7% had been on the waiting list for 0-6 months, 26.0% for 6-12 months, 11.2% for 12-18 months, 7.9% for 18-36 months, and 3.2% for over 36 months.
- Lower-acuity referrals make up the majority of dermatology outpatient referrals; however, most appointment slots are allocated to urgent cases due to necessary clinical prioritisation. Despite this, only a small proportion of urgent cases are seen within recommended timeframes.
- Delays in accessing specialist dermatology services can worsen health outcomes, including reduced survival for cancers diagnosed at later stages and increased physical and mental burden in chronic inflammatory conditions.

3.1 Introduction

Skin conditions are heterogeneous with over 1,000 skin or skin-related conditions listed on the International Classification of Disease (ICD 10) covering inflammatory conditions, skin cancers, autoimmune conditions, and hereditary diseases. This chapter examines the epidemiology and burden of dermatological conditions in Ireland, focusing on their impact on both patients and the healthcare system. The epidemiology of skin conditions presented in this chapter is limited to those most commonly seen in outpatient dermatology services: melanoma, non-melanoma skin cancer (NMSC), psoriasis, acne, eczema (dermatitis), hidradenitis suppurativa (HS), vascular lesions, rosacea, and skin infections. The burden of dermatology is further explored in the context of primary and secondary and or tertiary healthcare services, presenting the demand for dermatology care through outpatient waiting lists and alternative treatment schemes, and examining the impact on patients experiencing delayed access to care due to long wait times.

3.2 Epidemiology and clinical burden of skin conditions

The burden of skin conditions is significant, ranked as the eighth leading cause of non-fatal burden expressed as years lost due to disability in the most recent 2021 Global Burden of Disease Study.[123] Skin conditions affect between 30-70% of people worldwide,[124] and approximately 54% of the Irish population annually.[1] Skin conditions are often reported as the most frequent reason for a general practitioner (GP) consultation.[125-127] In Ireland, up to 33% of people at any one

time may have a skin condition that would benefit from medical care, with regional studies estimating that 7.6 to 8.6% of GP consultations relating specifically to the skin.[128, 129] Ireland has a growing population, which increased from 4.76 million in Census 2016 to 5.14 million in Census 2022 reflecting an increase of eight per cent.[130] Between 2002 and 2022, Ireland's population aged 65 years and over increased by 78.1%, rising from 436,001 to 776,315 compared with a 25.6% increase among those aged less than 65 years (3,481,202 to 4,372,824). [130] This demographic shift reflects Ireland's ageing population, a result of lower fertility rates and longer life expectancy, which is expected to continue in the coming years.[131] Population ageing combined with population growth, along with increasing and improving treatments and technologies available to patients, is expected to drive greater demand for healthcare.[132]

3.2.1 Skin cancer

Skin cancer is among the most prevalent cancers in the world, with its incidence continuously rising. In Ireland, invasive skin cancer accounts for 34% of all recorded invasive cancers.[133] Skin cancers are broadly classified into two main categories: melanoma and non-melanoma skin cancer (NMSC). The major subtypes of melanoma include superficial spreading melanoma, nodular melanoma, lentigo maligna melanoma, and acral lentiginous melanoma. NMSC primarily consists of cases of squamous cell carcinoma (SCC) and basal cell carcinoma (BCC). NMSC is more common, accounting for approximately 90% of the 56,208 registered skin cancer cases in Ireland between 2017 and 2021.[8]

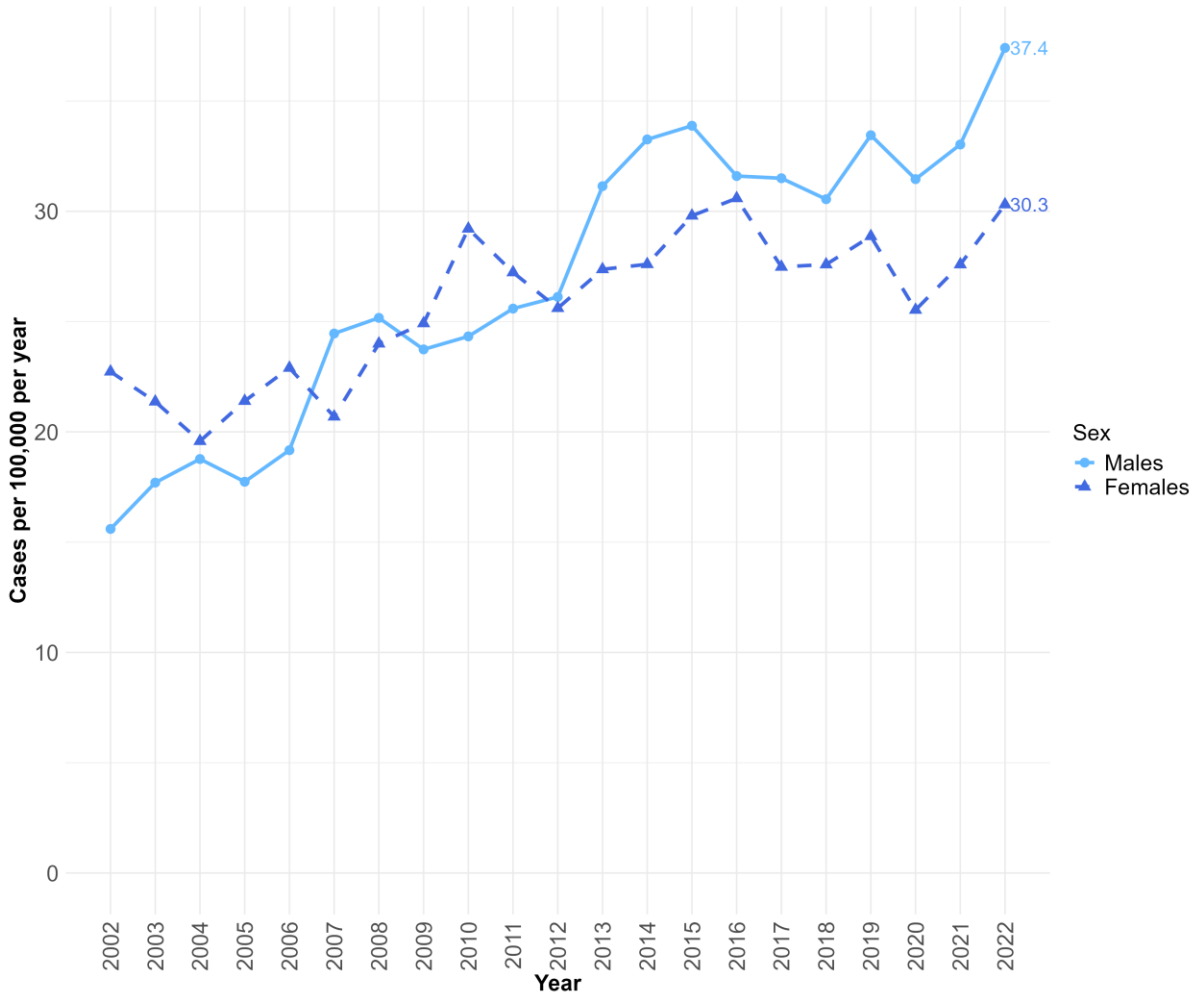
Skin cancer constitutes a significant and growing burden on the healthcare system. As the population ages, there is a corresponding rise in age-related health conditions, including a greater prevalence of skin cancers. Older adults are particularly vulnerable to skin cancer due to cumulative ultraviolet (UV) radiation exposure, thinning skin, and diminished immune function.[134, 135] As both the general and older populations expand, the incidence of skin cancer is projected to rise, intensifying demand for dermatological services.

3.1.1.1 Melanoma

Melanoma incidence rates in Ireland have increased significantly over the past two decades. Between 2002 and 2022, the age-standardised incidence rate for melanoma rose from 22.7 to 30.3 cases per 100,000 among women, and from 15.6 to 37.4 cases per 100,000 among men (Figure 3.1). This represented a 33% and 140% increase among women and men, respectively. The National Cancer Registry Ireland (NCRI) reports that between 2020 and 2022, melanoma was the fourth most commonly diagnosed cancer among men and women, accounting for 5.1% and

5.6% of all invasive cancers diagnosed excluding NMSC.[136] Although melanoma cases decreased in 2020, likely due to the impact of COVID-19 on healthcare utilisation, a sharp increase was seen in 2021 and 2022 as healthcare utilisation and detection rates returned to pre-COVID patterns. Projections suggest that between 2020 and 2045, the number of melanoma cases among males will triple (a 207% increase), while cases among females will rise by 140%.[137] Melanoma is rare in children, but represents the third most common cancer in 16 to 24 year olds. Between 2011 and 2020, there were an average of 13 cases of malignant melanoma diagnosed per year in 16 to 24 year olds in Ireland.[138] Incidence rates increase steadily with age, especially in those 70 years and older. Although most cases are detected at an early stage, 11% of female diagnoses and 17% of male diagnoses are already in stage III or IV at diagnosis. While five-year survival for patients diagnosed at earlier stages is high (stage I: 100%; stage II: 83-87%), this reduces significantly for those diagnosed at later stages (stage III: 71-77%; stage IV: 32-38%). The overall five-year net survival has improved over time, increasing from 82% for those diagnosed between 1994-1998 to 92% for those diagnosed between 2014-2018.[133] The average annual number of deaths attributable to melanoma between 2018 and 2022 was 171.[133]

Figure 3.1 Age-standardised incidence rate of melanoma in Ireland between 2002 and 2022



Source: NCRI incidence statistics.[8]

The main risk factor associated with melanoma is UV radiation exposure from both natural (such as the sun) and artificial sources (such as sunbeds).[139] The effect of UV exposure differs person to person. People with fair complexion, blonde or red hair, white ethnicity, a tendency to freckle, and skin that easily burns or tans, are more susceptible.[140] The Fitzpatrick skin type classification scale, which considers skin colour (pale to black) and how the skin reacts to UV (that is, whether it burns easily or tans), ranges from one (high risk) to six (low risk). The native Irish population has one of the most lightly pigmented skin tones in the world,[141] primarily Fitzpatrick skin types one and two, making them highly susceptible to melanoma.[142] Compared with international estimates from the European Cancer Information System, Ireland had the fifth highest age-standardised incidence rate of melanoma per 100,000 population among the EU-27 countries in 2022.[143] In England, the average annual age-standardised incidence rate across 2018 to 2020 was 26.6 per 100,000 compared with 29.4 per 100,000 observed in Ireland during

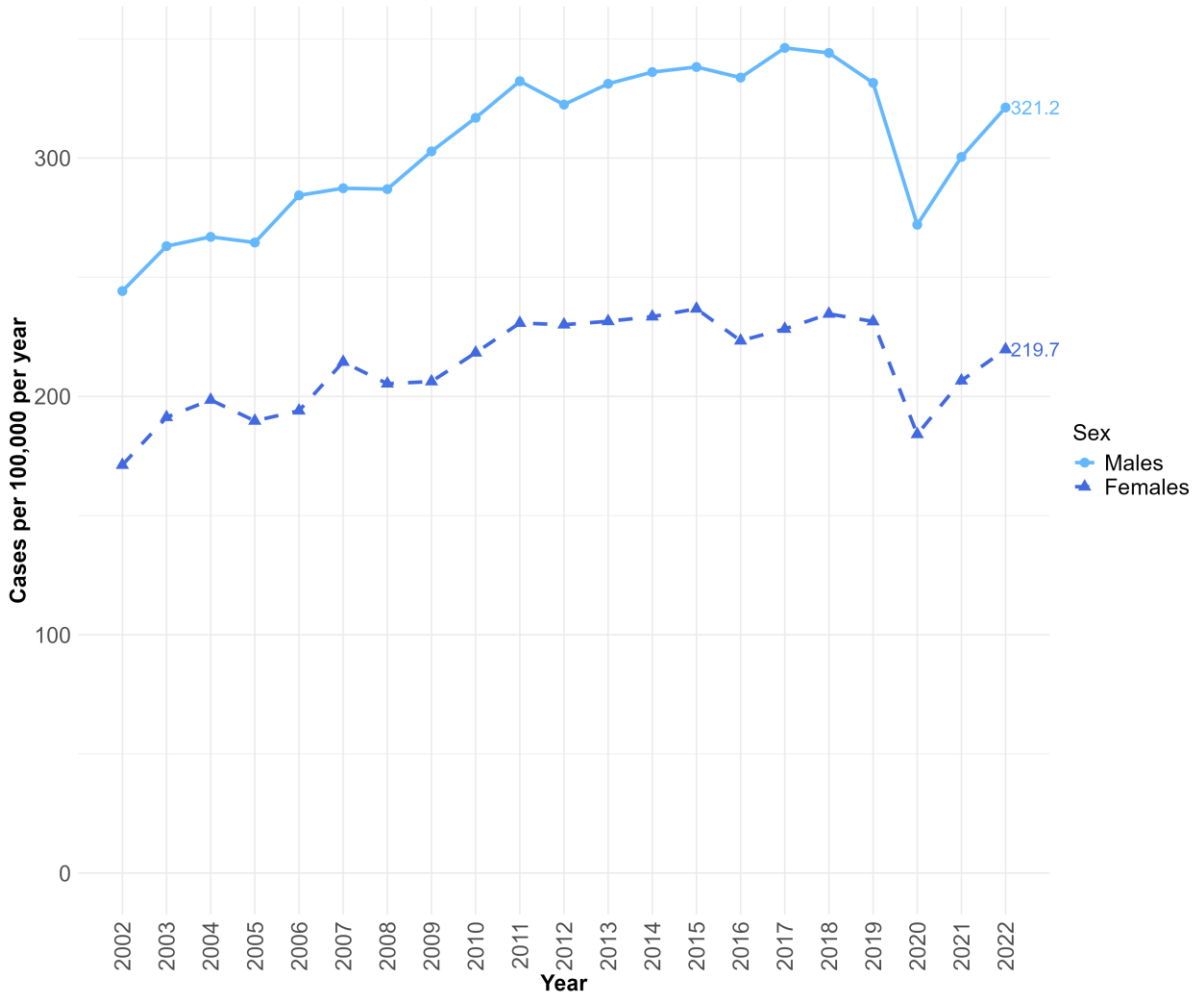
the same period.[144, 145] The lifetime risk for developing melanoma in Ireland is approximately 1 in 35 for males and 1 in 40 for females.[136]

Melanoma significantly impacts both the physical and mental well-being of patients, leading to impairments in their overall health-related quality of life (HRQoL). Among the various HRQoL domains measured in studies, fatigue and physical functioning are the most frequently reported concerns, particularly during treatment. Research has also explored the prognostic value of HRQoL scores in relation to disease progression and survival. Findings indicate increased symptoms such as fatigue, pain, and appetite loss have been linked to higher risks of disease progression and reduced survival rates.[146]

3.1.1.2 Non-melanoma skin cancer (NMSC)

As with melanoma, NMSC incidence rates in Ireland have increased steadily over the past two decades (Figure 3.2), except for the decrease observed in 2020 that likely resulted from COVID-19. Between 2002 and 2022, the age-standardised incidence rate for NMSC rose from 171.2 to 219.7 cases per 100,000 among women, and from 244.2 to 321.2 cases per 100,000 among men. This represented a 28% and 32% increase among women and men, respectively. Between the years 2015 and 2045, the average number of people diagnosed with NMSC each year is projected to increase from 6,004 to 16,623 (+177%) for males and from 4,669 to 13,503 (+189%) for females.[137] Due to cumulative sun exposure, rates of NMSC are higher in the older population. Of the NMSC diagnosed, almost all are exclusively BCC (74% of NMSCs) or SCC (26% of NMSCs) with less than 100 cases per year between 2018 and 2022 of other NMSC subtypes.[133] The age-standardised incidence rates from 1994 to 2019 for BCC have followed an increasing trend, while those for SCC have remained stable or marginally decreased.[133]

Figure 3.2 Age-standardised incidence rate of NMSC in Ireland between 2002 and 2022



Source: NCRI incidence statistics.[8]

The lifetime risk for developing NMSC in Ireland is approximately one in four for males and one in five for females which is similar to the estimates in England (one in five in the general population) and significantly higher than the lifetime risk of developing melanoma.[136, 147] The average annual age-standardised mortality rates for NMSC between 2018 and 2022 were 1.5 per 100,000 for females and 5.0 per 100,000 for males. The average annual age-standardised mortality rates for melanoma were higher for both females and males (3.1 and 6.1 per 100,000, respectively). The five-year net survival for BCC is 100% and 97% for SCC.[133] The average annual number of deaths attributable to NMSC between 2018 and 2022 was 101.[133]

Although NMSCs are associated with lower mortality rates than melanoma, their tendency to affect the face and neck can lead to physical discomfort, functional limitations, and cosmetic concerns. These factors can contribute to psychological

distress, including anxiety, depression, and reduced self-esteem.[148] Additionally, treatment for NMSC often involves repeated medical procedures, scarring, and the potential for recurrence, further impacting patients' daily lives and well-being.[148]

3.2.2 Inflammatory and infectious skin conditions

3.2.2.1 Psoriasis

Psoriasis is a chronic, non-communicable, inflammatory skin condition characterised by the presentation of pink plaques on white skin or grey plaques on black skin. Psoriasis is manageable without definitive cure.[149] The pooled age-and-sex standardised incidence rate of psoriasis in the UK between 2008 and 2019 was 103.2 per 100,000 person-years, with an estimated incidence rate of 86.6 per 100,000 person-years in 2019 specifically .[150] The prevalence of psoriasis in the UK in 2019 was 1.9%.[150] This estimate is similar to the 1.92% prevalence (95% CI 1.07% to 3.46%) reported in Western Europe by a systematic review and modelling study published in 2020.[151]

Psoriasis is multifactorial, influenced by environmental, lifestyle, and genetic factors.[152] It is more common in adults than in children and typically presents with a dual incidence peak: the first around 39 years of age (early-onset), and the second around 50 to 69 years (late-onset), declining in incidence thereafter.[151, 153] Approximately 50% of patients diagnosed with psoriasis suffer from moderate-to-severe disease.[154] Patients suffering from these forms of the disease could be candidates to receive biologic treatments if traditional treatments offered in primary care have failed. In Ireland and the UK, an estimated 60% of patients have been prescribed biologic treatments.[155] Psoriasis has a significant psychosocial burden often associated with the severity of the disease, impacting quality of life, mental health, and social and occupational functioning.[156, 157] Individuals living with psoriasis face a 21% higher risk of all-cause mortality compared to individuals without the condition (HR 1.21, 95% CI 1.13 to 1.3).[153] Therefore, the appropriate referral for patients with psoriasis and timely treatment is important for the management of the disease and associated conditions.

3.2.2.2 Acne

Acne is a chronic, inflammatory condition and one of the most common skin diseases.[158, 159] Acne management varies by severity, with non-prescription topical treatments available over-the-counter at pharmacies, GP care for persistent or severe cases, and dermatology referral for widespread, nodulo-cystic, or scarring acne.[160]

Acne is more common among adolescents and young adults, and correlates often with the onset of puberty and increase in sebum production.[158] According to the Global Burden of Disease (GBD) 2021, the prevalence of acne among Irish adolescents aged 10-14 years old was 14.5%, and for adolescents and young adults aged 15-19 years old was 23.2%. For people aged 20-24 years old the prevalence was 9.1% and followed a decreasing trend with age. The age-standardised incidence rate was 258.4 per 10,000. The highest incidence rate of 1,291.8 per 10,000 was among adolescents aged 10-14 years, followed by 694.2 per 10,000 among individuals aged 15-19 years.[123, 161]

The GBD reported that of disability-adjusted life years relating to acne in 2021, approximately 50% were related to years lived with non-disabling symptomatic acne and mild acne, while the other 50% to years lived with moderate acne and severe acne.[123] Limited information exists in the Irish context regarding the proportion of people that have moderate or severe acne and that seek medical care.

The clinical symptoms of acne – such as pain, swelling, and scarring – can be challenging for patients. Additionally, the impact of acne can extend to mental health challenges and suicidal ideation[162-165], experiences of stigmatisation[166], and side effects from treatment, particularly during prolonged courses of antibiotics.[167, 168] The negative impact of acne on HRQoL has been documented through dermatology-specific standardised questionnaires, with greater reduction in quality of life observed when acne affects both the face and the trunk.[169]

3.1.1.3 Eczema (dermatitis)

Eczema is a term used to describe multiple skin conditions characterised by itchiness, dryness, irritation, rashes, and blisters. Atopic dermatitis (AD) is the most common type of eczema and is influenced by both environmental and genetic factors.[170] It is manageable through treatment and lifestyle changes, but does not have a definitive cure.[171] AD is typically diagnosed during childhood[172]; however, over 25% of cases develop in adulthood.[173] In Ireland, it is reported that 20% of children and 10% of adults are affected by AD, though reliable data are scarce.[174] Patients with moderate-to-severe AD are typically referred to dermatology clinics. A study conducted in 2022[175] used aggregate data from three Irish secondary care sites to estimate the national number of moderate-to-severe AD cases in secondary care over a six-month period. The estimated prevalence of moderate-to-severe AD in secondary care was 2.9 per 10,000 people, with a total of 1,141 cases. The highest prevalence was in 12- to 17-year-olds (6 per 10,000), while among adults, the highest rates were in 18- to 24-year-olds. The six-month incidence rate was 0.4 per 10,000, with 152 new cases entering secondary care.[175] The psychosocial burden of AD is high. Respondents to an Irish-based online survey (n = 454) reported a range

of negative impacts due to their condition, including: interrupted sleep, social anxiety, feeling depressed, and avoidance of exercise, social activities, and sexual intimacy.[176]

3.1.1.4 Hidradenitis suppurativa

Hidradenitis suppurativa (HS) is a chronic, inflammatory skin condition characterised by the occurrence of painful lumps and abscesses in areas of the body where skin touches skin, such as skin folds.[177] A cross-sectional study conducted in four Irish dermatology clinics in 2015 found that of the 15,547 patients attending during a six month period, 221 (1.4%) had a diagnosis of HS.[178] Approximately 50% of patients presented to the study visit with the moderate form of the disease (Hurley stage II), while 26% presented with the severe form (Hurley stage III). Additionally, 70% of patients reported experiencing some degree of anxiety or depression due to HS.[178] HS is manageable through medical, surgical, and lifestyle interventions, but has no definitive cure. Genetic predisposition, as well as environmental and lifestyle factors are known to contribute to its development.[179] Diagnosis is often delayed, with patients experiencing years of symptoms before receiving treatment, which can affect their quality of life and psychological wellbeing.[180] The average age of disease onset has been challenging to estimate due to the typical delays in diagnosis; however, evidence suggests that HS usually develops between the age of 18 and 39.[178, 181, 182]

3.1.1.5 Vascular lesions

Vascular lesions, or vascular anomalies, refer to several conditions characterised by lesions of blood vessels in the skin. These are usually diagnosed during childhood and are classified into two groups: vascular tumours and vascular malformations. Vascular tumours are further classified into three subgroups: benign, locally aggressive or borderline, and malignant. Vascular malformations are categorised into four subgroups: capillary, venous, lymphatic and arteriovenous malformations.[183] Depending on the type and location of the lesion, multidisciplinary care may be required, involving dermatology, interventional radiology, vascular surgery, and plastic surgery.

The Joint Vascular Birthmark Clinic (JVBC) at Our Lady's Children's Hospital in Crumlin conducted a retrospective evaluation of the medical records of 144 patients with vascular birthmarks who were seen at the clinic from September 2003 to April 2005. From these patients, 57% were diagnosed with a vascular tumour, while the remaining 43% were diagnosed with a vascular malformation.[184]

Infantile haemangioma (IH) is a benign condition and the most common type of vascular tumour, affecting around 4% of children globally, although reported incidences range from 2% up to 10%.[185] Its incidence has increased over the past few decades, shown to be correlated with decreasing gestational age at birth and with lower birth weight.[186] The true incidence of IH in Ireland is unknown. However, a photo-triage project initiated by the Department of Dermatology at South Infirmary Victoria University Hospital in Cork since November 2016 revealed that over a 15-month period, 85% of the 171 lesions evaluated from 139 patients were IH.[187]

Kaposi sarcoma, a type of vascular tumour within the locally aggressive or borderline subgroup, is caused by infection with the herpes virus. Kaposi sarcoma can occur at any age, but is more common among male adults with impaired immune systems.[188] According to the NCRI, the annual average age-standardised incidence rate between 2020 to 2022 was 0.2 per 100,000,[136] with an average of six cases diagnosed per annum during this period.[136, 189] The two most common malignant vascular tumours are angiosarcoma and epithelioid hemangioendothelioma.[190] The age-standardised incidence rate in England between 2013 and 2017 of angiosarcoma and epithelioid hemangioendothelioma was 3.29 and 0.05 per million per year, respectively.[191] There are other less common locally aggressive or borderline vascular tumours, but available epidemiological data for Ireland are scarce.

Over 1.5% of the population globally have a type of vascular malformation.[192] In the review conducted by the JVBC, capillary malformations, often referred to as port-wine stains, represented 16% of the vascular birthmarks seen in the clinic.[184] The photo-triage project conducted by the South Infirmary Victoria University Hospital in Cork reported that 9% of the 171 vascular lesions examined were port-wine stains.[187] In the UK, capillary malformations affect one in 300 babies, and are equally common in girls as in boys.[193] Lastly, 13% of cases in the study conducted by JVBC were venous malformations.[184]

3.1.1.6 Rosacea

Rosacea is a chronic and inflammatory condition characterised by redness on the face and other possible symptoms such as burning or stinging, dryness, irritation, swelling around the eyes, among others. Rosacea is manageable without definitive cure. The most used classification of rosacea is based on clinical features and consists of four subtypes: erythematotelangiectatic rosacea, papulopostular rosacea (PRP), phymatous rosacea, and ocular rosacea. Rosacea typically develops after the age of 30, and is more common in people aged between 45 and 60.[194] Rosacea is

multifactorial, in which genetic predisposition and environmental triggers – such as UV light and extreme temperatures – contribute to its development.[195]

The exact prevalence of rosacea in Ireland is unknown. However, a 2010 study conducted among 1,000 workers with different levels of UV exposure found that the prevalence of PRP was 2.7%.[196] The incidence rate for diagnosed rosacea between 1995 and 2009 in the UK was 1.65 per 1,000 person-years.[197] A systematic review and meta-analysis published in 2018 estimated a global prevalence of rosacea of 5.5% in the general population.[194]

Rosacea has a negative impact on quality of life, often associated with stigmatisation and mental health comorbidities such as depression and anxiety.[198] The appropriate and timely treatment of rosacea that limits the severity of the disease can improve the quality of life of the people affected by it.[199]

3.1.1.7 Skin infections

There is a wide variety of skin infections caused by different infectious agents. Fungal skin infections were the most common skin infection and fourth most prevalent disease globally in 2010. Impetigo, *moluscum contagiosum* (also called water warts), and scabies are other skin infections that were among the 50 most common diseases.[200] In Ireland, a study on fungal skin infections reported that most of these are caused by dermatophytes species (also called ringworm or tinea).[201] Further epidemiological data in Ireland for the most common skin infections is scarce. In the UK, the incidence rate of skin and soft tissue infections is estimated to be 16.4 cases per 1,000 person-years.[202] Impetigo and water warts affect mainly children. The incidence rate of impetigo among children aged 0 to 14 years in the UK in 2010 was 1,447 per 100,000 person-years.[203] The incidence rate for all ages of water warts from 1994 to 2003 in the UK was 243 per 100,000 person-years among males and 231 per 100,000 person-years among women. The highest incidence rate was seen in those aged 1 to 4 years, followed by those aged 5 to 14 years.[204] Scabies affect mostly children, but also people living in disadvantaged and overcrowded spaces.[205] The incidence rate for all ages of scabies in the UK from 1994-2003 was 351 per 100,000 person-years among males and 437 per 100,000 person-years among women. Young adults aged 15 to 24 years showed the greatest incidence rates, followed by children aged 5 to 14 years.[204] Overall, the burden of skin infections has increased in the past decades, partly due to rising antimicrobial resistance to antibiotics used to treat these conditions.[206] Skin infections are typically managed in primary care.

3.3 Burden of skin conditions on the Irish health system

Understanding the burden of skin conditions on the healthcare system requires consideration across both primary, and secondary and tertiary care, as these services play distinct but interconnected roles in patient management. In Ireland, primary care often serves as the first point of contact for individuals with skin conditions, with patterns of presentation in this setting influencing referral rates to specialist secondary and tertiary care. This section aims to summarise the current burden as a result of skin conditions within these settings.

3.3.1 Primary care

Primary care plays a pivotal role in the delivery of dermatological care in Ireland. While patients can seek advice for skin conditions from pharmacists or primary care nurses, general practitioners (GPs) act as gatekeepers for referrals to secondary and tertiary care.[207] Given the role of GPs in the referral pathway and the focus of this Health Technology Assessment (HTA), the following section focuses specifically on demand for dermatology care within general practice.

3.3.1.1 Demand for skin-related care in primary care

In Ireland, there is no national database that systematically tracks GP consultations, as GPs operate independently. This makes it challenging to obtain accurate data on both the volume and reasons for consultations. Estimates of the GP workforce also vary. The 2023 Irish Medical Council Workforce Report reported 4,456 registered GPs,[208] while the Irish College of GPs (ICGP) reported 4,370 GPs and 1,015 in training in 2024.[209] An ICGP analysis noted that although the population grew by 3.1% between 2022 and 2023, GP numbers increased by only 0.6%,[209] suggesting workforce growth is not keeping pace with demand. The number of registered versus clinically active GPs is likely to vary as well as the proportion of clinically active GPs that work full time. A review of general practice services in Ireland by the Department of Health[210] found that in mid-2022, 3,262 clinically active GPs were providing standard services in Ireland across 1,451 general practice settings. This equates to one whole-time equivalent (WTE) GP per 1,879 people.

While Ireland lacks a national database to track GP consultations, studies have attempted to estimate both the overall volume and the proportion of consultations related to skin conditions. The 2024 Healthy Ireland Survey found that 79% of people aged 15 and over visited a GP in the previous year for any reason, with an average of 4.4 visits per person. Based on population estimates, this suggests there are approximately 17.6 million GP visits annually in Ireland among those aged 15 years and older. A 2020 national survey by Collins et al.[211] reported 34,594

consultations among all age groups occurring on the day prior to the survey responses across 507 GP practices. Extrapolation from these data estimated that an Irish person visits their GP on average 3.34 times per year, with 21,353,731 GP consultations and 7,749,615 practice nurse consultations annually. It should be noted however that these data encompass multiple GP consultation types, namely face-to-face (FTF) visits (87.8%), telemedicine (10%), home visits (1.3%), and nursing home visits (0.9%). Data in Ireland on the reason for a GP consultation are scarce. A retrospective analysis of a single practice over four years recorded 52,572 consultations from 5,210 patients, generating 70,489 reasons for consultation of which 6,055 (8.6%) were skin-related.[128] Another observational study including 171 GPs recorded 16,899 consultations between September 2008 and April 2010. Skin diagnoses were noted in 1,288 (7.6%) of cases.[129] These estimates align with findings from studies conducted in other European countries, including Finland (7.8% of 1.49 million GP consultations analysed),[212] Scotland (8.4% of 7,771 GP consultations, with 25% of all dermatological consultations being frequent attendees),[213] and the Netherlands (12.4% of diseases seen across 11 family physicians).[214] More variable estimates have been reported in the UK, with 14.4% of 382 concerns raised in one study being skin-related[215] and 6.8% of 485 e-consultations in another study related to skin issues.[216] A further study was conducted in the UK using surveillance data collected in the Weekly Returns Service of the Royal College of General Practitioners, representative of a population of 950,000 in England and Wales. The study found that skin conditions were the commonest new reason for GP consultation in 15 to 24% of the population, varying based on ICD9 classification.[126]

There are limited data on the specific nature of skin-related presentations in GP consultations. A nationwide database study[212] of GP visits in Finland between 2015 and 2019 found that among 1,489,228 skin-related consultations, eczematous eruptions/dermatitis, bacterial skin infections, and benign skin neoplasms accounted for half of the skin-related conditions requiring care. In a Scottish study, among 654 skin-related GP consultations, the most common skin conditions were eczema (22.5%), infections (20.3%), and benign tumours (11.4%). Among 165 frequent attendees, 44% had eczema, 10.5% had acne, 8.8% had infection or infestation, a further 8.8% had psoriasis, and 6% had urticaria. Of the 654 consultations, 14% were referred to secondary care with the commonest conditions in this cohort being eczema (26%), suspected skin malignancy (13%), psoriasis (12%), uncertain diagnosis (11%), benign tumours (8.7%), acne (7.6%), and infections (5.4%).[213]

The HSE Model of Care for Dermatology recognises the pivotal role that GPs play in the first-line management of skin cancers through recognition, and treatment of pre-malignant skin cancers.[1] National Cancer Control Programme (NCCP) GP guidelines

for the referral of patients with high risk SCC are available.[10] Additionally, the Primary Care Surgical Association (PCSA) Ireland have published guidelines[217] on the management of NMSC, which provide direction on managing these cancers based on a GP's level of skin surgery training and experience. Dependent on the level of training and experience, GPs can provide skin surgery services including biopsy or complete resection of NMSC, but practices are likely to differ across GP settings and may be dependent on whether a GP has a special interest in skin surgery or dermatology. One study[218] from a single GP practice in Ireland reported that between January 2012 and July 2015, 71 NMSC lesions were diagnosed, of which 82% were managed within the practice and 18% referred to a consultant dermatologist. Another retrospective study[219] in a separate primary care centre in Ireland found that among 184 histologically-confirmed basal cell carcinomas (BCCs), 54% were treated with cryosurgery, 31% were excised in primary care, and 7% were referred to plastic surgery; the remainder were managed with photodynamic or topical therapies. While these studies demonstrate that these activities and outcomes can occur in primary care, they are single centre experiences and may therefore have limited generalisability nationally.

While data on dermatology in primary care remain limited and variable, the available evidence suggests that skin-related concerns represent a significant component of GP workload. Considering the Irish estimates presented, and assuming approximately 21.35 million GP consultations occur annually in Ireland,[211] 1.6 to 1.8 million of these consultations may be skin-related. As discussed further in Section 3.3.2.2, almost 100,000 referrals to dermatology services were received in 2024. This suggests that the vast majority of skin-related complaints are managed in primary care without referral to a consultant dermatologist. However, it is important to consider that if the burden of skin conditions increases, it is likely that the burden on both primary, and secondary and tertiary care services, will increase too.

Data on GP consultation length in Ireland are limited, but available estimates suggests a range of 13.7[211] to 14.1[220] minutes. This is longer than in the UK where average GP consultation times have been reported to range from 5 to 11.7 minutes.[221]

3.3.2 Secondary and tertiary care

The following sections examine the growing demand on dermatology outpatient services. An overview of the current workforce is presented, followed by an analysis of outpatient waiting list activity in dermatology. As noted in Chapter 2, some dermatology-related referrals are sent to plastic surgery departments for management, particularly for the review and excision of suspected melanomas and pigmented lesions. While this HTA focuses on dermatology services, and therefore does not present data on plastic surgery activity, it is important to acknowledge that plastic surgeons play a role in the delivery of dermatology-related care and augment the overall workforce, particularly in the management of some skin cancers.

3.3.2.1 Dermatology workforce

Ireland has historically had one of the lowest ratios of dermatologists per capita in Europe.[222] Currently, there are 68 consultant dermatologists in post across 30 hospitals equating to 63.6 whole-time equivalents (WTE), with an additional 5.0 WTE in recruitment. This represents steady progress from 49.96 WTE consultant dermatologists in post in 2019. However, considering current CSO population estimates (5.38 million, April 2024), the current ratio (one consultant per 84,000 population) remains below both the 2019 HSE Model of Care for Dermatology five-year target of one dermatologist per 80,000 and the British Association of Dermatologists (BAD) guideline recommended ratio of one per 62,500 population.[223] Table 3.1 outlines the current distribution of consultant dermatologists and specialist registrars nationwide and Table 3.2 shows the total population per consultant within each Regional Health Authority (RHA).

Table 3.1 Overview of WTE consultant dermatologist and specialist registrars in Irish hospitals at April 2025

Regional Health Authority	No. of WTE consultants	No. of Specialist Registrars
HSE Dublin and Midlands		
Children's Health Ireland	7.0	4
Midlands Regional Hospital Tullamore	0.4	-
Naas General Hospital	0.6	-
St James's Hospital Midlands Regional Hospital Mullingar	6.3	1
Tallaght University Hospital*	4.8	2
HSE Dublin and North East		
Beaumont Hospital	6.2	2
Connolly Hospital	0.6	-
Mater Misericordiae University Hospital	6.5	2

Monaghan Hospital*	3.4	3
Our Lady of Lourdes Drogheda		
HSE Dublin and South East		
St Vincent's University Hospital	5.4	2
St Michael's Hospital		
University Hospital Waterford	3 (2 advertised)	3
South Tipperary General		
HSE Mid West		
University Hospital Limerick*	4 (1 advertised)	3
HSE South West		
Cork University Hospital*	8.4	4
South Infirmary Victoria University Hospital		
University Hospital Kerry*		
Bantry General Hospital*		
Mallow General Hospital*		
HSE West and North West		
University Hospital Galway*	6.0	3
Mayo University Hospital*		
Portiuncula University Hospital*		
University Hospital Sligo*	1.0 (2 advertised)	1
Letterkenny University Hospital	0	-
Total	**63.6**	**30**

Key: HSE – Health Service Executive.
Note: Data based on figures at April 2025.[224]
Footnote: *Seeing adult and paediatric patients. Children's Health Ireland (CHI) includes CHI at Crumlin, Tallaght, and Temple Street.

Table 3.2 Population per WTE consultant by Regional Health Authority

Regional Health Authority	Population (2022)	Consultants	Population per consultant
HSE Dublin and Midlands	1,077,639	19.1	56,420
HSE Dublin and North East	1,187,082	16.7	71,083
HSE Dublin and South East	971,093	8.4	115,606
HSE Mid West	413,059	4.0	103,265
HSE South West	740,614	8.7	85,128
HSE West and North West	759,652	7.0	108,522
Total	5,149,139	63.6	80,961

Key: HSE – Health Service Executive; WTE – whole time equivalent.
Note: Population estimates are based on CSO 2022 data, while consultant WTE figures are from 2024; due to population increases, there may be a minor over-estimate in the calculated consultant-to-population ratio.

3.3.2.2 Demand for outpatient dermatological care and hospital activity

Referral data provides a useful way to reflect demand on dermatology outpatient services. Although not all referrals translate into appointments, it offers insight into the pressure on health services. This section examines total referral volumes, and new and return outpatient attendances, to provide an overview of current demand and capacity within the dermatology service.

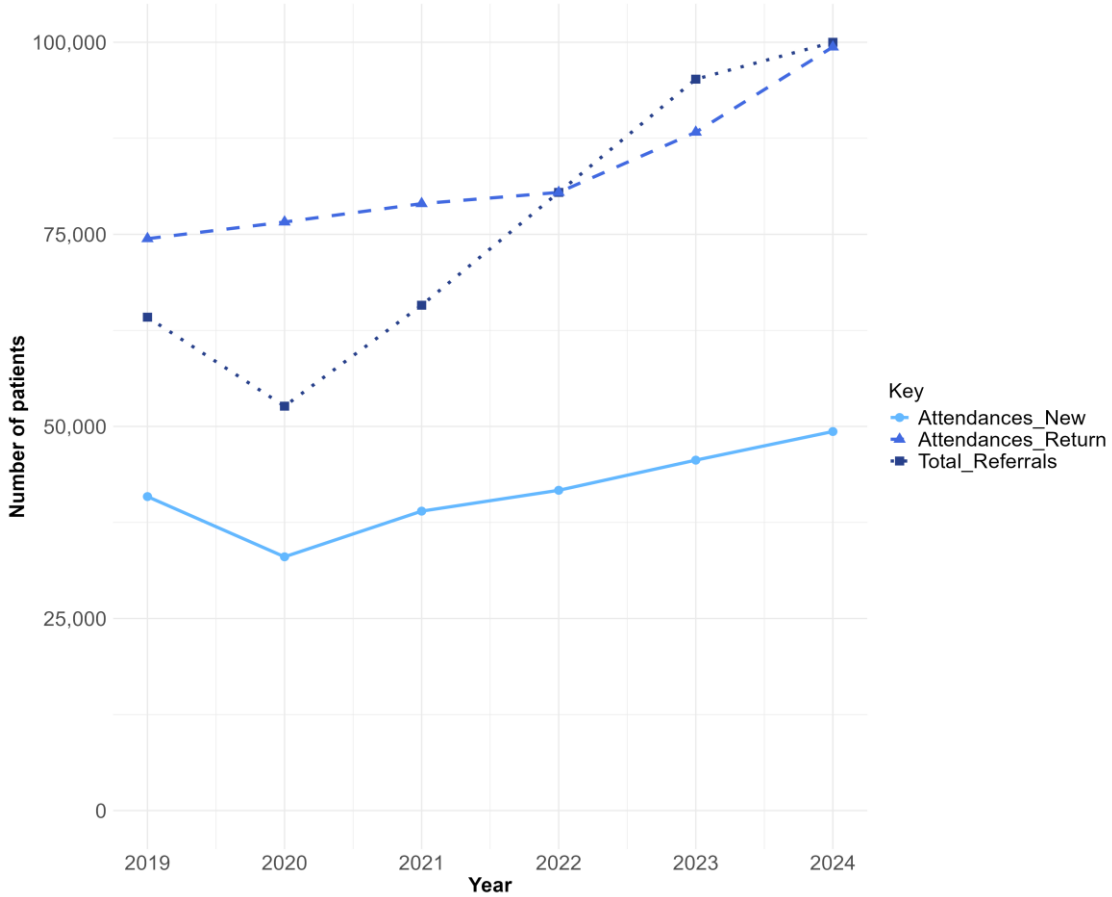
Demand for dermatology outpatient services has increased over time. Figure 3.3 presents the total number of referrals received, new attendances, and return attendances across dermatology outpatient departments (OPDs). In 2019, 64,220 referrals were received; by 2024, this number rose to 99,994, representing an increase of over 55% in referral volume.[225] However, the number of new patients seen increased by only 21% during the same period, from 40,868 to 49,334. In 2019, the HSE Model of Care for Dermatology reported a demand-capacity gap (that is, the difference between new referrals and new patients seen) of 23,352.[1] By 2024, this gap had more than doubled to 50,660.

While total attendances grew by 29% over the six-year period (from 115,302 in 2019 to 148,715 in 2024), challenges remain in meeting demand for dermatology services.[225] A substantial proportion of outpatient capacity is occupied by return visits. Between 2019 and 2024, return attendances consistently outnumbered new attendances. The ratio of return to new attendances in 2024 was 2.0, indicating that there were twice as many return patients attending OPD appointments than new patients, despite the increasing referral volume. The high volume of return attendances reflects the ongoing clinical need for chronic disease management in dermatology. It also limits the system's ability to absorb new referrals, which can contribute to increasing waiting lists. It is important to note, however, that the available data do not differentiate between consultant-led and non-consultant led return appointments. As such, return attendance figures may include appointments conducted by advanced nurse practitioners (ANPs), or other members of the dermatology workforce. This limits the ability to fully assess the extent to which consultant capacity is being utilised for follow-up care versus new patient consultations.

Table 3.3 presents details of referrals and attendances by the receiving RHA for 2024. Referrals are reported according to the RHA to which the case was referred, which may not correspond to the patient's area of residence. The largest number of referrals received per 100,000 population were in the HSE South West (2,439) and HSE Dublin and North East (2,420) RHAs. The remaining RHAs received between 1,294 referrals per 100,000 (HSE West and North West) and 1,969 referrals per 100,000 (HSE Dublin and Midlands). However, patients may be referred outside of

the RHA in which they attended their GP appointment, and so data may not reflect true demand in a given area. Table 3.3 further presents data on total attendances per WTE consultant dermatologist; while the data provide an indication of overall activity levels, they may not reflect variation in case mix, clinic types, or differing clinical and non-clinical responsibilities among dermatologists. Additionally, some dermatology patients are managed within plastic surgery departments. As these cases cannot be fully quantified, they are not included in the data presented and is a limitation of the analysis.

Figure 3.3 Number of dermatology OPD referrals, new attendances, and return attendance for 2019 to 2024



Key: OPD – outpatient department.
Source: HSE Business Intelligence Unit – Acute Operations.[225]

Table 3.3 Dermatology OPD referrals and attendance – 2024

Regional Health Authority	Total referrals received	New patient attendances	Return patient attendances	Return to new ratio attendances	Referrals per 100,000 population*	Total attendances per 1 WTE
HSE Dublin and Midlands	21,216	9,190	21,294	2.3	1,969	1,596
HSE Dublin and North East	28,731	12,714	30,815	2.4	2,420	2,607
HSE Dublin and South East	15,794	12,651	17,012	1.3	1,627	3,531
HSE Midwest	6,348	2,238	6,820	3.0	1,537	2,265
HSE South West	18,067	10,513	12,399	1.2	2,439	2,634
HSE West and North West	9,832	5,015	11,061	2.2	1,294	2,297
TOTAL	**99,994**	**49,334**	**99,381**	**2.0**	**1,942**	**2,338**

Key: HSE – Health Service Executive; OPD – outpatient department.
Footnote: *Based on CSO 2022 population estimates.
Source: HSE Business Intelligence Unit – Acute Operations.[225]

3.3.2.3 Referral patterns from primary care

While there is a trend of increasing referrals to Irish dermatology OPDs, the absence of a national referral data collection system means that information on referral types and patterns remains limited. However, several single-centre studies have examined the nature and volume of their dermatology referrals.

A review of 200 outpatient dermatology appointments scheduled over a five-week period in August and September 2011 was conducted.[226] During this period, 171 patients were seen and 29 patients did not attend their appointment. Of the 165 patients with available data, 44% were referred with benign skin lesions (seborrhoeic keratoses, actinic keratoses, and warts) while 6% were considered to have suspicious skin lesions (BCC, SCC, and Bowen's disease). Following initial consultation, 66% of patients were discharged back to primary care. Of those requiring follow-up, 16.7% were brought back to the dermatology OPD, 8.7% to nurse-led clinics, 5% added to minor surgery lists, 2.5% referred to other specialities, and 1.2% referred to daycare for phototherapy. Another review of referrals to a Dublin dermatology OPD service over a four-week period in November 2020 found that 407 referrals were received via various routes: Healthlink e-referral (n=206), NCCP e-referral (n=89), post (n=88), fax (n=12), NCCP post/fax (n=11), and email (n=1).[227] Thirteen referrals included a suggested diagnoses listed on the Dermatology National Clinical Programme's exclusion list, including viral or other warts (n=8), skin tags (n=1), dermatofibromas (n=1), spider naevi (n=1), and other cysts (n=2). Notably, 60% of referrals were for suspected skin cancer including pigmented lesions (7.8%), likely malignant melanoma (6.1%), changing moles (17.2%), ugly duckling lesions (6.4%), squamous cell carcinoma (9.3%), basal cell carcinoma (7.4%), actinic keratosis (3.7%), and Bowen's disease (1.5%). Inflammatory conditions accounted for 37% of referrals. While the study highlighted the high proportion of suspected cancer referrals, it did not report the final diagnostic outcomes.

Two other studies assessed referrals through the National Pigmented Lesion Pathway. A review of 727 pigmented lesion referrals at University Hospital Limerick (August 2018 to May 2019) found that "a changing mole requires assessment" was the most common reason for referral (55%).[228] However, 64% of patients were ultimately diagnosed with clinically benign lesions, which the authors noted contributed to delayed access for patients with melanoma. Similarly, a retrospective review of NCCP pigmented lesion e-referrals at St. Vincent's University Hospital in

2019 found that of approximately 874[a] referrals, 186 (21%) resulted in a diagnosis of primary melanoma.[229] The studies highlight the high volume of cancer-related referrals requiring urgent assessment, the majority of which result in benign diagnoses. This has implications for access to care, as it may contribute to longer wait times for patients with other dermatological conditions. Evidence also suggests that some referrals may be inappropriate, or could be managed in primary care. A retrospective review of 292 new referrals to a national paediatric dermatology centre in Ireland (17% of referrals over 13 months) assessed the appropriateness of referrals and whether cases could have been managed in primary care.[230] Based on established guidelines, 41% of referrals were deemed inappropriate, and it was considered that 51% could have been managed in primary care with suitable support. Following their first OPD appointment, 43% of patients were discharged.

Larger scale, nationally representative data quantifying referral patterns and the case mix of referrals are limited in Ireland. However, findings from international studies align with those from smaller Irish studies in terms of the most commonly referred types of conditions. An analysis[231] of public and private dermatology patient data collected was conducted in Scotland across three Health Board areas in November 2010. Of the 5,470 consultations, of which 2,882 were new referrals, 30% were for benign tumours, 13% for malignant tumours, 13.3% for dermatitis, 6.2% for psoriasis, and 5% for acne/rosacea.

A cross-sectional study[79] (n=8,832) conducted in Spain over six days in 2016 described the conditions referred to both public and private dermatology clinics from primary care, dermatologists, and other specialists. The most frequently referred condition was actinic keratosis, followed by seborrheic keratosis, basal cell carcinoma (BCC), and melanocytic nevus. After being referred, patients were assessed either through teledermatology (TD) (n=107) or FTF consultations (n=8,725). Among TD cases, the most common diagnosis made was seborrheic keratosis (9%), followed by BCC (8%), melanocytic nevus (7%), actinic keratosis (7%), and verruca vulgaris (5%). In FTF consultations, actinic keratosis was the most frequent diagnosis (7%), followed by seborrheic keratosis (6%), BCC (6%), melanocytic nevus (4%), and verruca vulgaris (2%). A randomised controlled trial, also conducted in Spain,[232] enrolled patients referred from two primary health centres to a dermatology department between 2003 and 2004. A total of 147 patients participated, with the following consultation reasons recorded: 43.5% for tumours, 27% for inflammatory

[a] Estimated from study Figure 1 using PlotDigitizer.

conditions, 16% for infectious diseases, 9.5% for skin annexes, and 5% for other reasons.

A retrospective study (n=809) conducted in the United States[233] examined referrals from primary care providers to dermatology services during 2015 and 2016. Cancer-related diagnoses accounted for 32% of FTF dermatology referrals. The remaining referrals involved inflammatory or infectious conditions, with eczema being the most commonly referred diagnosis (15%). In TD consultations, malignant conditions made up 13% of referrals, while the rest were inflammatory or infectious in nature, with eczema again being the most commonly referred diagnosis (36%).

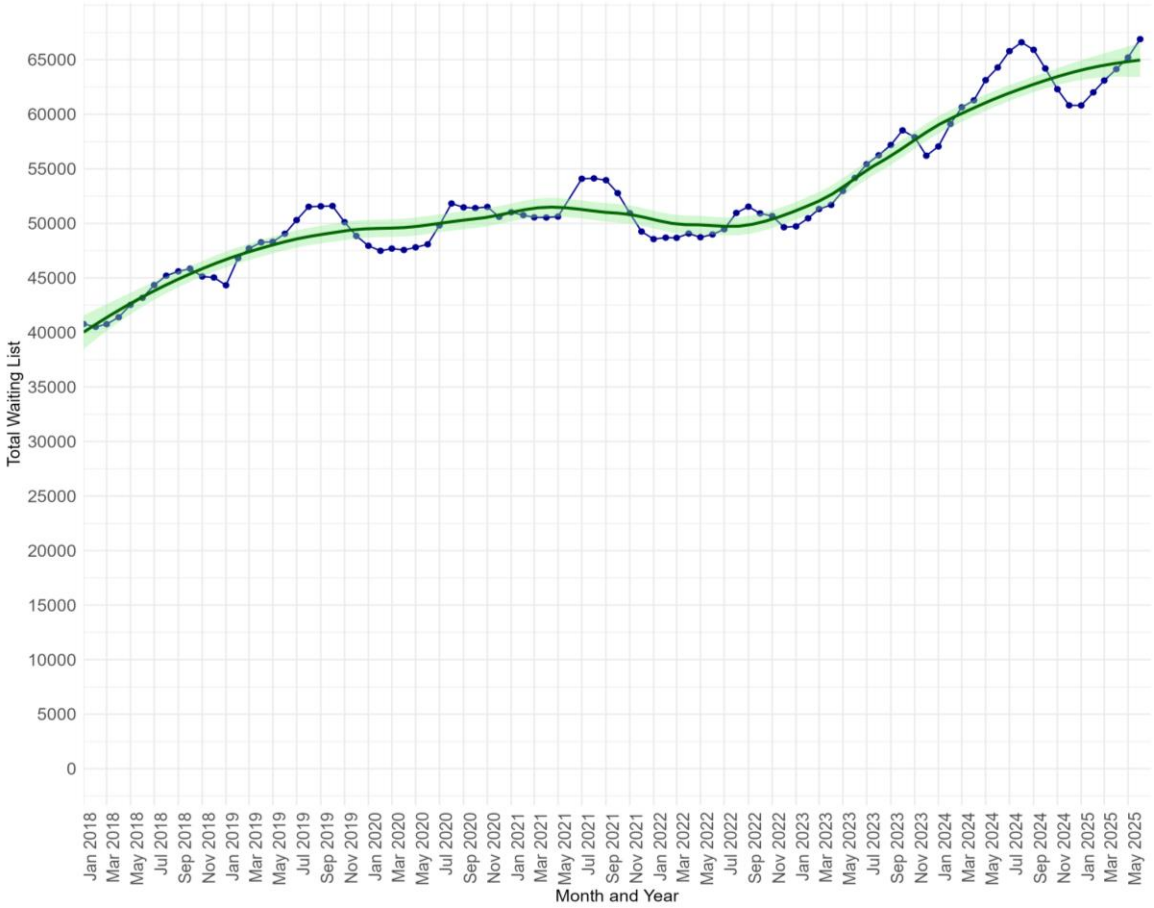
3.3.2.4 Dermatology outpatient department waiting lists

The following sections explore OPD dermatology waiting list data obtained from the National Treatment Purchase Fund (NTPF). The section provides insight into aspects of access to dermatology services, including how long patients are on the waiting list overall, the length of time to appointments, the triage status assigned to referrals received, and an overview of alternative treatment schemes funded by the HSE to alleviate the burden of extensive waiting lists. It is important to note that the data represent point-in-time 'snapshots' taken at the end of January each year from 2015 to 2025. As such, they may not fully reflect fluctuations or patterns occurring throughout the year, particularly in relation to appointment scheduling or discharges. The analyses were conducted using Microsoft Excel and RStudio. Where data were incomplete or unavailable for specific analyses, this is documented accordingly.

3.3.2.4.1 Overview of dermatology OPD waiting list size

As described in Section 3.3.2.2, the demand for dermatology services in Ireland has increased in recent years, placing pressure on the healthcare system. As illustrated in Figure 3.4, the dermatology OPD waiting list remained relatively stable from 2018 to May 2021. Since then, there has been a sharp and sustained rise in the number of patients waiting to see a consultant dermatologist. Although the waiting list reduced marginally during the second half of 2024, numbers began to rise again thereafter, reaching a peak of just over 66,800 in June 2025. Once a referral is received and a patient is added to the waiting list, there may be a delay before an appointment date is assigned. As of the end of January 2025, 16% of patients on the dermatology OPD waiting list had been assigned an appointment date, while the remaining 84% were still awaiting allocation of one. The overall trend highlights a significant surge in demand for dermatology services and an increasing strain on secondary and tertiary care.

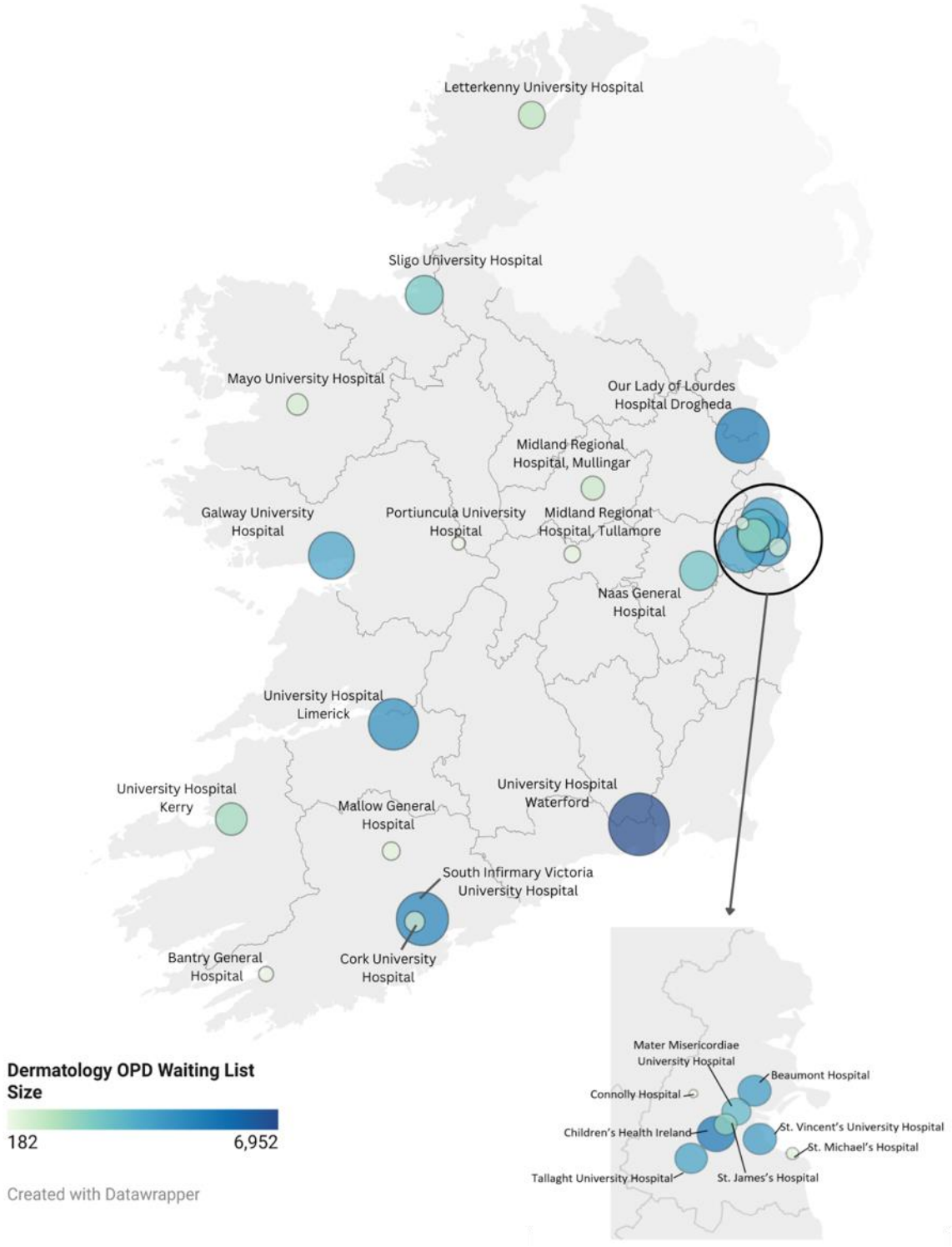
Figure 3.4 Dermatology OPD monthly waiting list trend over time (January 2018 to June 2025



Key: Blue line represents actual number of patients on the waiting list at each time point. Green line represents a smooth trend (LOESS) and standard error.
Note: Data represents the total number of patients on the OPD dermatology list at a point in time (end of each month). Data for June 2021 are missing.

There is variation in dermatology OPD waiting list size across hospital locations (Figure 3.5), with larger waiting lists concentrated in several designated dermatology 'hubs' which tend to be staffed with more consultant dermatologists. At the end of June 2025, the largest number of patients waiting for a dermatology OPD appointment were in the HSE Dublin and North East (n= 21,687), HSE Dublin and South East (n=12,387), and HSE Dublin and Midlands (n=10,593) RHA's. However, the RHA's with the highest number of patients (more than 1,000) waiting per 1 WTE consultant, were HSE Dublin and South East, HSE Mid West, HSE Dublin and North East, and HSE West and North West (Table 3.4).

Figure 3.5 Overview of dermatology OPD waiting list size by hospital as of January 2025



Key: OPD – outpatient department.
Note: Darker shades and larger circles indicate higher numbers of patients on the waiting list. Children's Health Ireland (CHI) includes CHI at Crumlin, Tallaght, and Temple Street.

Table 3.4 Ratio of patients waiting per WTE consultant dermatologist

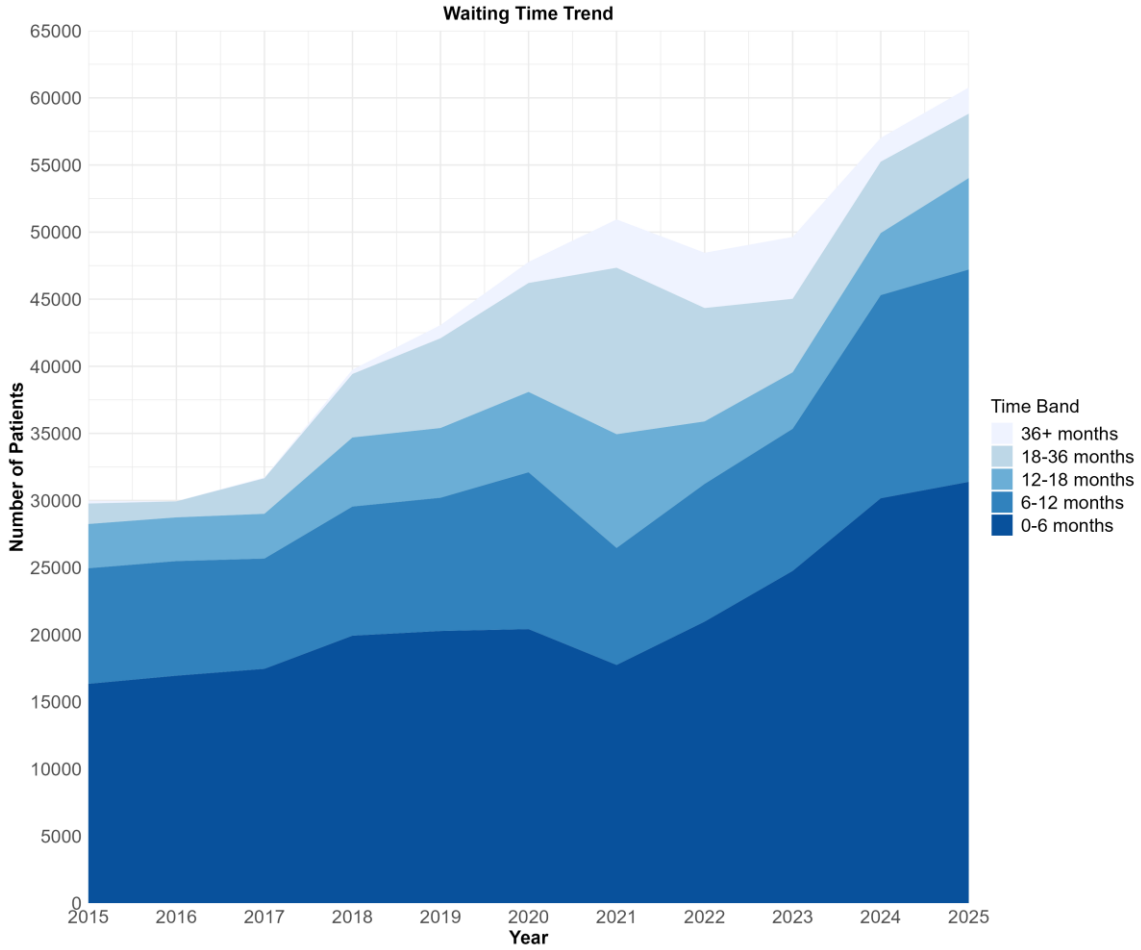
Regional Health Authority	Patients waiting	WTE	Patients waiting per 1 WTE
HSE Dublin and Midlands	10,593	19.1	555
HSE Dublin and North East	21,687	16.7	1,299
HSE Dublin and South East	12,387	8.4	1,475
HSE Mid West	5,238	4	1,310
HSE South West	8,201	8.7	943
HSE West and North West	8,781	7.0	1,254
Total	66,887	63.6	1,052

Key: HSE – Health Service Executive; WTE – whole time equivalent.
Note: Data represents a standardised ratio of patients to one WTE. Waiting list data at June 2025; WTE in post as of April 2025.

3.3.2.4.2 Overall time on the dermatology OPD waiting list

Examining the length of time patients spend on waiting lists is essential for understanding not just the scale of demand for dermatology services, but also the potential impact on patient care which is further discussed in Section 3.4 of this chapter. The overall trend in time on the OPD waiting list is shown in Figure 3.6. The trend highlights both a rise in the total number of patients on the dermatology OPD waiting list and a shift toward longer wait durations over the past decade. During the COVID-19 pandemic period, there was a substantial increase in the proportion of patients on the waiting list for between 18 and 36 months and the proportion on the list for over 36 months, reflecting the disruption to services caused by the pandemic. While the number of patients in these longest waiting time bands slightly declined in 2023, there was an increase in the number of patients on the waiting list for longer than 12 months in 2024. At the same time, the number of patients on the waiting list for six months or less has also increased. This may be a reflection of the ongoing high levels of new referrals, or possibly improved capacity to see patients more quickly in some settings. However, the impact of the pandemic on both service delivery and referral patterns makes it challenging to identify a clear or consistent trend in recent years.

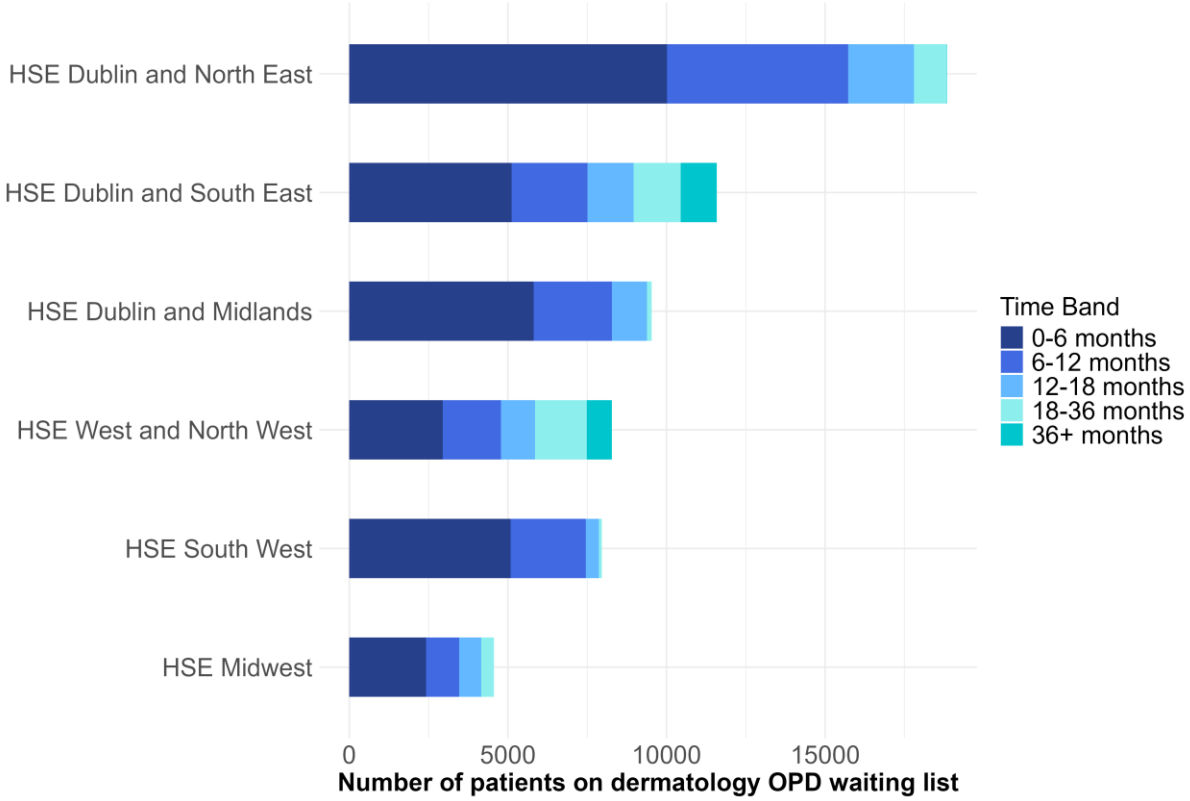
Figure 3.6 Time on dermatology waiting list, trend over time (2015 – January 2025)



Note: Analysis only considers patients on the waiting list with an appointment date assigned and those without an appointment date at the end of January of each year. Those with no documented referral received date (n= 1,203) are excluded from the analysis.

Considering the waiting list at the end of January 2025, 51.7% of patients had been on the waiting list for 0-6 months, 26.0% for 6-12 months, 11.2% 12-18 months, 7.9% for 18-36 months, and 3.2% for over 36 months. Figure 3.7 provides an overview of waiting time bands by RHA as of January 2025. HSE West and North West had the largest proportion of patients on their list waiting for either 18-36 months or longer than 36 months (29.3%), followed by HSE Dublin and South East (22.7%), HSE Midwest (8.8%), HSE Dublin and North East (5.5%), HSE Dublin and Midlands (1.5%), and HSE South West (1.2%).

Figure 3.7 Time on waiting list from referral received date to 30 January 2025 by RHA



Key: HSE – Health Service Executive; OPD – outpatient department; RHA – Regional Health Authority.
Note: Based on N=60,766 patients. N=55 cases excluded from analysis as no referral received date documented.

3.3.2.4.3 Time to dermatology OPD appointment

Table 3.5 presents trends in median waiting times for dermatology OPD appointments and time on the waiting list without an assigned appointment date. Among patients assigned an appointment, the median time to appointment remained stable at six months between 2015 and 2018. This gradually increased, reaching a peak of 10 months in 2021, coinciding with the COVID-19 pandemic. The median time to appointment then declined to seven months in 2022 and 2023, before rising again to nine months in 2024. In January 2025, the median waiting time for an appointment was five months. Similar trends are seen in the median time on the waiting list without an appointment assigned. After a peak of 13 months in 2021, at the end of January 2025 the median time patients were on the waiting list without an appointment date was seven months. A breakdown by hospital at January 2024 and 2025 is shown in Table A 1 and Table A 2. The data suggest that while some recovery has occurred following pandemic-related disruption, patients still face long waiting times, particularly those who face delays in receiving an

appointment date. Overall, the proportion of patients on the waiting list with an allocated appointment date has declined, and as of January 2025, approximately 80% of those awaiting dermatology review had not been given a scheduled date. It is however important to note that these figures are based on point-in-time data and may not fully reflect waiting time dynamics or fluctuations throughout the course of each year.

Table 3.5 Median months to appointment and median months on the waiting list without an appointment at January of each year (2015 to 2025)

Year	Appointment assigned, n (%)*	Median time to appointment (months)	IQR (Q1- Q3)	No appointment assigned, n (%)#	Time on waiting list without appointment (months)	IQR (Q1-Q3)
2015	8,769 (28)	6	7 (3-10)	22,836 (72)	6	8 (3-11)
2016	8,513 (28)	6	7 (3-10)	22,293 (72)	6	8 (3-11)
2017	9,011 (27)	6	6 (3-9)	23,915 (73)	7	9 (3-12)
2018	9,885 (24)	6	7 (3-10)	31,025 (76)	8	11 (4-15)
2019	10,667 (24)	8	10 (4-14)	33,769 (76)	8	13 (4-17)
2020	12,261 (25)	9	13 (5-18)	36,003 (75)	9	14 (4-18)
2021	9,280 (18)	10	16 (5-21)	41,750 (82)	13	17 (5-22)
2022	10,538 (22)	7	9 (4-13)	38,075 (78)	9	20 (4-24)
2023	12,303 (24)	7	7 (3-10)	38,593 (76)	8	14 (4-18)
2024	14,517 (25)	9	9 (4-13)	43,633 (75)	6	9 (3-12)
2025	11,263 (18)	5	7 (3-10)	51,047 (82)	7	9 (3-12)

Key: IQR – interquartile range; N – number; Q1 – quartile one; Q3 – quartile three.

Notes: Time shown as median number of months. IQR reflects the spread of the middle 50% of values and is presented as Q1-Q3, where Q1 is the 25th percentile and Q3 is the 75th percentile.

Footnotes: *Analysis based on 117,007 patients with an assigned appointment date or listed as having attended an appointment at January of each year; percentage indicates proportion of all those on the waiting list with available data with an assigned appointment date at January of each year. #Analysis based on 382,939 patients with no appointment assigned at January of each year; percentage indicates proportion of all those on the waiting list with available data without an assigned appointment date at January of each year.

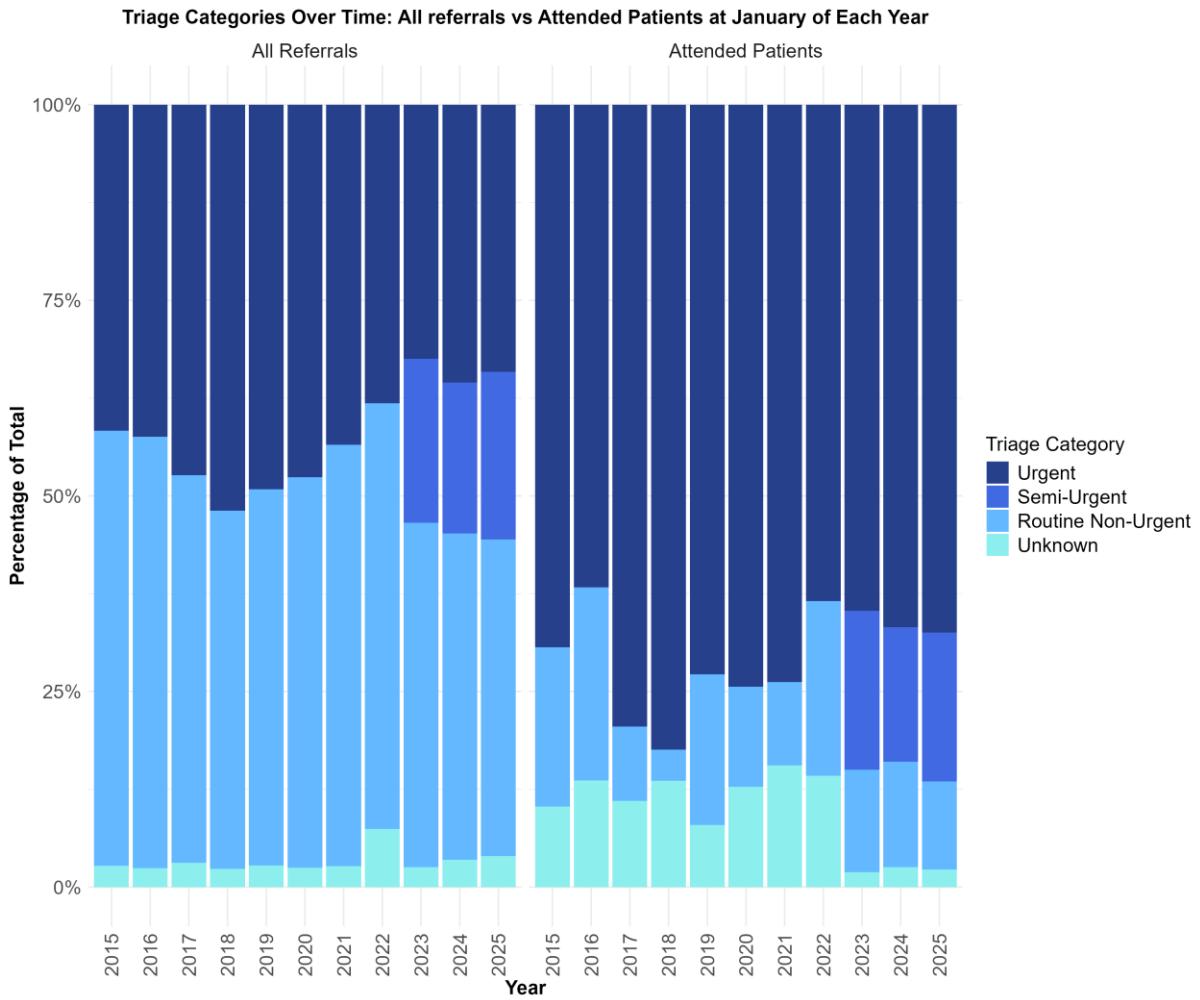
3.3.2.4.4 Triage of dermatology referrals

As outlined in the National Waiting List Protocol, all referrals received by an OPD should be triaged based on clinical need.[6] The protocol, updated and published in 2022 provides the following guidance on the clinically recommended time-frame to consultation to minimise risk and or achieve best clinical outcomes:

- Urgent: within 28 days
- Semi-urgent: within 13 weeks
- Routine non-urgent: within 26 weeks.

Figure 3.8 presents the distribution of triage categories assigned to dermatology OPD referrals that were not rejected or redirected, captured each January from 2015 to 2025. It also presents the triage status of patients who had attended appointments at those same time points. Between 2015 and 2022, 45.2% of referrals were categorised as 'urgent', and 51.4% as 'routine non-urgent'. From 2023 onwards, following the introduction of the 'semi-urgent' category, 34.1% of referrals were triaged as 'urgent', 20.6% as 'semi-urgent', and 42.0% as 'routine non-urgent', indicating a predominance of lower-acuity cases overall. However, among those who attended appointments, a disproportionately higher share were triaged as 'urgent'. Across the 10-year period analysed, 'urgent' cases accounted for 68.5% of attended appointments, while 'routine non-urgent' referrals made up just 13.1%. This suggests that, in the context of a limited number of available appointments and growing demand for dermatology services, patients with urgent needs are being prioritised. As a result, lower-acuity cases are increasingly deprioritised and may face extended waiting times for access to care. This is illustrated in Table 3.6 which presents the median months to appointment for each triage category, and the proportion in each category which are seen in the recommended guideline timeframe. Although most patients in this dataset who had attended an appointment at each point in time were triaged as 'urgent', the proportion being seen within the protocol recommended timeframe was below 10% across the 10 years. No patients triaged as 'routine non-urgent' were seen within the recommended 26 weeks from referral.

Figure 3.8 Overview of triage categories assigned to referrals at January each year (2015 to 2025)



Note: Data based on 500,839 entries with complete information. All referrals includes those listed as 'attended', 'Has appointment date', and 'No appointment date' and 'removed' for attendance or DNA at January of each year. 'Attended' patients only captures a snap shot of those who have attended an appointment in January of each year. 'Semi-urgent' category was introduced in 2023.

Table 3.6 Overview of time to appointment by triage category at January of each year (2015 to 2025)

Year	Urgent			Semi-urgent			Routine non-urgent			Unknown		
	N	Median months to appointment (Q1-Q3)	Proportion seen in guideline*	N	Median months to appointment (Q1-Q3)	Proportion seen in guideline*	N	Median months to appointment (Q1-Q3)	Proportion seen in guidelines*	N	Median months to appointment (Q1-Q3)	Proportion seen in guidelines*
2015	4,924	5 (2-8)	5.2				3,631	8 (5-12)	0.0	214	2 (1-3)	-
2016	4,305	5 (3-7)	4.7				4,102	7 (4-12)	0.0	105	2 (1-4)	-
2017	5,382	5 (3-8)	4.5				3,495	8 (5-12)	0.0	137	2 (1-3)	-
2018	5,867	4 (3-8)	4.0				3,868	8 (6-12)	0.0	160	2 (1-4)	-
2019	5,474	5 (3-8)	2.7				4,882	13 (8-18)	0.0	314	3 (2-6)	-
2020	5,826	6 (3-10)	6.3				6,331	13 (8-23)	0.0	143	1 (1-3)	-
2021	5,062	6 (3-13)	3.3				4,106	20 (10-30)	0.0	134	2 (1-5)	-
2022	5,726	6 (3-10)	5.6				4,445	9 (6-16)	0.0	397	11 (4-13)	-
2023	5,722	4 (2-7)	6.6	1931	9 (6-12)	9.8	4,629	9 (7-12)	0.0	97	2 (1-3)	-
2024	6,383	5 (3-9)	3.2	1,759	10 (6-12)	7.1	6,365	12 (8-16)	0.0	122	2 (1-4)	-
2025	6,452	4 (2-6)	4.6	1,066	9 (4-15)	11.0	3,745	9 (6-12)	0.0	108	2 (1-3)	-

Key: IQR – interquartile range; N – number; Q1 – quartile one; Q3 – quartile three.

Notes: Time shown as median number of months. IQR reflects the spread of the middle 50% of values and is presented as Q1-Q3, where Q1 is the 25th percentile and Q3 is the 75th percentile.

Footnote: Proportion seen within recommended timeframe based on National Outpatient Waiting List Management Protocol 2022.[6]

Table 3.7 shows the referral priority assigned by GPs and corresponding triage category later determined at hospital level, as a proportion of total referrals. As shown below, among referrals marked as urgent by GPs, almost three-quarters were also triaged as urgent after Consultant review, indicating fairly high concordance in cases perceived as high priority. Overall, the table shows that while there is good agreement for clearly urgent cases, variation exists in how non-urgent referrals are ultimately prioritised.

Table 3.7 GP versus Hospital Triage status as a percentage of total referrals (2023 to 2025)

GP Priority Level	Hospital Assigned Triage				
	Urgent %	**Semi-urgent %**	**Routine non-urgent %**	**Unknown %**	**Total %**
Urgent	14.7	2.6	1.9	0.4	19.8
Routine	2.3	12.2	17.2	1.2	32.9
Unknown	16.0	6.8	24.2	0.3	47.2
Total	33.0	21.6	43.3	1.9	100.0

Key: GP – general practitioner.
Note: Data reflect 2023 to 2025 to account for the introduction of the Routine Non-Urgent triage category.

3.3.2.5 Suspensions and removals from the OPD waiting list

According to the National Waiting List Protocol, patients may be removed from the waiting list for various reasons. Table 3.8 presents the number of patients removed from the waiting list for a selection of reasons at January of each year. The data should be interpreted with caution, as the removal reason field captures free-text entries, which are not standardised. As a result, the data may not fully or consistently reflect all removal reasons across the time points.

Table 3.8 Reason for waiting list removal at January (2020 to 2025)

Removal reason	2020	2021	2022	2023	2024	2025	Total
Appointment cancelled by patient	135	98	126	315	259	272	1,205
Patient did not attend two appointments	146	49	102	212	289	184	982
Redirected to another hospital	8	0	2	22	40	37	101
Treated privately	10	9	6	49	37	25	133

Source: Data requested from National Treatment Purchase Fund.

3.3.2.6 Waiting list initiatives

In response to ongoing challenges with long waiting lists, the HSE has continued to publish annual waiting list action plans.[14] The 2025 plan builds on previous years' efforts and sets out specific goals to reduce the number of patients waiting longer than the Sláintecare-recommended targets, including those in high-demand specialties such as dermatology. For 2025, €420 million in funding has been allocated to the Action Plan, of which €190 million is assigned to the HSE and €230 million to the NTPF.[14] A range of initiatives are being implemented under this plan, including both insourcing, which provides additional capacity within public hospitals, and outsourcing, which involves procuring treatment capacity from private providers. While detailed breakdowns of dermatology-specific initiatives by hospital or through the NTPF are not routinely published, it is likely that the funding of additional outpatient clinics represents a significant component of dermatology-related insourcing or outsourcing activity. Additionally, between quarter one of 2023 and quarter one of 2025, 17,072 appointments were outsourced under a mixture of NTPF and HSE funding models to a private TD clinic.[234] If a patient is scheduled to receive care through an insourcing or outsourcing initiative, they are listed as 'suspended' on the waiting list. Table 3.9 provides an overview of the number of patients recorded as 'suspended' on the waiting list due to an insourcing or outsourcing initiative at January of each year 2020 to 2025. However, these figures may not fully reflect the true extent of suspensions, as data collection and recording practices can vary across hospitals, potentially leading to inconsistencies in how the reason for suspension is documented. Moreover, if the insourcing activity is contained within the same hospital a patients was referred to, the patient is not listed as 'suspended' – this may underestimate the total figures.

According to NTPF annual reports,[235-237] patient care expenditure for surgical dermatology incurred by the NTPF, relating to payments to private and public hospitals, was €419,000 in 2020; €595,000 in 2021; €3.3 million in 2022; and €3.9 million in 2023. This reflects a substantial and growing investment in dermatology through NTPF-led initiatives over recent years.

Table 3.9 Number of patients suspended from waiting list due to NTPF or HSE initiatives at January (2020-2025)

Activity	2020	2021	2022	2023	2024	2025	Total
NTPF insourcing/ outsourcing initiative	218	792	1,239	2,993	2,451	352	8,045
HSE outsourcing initiative	0	0	119	10	986	1,862	2,977
Total	218	792	1,358	2,997	3,340	2,053	10,758

Key: HSE – Health Service Executive; NTPF – National Treatment Purchase Fund.
Source: Data requested from National Treatment Purchase Fund.

3.3.2.7 Alternative treatment pathways

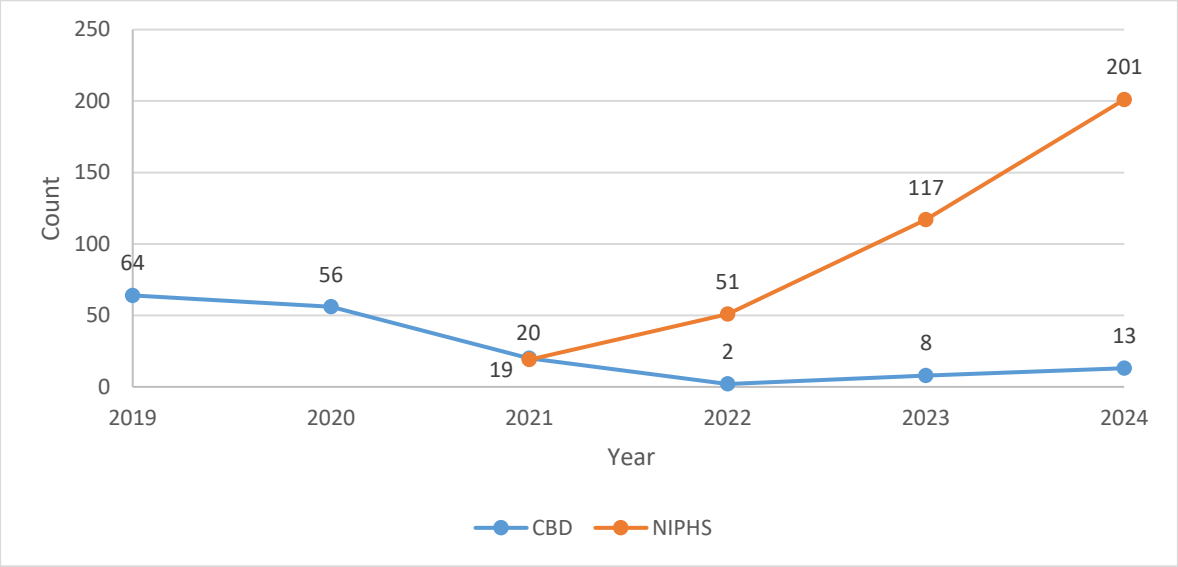
Patients seeking dermatological care have access to three alternative treatment schemes: the Cross-Border Directive (CBD), the Northern Ireland Planned Healthcare Scheme (NIPHS), and the Treatment Abroad Scheme (TAS). These schemes enable individuals to receive dermatological treatment outside of Ireland. As discussed in Chapter 2, each scheme operates under distinct eligibility criteria and reimbursement structures. This section presents data from these schemes. Overall, the schemes represent a very small proportion of current dermatology care.

3.3.2.7.1 Cross Border Directive and Northern Ireland Planned Healthcare Scheme

Between 2019 and 2024, reimbursement under the CBD was approved for 97 patients, covering 163 dermatology-related episodes of care outside of Ireland. The number of episodes of care reimbursed under the CBD decreased between 2019 and 2022, and while it has since increased again, it remains low (Figure 3.9). This is likely due to the introduction of the NIPHS in 2021. In 2019 and 2020, 86% of reimbursements under the CBD were for patients who had received care in Northern Ireland. Since the introduction of the NIPHS, the number of reimbursements have consistently increased (Figure 3.9). By the end of 2024, 248 patients had reimbursement applications approved, covering 388 episodes of care. Most reimbursements under the CBD were for patients living in Dublin (26.4%), followed by Donegal (12.3%), Louth (11.7%), and Meath (7.4%). For the NIPHS, most patients resided in Donegal (54.4%), Dublin (11.1%), Monaghan (7.5%), and Louth (6.7%). Total expenditure across the two schemes between 2019 and 2024 amounted to €147,261. As noted in Chapter 2, reimbursement is limited to the lower of two amounts: the cost of healthcare received abroad or the equivalent cost within Ireland's public healthcare system. As a result, some patients incurred higher treatment costs than what was ultimately reimbursed. Under the CBD, €42,552 was reimbursed between 2019 and 2024, while the total cost to patients over the same period was €72,711. Similarly, for the NIPHS, only half of patients' total treatment

costs were reimbursed, with €104,708 reimbursed compared to a total patient expenditure of €202,293.

Figure 3.9 Number of episodes of dermatology care reimbursed by the CBD and NIPHS between 2019 and 2024



Key: CBD – Cross Border Directive; NIPHS – Northern Ireland Planned Healthcare Scheme.
Notes: Data refer to the number of patients with an approved application for reimbursement. The NIPHS was introduced in 2021 and therefore no data are available for 2019 and 2020.
Source: HSE

3.3.2.7.2 Treatment Abroad Scheme

Between January 2019 and January 2025, 24 applications for dermatological care under the TAS were approved, involving 19 patients. The UK was the most common treatment destination, followed by Germany, and Denmark. Patients approved under the scheme had a diverse range of conditions and received various treatments. Among the 19 patients, 14 different conditions were recorded, with lymphoedema being the most common (5 patients), followed by complications of Crohn's disease (2 patients). The most common treatments included lymphatic drainage, surgery, excision, expert review and treatment, expert review and development of a treatment plan for the referring consultant, phototherapy, and Mohs surgery. The expenditure under the scheme between 2019 and January 2025 was €179,312.

3.4 Patient burden

Skin conditions have a significant impact on patients' lives, affecting their physical and mental health, social functioning and quality of life. Long-term skin conditions place an even heavier burden on patients including reduced workforce productivity alongside high socioeconomic and psychological impacts.[238] Even after the disease has resolved, long-term alterations can occur, continuing the burden on patients, their families, and healthcare systems.[239] As many skin conditions are visible, chronic, and symptomatic, patients may experience stigma, emotional distress, and functional impairment.[240] While some conditions are life-threatening, such as melanoma, others may not pose immediate clinical urgency but still carry a substantial personal burden if left untreated. As a result, timely access to specialist dermatological care plays an important role in alleviating and mitigating patient burden.

The consequences of delayed access to dermatology services vary depending on the nature and urgency of the condition. While there are limited data on the impact of being placed on dermatology OPD waiting list for prolonged periods, data are available relating to the impact of delayed diagnosis or treatment for skin conditions. For patients with suspected skin cancer, delays in treatment can have prognostic implications. Early diagnosis and treatment of skin cancer, particularly melanoma, is critical for improving survival outcomes. The prognosis of melanoma is strongly linked to tumour thickness at the time of diagnosis;[133] when identified and excised early, thin melanomas (<1 mm) have five-year survival rates exceeding 90%.[241] In contrast, as melanomas become thicker or metastatic, treatment becomes more intensive, physically demanding, and costly on the patient, and survival rates decline. Similarly, NMSC such as SCC can become locally invasive and, in some cases, metastasise if not treated promptly.[242] Although suspected skin cancers are prioritised for urgent referral, delays can still occur. In Ireland, data presented earlier in this chapter show that only a small proportion of OPD dermatology referrals triaged as urgent are seen within recommended timeframes. This imbalance between referral urgency and service capacity increases the risk that patients with malignancies could experience clinically significant delays in diagnosis and treatment.

For patients with chronic inflammatory skin conditions, such as psoriasis, atopic dermatitis, acne, and HS, delays in accessing dermatology services may not carry the same immediate mortality risk as for skin cancers, but can lead to long-term health consequences. These conditions are often painful, disfiguring, and psychologically distressing, with well-established links to anxiety, depression, and social withdrawal.[243, 244] Without timely specialist input, patients may experience prolonged disease flares, suboptimal symptom control, and progression to more

severe disease states.[245] In Ireland, where dermatology OPD waiting times are lengthy and prioritisation for urgent referrals is skewed towards patients with suspected skin cancers, patients with inflammatory conditions may be pushed further down the waiting list. This can result in long periods without specialist review, leaving many reliant on primary care, where access to diagnostics and advanced therapies or disease-modifying treatments may be limited. For conditions that benefit from early intervention or close monitoring of systemic therapies, such delays risk poorer clinical outcomes, reduced quality of life, and increased long-term healthcare costs.[243, 245]

Long waits for dermatology appointments can also increase the likelihood of patients not attending appointments. As time passes, patients may forget appointments, seek care elsewhere, or disengage due to frustration or symptom fluctuation. Patient 'did not attends' (DNAs) limit effective utilisation of available clinic capacity and may contribute to longer waits for other patients, placing additional pressure on the system.[246] Overall, long waiting lists for dermatology services can significantly delay access to diagnosis and treatment, leading to worse outcomes for patients with both urgent and non-urgent conditions.

3.5 Discussion

Dermatology encompasses a broad spectrum of conditions from common but burdensome concerns such as acne or skin infections, to chronic and often debilitating diseases like psoriasis and eczema, as well as high-risk malignancies. The clinical diversity of skin conditions presents challenges in fully quantifying the epidemiological burden, particularly in Ireland where no centralised surveillance or national data collection system exists. Nevertheless, the available data reflects a clear and increasing demand for dermatological care. Data from the NCRI show a rise in skin cancer incidence across both melanoma and NMSC,[8] placing increased pressure on dermatology services which are required to prioritise cases of suspected high-risk skin cancers. Inflammatory and infectious skin conditions requiring specialist input further contribute toward demand on dermatology OPD services. However, there is limited granularity in national data to understand the scale of these conditions in both primary, and secondary and tertiary care.

An estimated 1.6 to 1.8 million skin-related GP consultations occur annually highlighting the central role of GPs in managing skin conditions. However, in the absence of a centralised national GP database, these figures are derived from smaller regional studies, potentially limiting the overall generalisability. Despite these limitations, the estimates are broadly consistent with international data regarding the proportion of GP consultations attributable to skin conditions. High demand at the primary care level, combined with rising incidence of dermatological conditions, has

contributed to a corresponding increase in pressure on secondary and tertiary care services. Referrals to dermatology OPDs rose by over 50% between 2019 and 2024. Although there has been an increase in the consultant dermatologist workforce during this period, service capacity has not kept pace with the growing demand. As a result, dermatology OPD waiting lists are growing, causing delayed access to care for many patients. As of January 2025, more than 66,000 patients were awaiting dermatology appointments with almost half on the waiting list for over six months, of which approximately 8% had been waiting for longer than 18 months and just over 3% waiting longer than three years. Return patients tend to dominate clinic time, further constraining access for new referrals. Triage data show that while most referrals are for routine or semi-urgent cases, clinical capacity is largely directly toward urgent cases, many of whom still face delays. While prioritisation based on clinical need is justified, the current systems faces an inability to accommodate the breadth of dermatological need, particularly for chronic but non-urgent conditions that still cause substantial morbidity and burden on the patient without treatment. Delays in diagnosis and treatment not only affect outcomes in serious conditions such as skin cancer but also prolong the burden of disease in patients with chronic inflammatory skin diseases or persistent infections. These conditions can have considerable psychosocial and HRQoL impacts.[243-245]

Inefficiencies in the referral pathway may contribute to the burden with two single-centre studies suggesting that a substantial proportion of pigmented lesions referrals result in benign diagnoses.[228, 229] Two other studies have also reported that a proportion of referrals received may be unnecessary or could be managed appropriately in primary care.[227, 230] In the context of a limited dermatology workforce, this results in appointments being filled by patients who do not require specialist care, limiting availability for those who do.[247]

Alternative treatment pathways, such as the CBD and NIPHS, as well as HSE and NTPF insourcing and outsourcing initiatives, provide additional avenues to support reductions in waiting lists and aim to facilitate additional access to treatment outside of standard public pathways. However, their overall impact is influenced by the availability of capacity within the private sector, funding, capacity abroad and the willingness or ability of patients to travel for care. Currently, treatment abroad (via the CBD, NIPHS, or TAS schemes) account for a negligible proportion of all publicly-funded dermatology care.

There are limitations to the data presented in this chapter which must be acknowledged. Dermatology itself encompasses a wide range of conditions, making it difficult to generalise trends or service needs across the whole specialty. Much of the current data are derived from point-in-time snapshots, which may not accurately reflect trends or fluctuations in demand. Suspected pigmented lesion referrals are

also directed to plastic surgery departments. However, it was not possible to quantify these referrals, and the demand for dermatology-related services are therefore likely underestimated. This emphasises the clear unmet need for timely access to dermatology care and increasing capacity challenges.

4 Clinical efficacy, effectiveness, healthcare service utilisation, and safety

Key points

- A systematic review was undertaken of the clinical efficacy, effectiveness, impact on service utilisation, and safety of teledermatology (TD)-supported management of primary care referrals compared with traditional referral pathways.
- Overall, 120 studies (across 141 publications), of which 10 were randomised controlled trials, were included. To assess the certainty of evidence, GRADE was conducted on the key outcomes of percentage of appointments avoided, diagnostic concordance, risk of incorrect diagnosis, and safety.
- Most studies evaluated store-and-forward (SAF) TD, with limited evidence for live interactive approaches. In most SAF studies, images were acquired at the primary care appointment rather than at a specialised imaging clinic.
- The evidence should be considered collectively in the context of a complete care pathway as individual outcomes reflect only one element of the process; interpretation of outcomes in isolation may give an incomplete picture of the overall impact of TD.
- Concordance between TD and usual referral pathways was assessed using multiple measures across various clinical outcomes:
  - TD demonstrated moderate to high triage concordance with usual care referral pathways.
  - Percentage concordance with primary diagnosis between TD and face-to-face (FTF) or histology in a suspected melanoma population ranged between 75% and 91% across three small heterogeneous studies. In a population with inflammatory/infectious conditions, concordance between TD and FTF ranged between 62% and 70%. Pooled estimates were 75% (95% CI: 68% to 81%) in a suspected cancer (mixed) population and 78% (95% CI: 74% to 81%) in a mixed dermatology population; the analyses however were subject to significant heterogeneity.
  - The risk ratio (RR) of an incorrect diagnosis with TD and with FTF evaluation compared to histology could only be pooled for a suspected cancer (mixed) population; risk of incorrect diagnosis was higher for TD compared with FTF evaluation (RR: 1.27 (95% CI: 1.15 to 1.40)). Across individual studies, the RR was 1.51 in a non-melanoma skin cancer (NMSC)

population, and ranged from 0.67 to 0.77 in a suspected melanoma population, and from 0.85 to 1.43 in a mixed dermatology population; these results however were not statistically significant.

  - Including differential diagnoses improved concordance estimates, suggesting that TD aligns well with FTF in clinical reasoning.
  - Diagnostic concordance was positively influenced by higher image quality and also by the confidence of the teledermatologist in their diagnosis as well as their years of TD experience.
  - Management recommendations made by TD within a suspected melanoma population appeared comparable to FTF evaluation. In a suspected cancer (mixed) population, recommendations also tended to align with those made through traditional FTF consultation. In a mixed dermatology population, TD showed high agreement for surgical and biopsy-related decisions and moderate concordance for recommendations relating to general medical management and diagnostic requirements. Overall, management concordance tended to exceed diagnostic concordance, supporting the reliability of TD in guiding management decisions within a broader referral management pathway.

- Evidence on the clinical course of disease following TD assessment compared with usual care assessment was limited. Of the six studies assessing this outcome, none demonstrated a significant difference between TD assessment and FTF evaluation.
- Safety was reported in the context of incidental detection rates, misdiagnosis frequencies and the clinical impact of incorrect diagnoses. Across studies, the direction of effect was generally consistent, with no major safety issues unique to TD identified. Occasional diagnostic or management inaccuracies were reported, underscoring that while TD can support referral management, it does not eliminate the inherent risk of error in clinical assessments.
- Compared with routine referral to FTF dermatology consultation, there is evidence that TD-supported referral management reduces times to definitive treatment, biopsy and consultations; averts the need for FTF specialist dermatology consultation in 13 to 94% of cases; and has a lower risk of missed appointments.
- GRADE certainty of evidence ranged across indication subgroups from very low to low for percentage appointments avoided; low to moderate for percentage

concordance; very low to moderate for risk of incorrect diagnosis; and low to moderate for safety.

- While there is a large body of evidence assessing the use of TD-supported referral management, studies were heterogeneous in the type of intervention used, how outcomes were measured, and often included relatively small sample sizes. Despite the limitations, the direction of effect across most studies was similar and supported the use of TD. As TD is now widely implemented internationally, further large, high-quality RCTs are unlikely, and the existing evidence base is therefore likely to represent the best available to inform decision-making.

4.1 Introduction

The aim of this chapter is to present the current evidence on the safety and effectiveness of teledermatology (TD) to manage referrals from primary care. To address the aim of this chapter, the following research question was set out:

> What is the clinical efficacy, effectiveness, impact on service utilisation, and safety of TD to support the management of primary care referrals compared with direct referrals to traditional face-to-face (FTF) dermatology consultations?

A systematic review was conducted, with the reporting adhering to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria and national guidelines.[248, 249]

4.2 Methods

4.2.1 Inclusion criteria

The eligibility criteria for inclusion in the review were formulated according to the Population, Intervention, Comparator, Outcomes, and Study Design (PICOS) framework and are outlined in Table 4.1. The review focused on comparative studies only.

Studies with adult and or paediatric patients with skin conditions being referred from primary care to consultant dermatologists were included. Studies were excluded if they did not provide sufficient detail to accurately categorise the study population, including the proportion of participants with cancer within mixed dermatology populations. Studies conducted in institutions, such as nursing homes, long-term care facilities, or prisons were also excluded. Patients in these settings are unable to directly access primary healthcare services in a community-based setting; they would not be able to attend a GP practice or image-clinic for a store-and-forward

(SAF) image to be taken, and may have difficulty attending an appointment in secondary or tertiary care. Additionally, they may have specific healthcare needs that differ from the broader population. Lastly, only studies from countries within the Organisation for Economic Co-operation and Development (OECD) were included. This criterion was applied to ensure that included studies came from healthcare systems with the necessary technological infrastructure and resources to support TD services. While TD-supported referral management should be compared to regular FTF consultations, it is important to highlight that TD-supported referral management extends beyond the scope of traditional referral triage, offering additional capabilities and efficiencies.

4.2.2 Search strategy and information sources

A comprehensive search was performed in the following databases: Embase (Elsevier), Medline Complete (Ebscohost), CINAHL Complete (EBSCOhost), PsycInfo (EBSCOhost), INAHTA database, and the Cochrane Database of Systematic Reviews. The search strategy was developed by a librarian and peer-reviewed by a second librarian. Searches were initially limited to the period from 2004 to June 2024. Studies pre-2004 were not considered applicable due to advances in technologies available for TD. Following feedback from the first Expert Advisory Group meeting held in January 2025, it was agreed that the scope of the HTA would be expanded to include studies assessing the use of TD in patients suspected of having melanoma. As a result, a second search was conducted to identify relevant evidence for this population published from 2004 to February 2025. A search for ongoing clinical trials relevant to the research question was also conducted in the following clinical trial registries: CENTRAL and clinicaltrials.gov. The search strategies are provided in Table A 3 in the Appendix.

Forward and backwards citation chasing was conducted during both searches to ensure comprehensive capture of relevant studies. This process involved reviewing the reference lists and citations of initially included studies, to identify any additional publications that might meet the inclusion criteria but were not retrieved in the initial search. The reference lists of related systematic reviews were also screened.

Table 4.1 Eligibility criteria

Item	Inclusion	Exclusion
Population	Adults and children with skin conditions being referred to a consultant dermatologist.	▪ Studies involving unclear skin conditions, or mixed populations without a clear breakdown of the proportion of participants with suspected cancer. ▪ People with cosmetic or aesthetic concerns.
Intervention	TD for referrals from primary care (synchronous and asynchronous) with or without dermatoscopy.	▪ TD used in the ongoing treatment and management of patients.[∞] ▪ TD with ultrasound. ▪ Referral from institutions such as long-term care facilities and prisons. ▪ Referrals from population screening programmes. ▪ Self-referred patients.[Y] ▪ Referrals which also require input from a speciality other than dermatology.
Comparators	Usual care with FTF interaction or another form of TD (such as studies that compare different modes of TD).	▪ Non-comparative studies. ▪ Comparisons of two teledermatologists using the same method. ▪ Comparison to GP care/diagnosis. ▪ Comparisons between SAF and FTF where only those deemed to be a greater risk or needing further review received a FTF appointment.
Outcomes	Health service utilisation, including: ▪ waiting list reduction ▪ wait time reduction ▪ referral rates ▪ patient and provider satisfaction. Triage and diagnostic concordance: ▪ triage accuracy ▪ diagnostic concordance/agreement ▪ referral accuracy (patient management decisions). Clinical outcomes, including: ▪ disease course ▪ survival. Quality of life, including: ▪ SF-36	

Item	Inclusion	Exclusion
	▪ EQ-5D. Safety, including: ▪ missed or delayed diagnoses ▪ incorrect diagnoses ▪ death.	
Study design	Randomised controlled trials, comparative cohort studies.	Systematic reviews, single-arm trials.
Publication type	Full publications	Conference abstracts.
Location	OECD countries.	Non-OECD countries.

Key: FTF – face-to-face; GP – general practitioner; OECD – Organisation for Economic Co-operation and Development; SAF – store and forward; TD – teledermatology.

Footnotes: [∞]If a study included both new patients and those requiring ongoing management, and data are not reported separately for these groups, the study was excluded.

[ϒ]Where a study presented both self-referrals and healthcare provider referrals, this was included; studies of self-referral only were excluded.

4.2.3 Study selection

Titles and abstracts were reviewed independently by one reviewer. In the first search, a second reviewer screened the same titles and abstracts using an active learning machine model in Covidence to sort the records by likelihood of being relevant.[250] This reviewer then used the SAFE procedure to determine an appropriate point at which to stop screening. Nineteen per cent of the records were screened in duplicate before all stopping heuristics were met.[251] In the second melanoma search, all titles and abstracts were independently reviewed by two reviewers.

The full text of potentially eligible articles was retrieved and independently assessed for eligibility by two reviewers according to the specified criteria (outlined in Table 4.1). A PRISMA flow diagram outlining the study selection process was completed.[249] Disagreements were resolved through discussion or, if necessary, through the involvement of a third reviewer. Where needed, studies not originally in English were translated using DeepL Translate.

4.2.4 Quality assessment

Two reviewers independently assessed the quality of the included studies. Risk of bias was assessed using the Cochrane revised risk-of-bias tool for RCTs (RoB2).[252] The Risk of Bias in Non-randomised Studies of Interventions (ROBINS-I) tool was used to assess the quality of non-randomised studies.[253] Disagreements were resolved through discussion or, if necessary, by a third reviewer.

4.2.5 Data extraction

Data extraction was conducted by one reviewer using a standardised, pre-piloted electronic data extraction form. The extracted data were independently checked for accuracy and omissions by a second reviewer. Disagreements in data extraction were resolved through discussion or, if necessary, by a third reviewer.

The authors of two papers were contacted for supplementary material which was mentioned in the publication but not available online. Of the two papers, supplementary material was received for one[254] publication while the email for the contact author of the second[255] paper was no longer reachable.

4.2.6 Data synthesis and analysis

Where feasible, a meta-analysis of outcomes was undertaken. Where meta-analysis was not considered appropriate, for example, in the case of considerable clinical heterogeneity, outcomes were synthesised narratively with the aid of tables and graphs.

Meta-analysis was undertaken in accordance with Cochrane methodology and performed where appropriate to assess diagnostic concordance.[256] To pool the percentage diagnostic concordance between TD and the final FTF consultation diagnosis with or without histology, a meta-analysis of proportions using the *meta* package was conducted in R version 4.4.1.[257, 258] Proportion data were entered as raw concordant counts (n) and total counts (N) for each study. The *metaprop* function was applied to calculate pooled concordance estimates with 95% confidence intervals (CIs) across studies. Results for both fixed effects and random effects meta-analyses were computed. Preference was given to random effects meta-analysis, due to heterogeneity in study populations. For studies with comparative concordance data between TD and FTF consultation, risk ratios (RR) were calculated to assess the relative risk of an incorrect diagnosis between TD and FTF consultation. The RR summary is suited for comparing the probabilities of a binary outcome such as risk of incorrect diagnosis and provides an estimate of the relative difference in diagnostic performance between TD and FTF consultation. The analysis was conducted using the *metabin* function, enabling an additional analysis of the relative diagnostic concordance. The Knapp-Hartung method was used to adjust for the uncertainty in estimates of the between-study heterogeneity. Subgroup analyses were performed to differentiate between studies using different types of TD to investigate potential variations in concordance due to diagnostic methods. Statistical heterogeneity (a consequence of clinical or methodological heterogeneity) was assessed using the I^2 statistic, in line with Cochrane methodology.[256] For the analysis, an RR greater than one indicates that FTF consultation performs better than TD, while RR less than one suggests TD carries a lower risk of incorrect diagnosis.

In addition to the primary analysis of diagnostic concordance, secondary analyses were conducted where sufficient data were available. These included: percentage concordance between TD and FTF evaluation when differential diagnoses were considered; the ability of TD to distinguish between benign and malignant lesions; and the impact of effect modifiers such as image quality, diagnostic confidence, and years of dermatologist experience, as reported in the included studies. Where appropriate, a meta-analysis of proportions was performed to synthesise these outcomes. When data were not suitable for pooling, results were summarised narratively and tabulated for clarity.

For studies reporting kappa coefficients as a measure of diagnostic reliability between TD and FTF evaluation, a random-effects meta-analysis was conducted using the *meta* package in R.[257] Kappa coefficients and their respective standard error were included in the analysis to pool diagnostic reliability across studies.

Outcomes related to health service utilisation were not amenable to meta-analysis due to considerable heterogeneity in the reported outcomes. Results are presented in graph and table format, where appropriate. Scatter plots were created to aid interpretation using the *ggplot2* package in R version 4.4.1.[258, 259] Data on wait times were standardised to days. Wait time data were reported as either a median or mean; where not reported, average wait time was assumed to be a mean. In order to facilitate comparisons where studies have reported wait times in working days, a conservative adjustment was applied whereby two additional days were added for every five days wait, in excess of five business days.

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) framework was applied to three outcomes deemed most critical to decision-making: appointments avoided; diagnostic concordance; and safety. One reviewer conducted the initial GRADE assessment independently. Subsequently, the findings were discussed and consensus was reached in consultation with two additional reviewers. In addition, an evidence and gap map was developed using the *ggplot2* package in R version 4.4.1[258, 259] to illustrate the distribution of evidence and highlight areas of scarcity or concentration.

4.2.7 Presentation of results

Studies were grouped into 'suspected melanoma', 'suspected cancer (mixed)', 'suspected non-melanoma skin cancer', 'mixed dermatology' and 'inflammatory/infectious conditions' based on the GP suspicion or referral diagnosis for the patient population. Table 4.2 provides further information on how studies were classified into groups. It is important to note that while studies are grouped based on the included patient populations, the underlying dermatology pathway may or may not be restricted to specific groups. Where appropriate to the outcome being discussed, results were also grouped by intervention type. Populations with no available data for a given outcome were omitted from that results section.

Table 4.2 Condition subgroups

Classification	Criteria for classification*
Suspected melanoma	If patient referred from GP as a suspected melanoma. Patient cohort of confirmed melanoma patients.
Suspected cancer (mixed)	Suspected cancer or pigmented lesion populations where it is not specified that it is suspected melanoma and melanoma is not excluded.
Suspected non-melanoma cancer	Suspected cancer or pigmented lesions where it is specified that melanoma are excluded. Including any suspicious tumour - benign or malignant.
Mixed dermatology	General dermatology population - mix of melanoma, non-melanoma skin cancer, inflammatory and infectious conditions.
Inflammatory/infectious conditions	Studies excluding melanoma or non-melanoma skin cancer populations, such as psoriasis, eczema.

Footnotes: *Based on GP suspicion/referral diagnosis.

4.3 Results of the search

In the first search, after removal of duplicates, 5,709 title and abstracts were assessed for eligibility. A total of 305 reports required full text review, with 91 studies reported across 111 papers fulfilling the eligibility criteria. In the second search, 714 title and abstracts were screened and 185 new reports required full text review. Additionally, 42 reports excluded in the original search for having the wrong population were checked again to ensure no studies with a suspected melanoma population relevant to the review were missed. Twenty-nine unique studies (across 30 reports) were included. In total, 120 studies across 141 papers were included in the systematic review. An overview of the study selection process for both searches, along with the full list of included studies is in the Appendix (Table A 4, Figure A 1, Figure A 2).

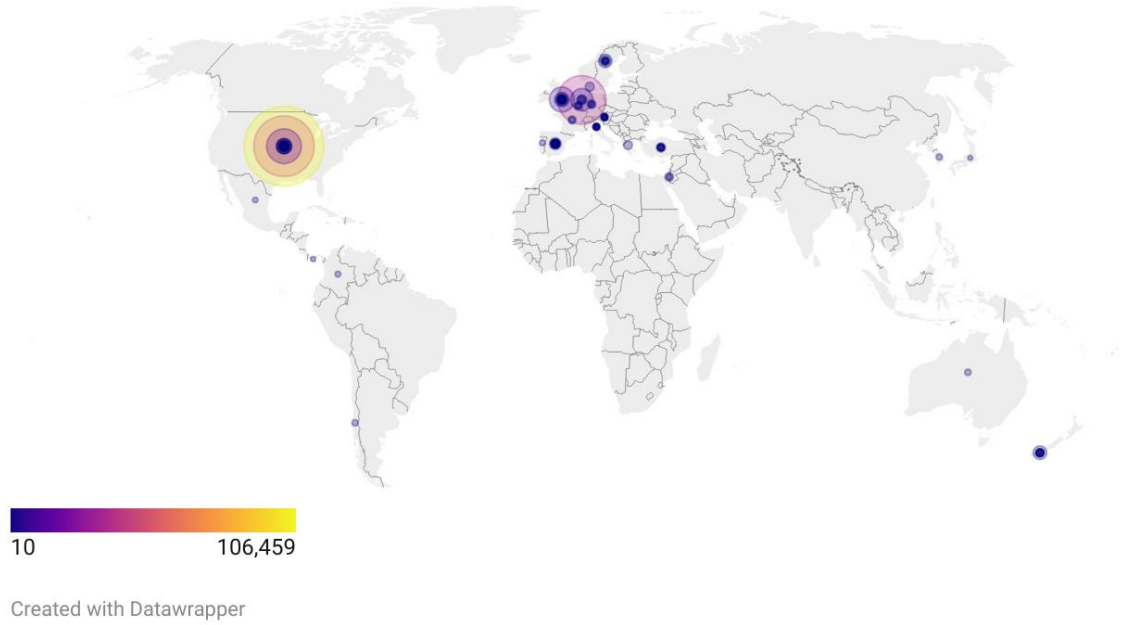
4.3.1 Characteristics of included studies

The review identified 10 randomised controlled trials (RCTs), two quasi-RCTs, 76 prospective non-RCTs, and 32 retrospective non-RCTs. Included studies either utilised a between-group (n= 53 studies), a within group comparison (n= 65), or both comparison types (n=2). Between-group comparisons involved the use of a completely separate comparator group of participants, whereas within group comparisons compared results of intervention and comparator strategies in the same participants. Identified studies either began collecting data in primary care (such as

from the point of GP referral) or in secondary care (such as the point the referral is received for triage). Of the 120 included studies, 58 studies began collecting data in primary care and 62 began collecting data in secondary care. It is noted that these two study types mostly reported on different outcomes, with waiting time data mostly available from those studies that began in primary care. Where the study types reported on the same outcomes, these data were aggregated.

Twelve studies reported on a suspected melanoma population, four on a suspected NMSC population, 39 studies on a population suspected of cancer (mixed), 56 included a mixed dermatology population, and nine recruited a population with inflammatory/infectious conditions. Additional study characteristics are reported in Appendix Table A 5. Studies were reported from 23 locations: 32 from the USA, 14 from the UK (10 from England, three from Scotland, one from Wales), 12 from Spain, nine each from Austria and Italy, seven from New Zealand, six each from Turkey and Sweden, five from the Netherlands, three each from Germany and Belgium, two each from France and Israel, and one each from Portugal, Denmark, Greece, Australia, Chile, Colombia, Panama, Mexico, Japan and South Korea. Study sample sizes varied greatly ranging from 10 to almost 106,500 participants. For five studies conducted across multiple countries, the location was determined based on either the country with the highest participant representation or that of the corresponding author. Figure 4.1 illustrates the geographical spread and size of included studies. All included studies were published from 2004 onwards; however, some studies began collecting data prior to this with the earliest commencing data collection in 1996 and the most recent ending in 2024. Over half of the studies were published in the last 10 years (56% published between 2015 and 2024). Thirty-two studies did not clearly report a study period. A detailed overview is available in Appendix Figure A 3.

Figure 4.1 Study locations and sample size



Footnote: * Map created with Datawrapper.[260] # Seven studies report intervention arm sample sizes which may under-represent overall size in comparison to other studies.[52, 261-266]

4.3.2 Intervention and comparators

Details of the intervention and comparators by study population are presented in Table 4.3 to Table 4.7.

Studies were labelled based on the type of TD intervention used, which included several approaches:

- standard SAF) using clinical images accompanied by clinical notes
- SAF with the addition of dermatoscopic images (SAF_DSC)
- SAF specifically using macroscopic images (SAF_MSC)
- live interactive (LI)
- SAF utilising a video (SAFvideo)
- studies using combinations of these methods.

To further capture the nuances across the studies, additional labels were applied to indicate if:

- images were taken at a designated imaging clinic (SAF_imageclinic)
- images were provided without accompanying clinical notes (SAF_withoutnotes, SAF_DSC without clinical notes)
- dermatoscopic images were used without standard clinical images (SAF_DSC_alone)

- the study arm focused on pre- or post-intervention periods (SAF_DSC_pre/post).

For this review, images taken with microscopic attachments were classified as a form of dermatoscopy. Most studies (n=86) included traditional FTF evaluations as a comparator. In the remaining studies, FTF was combined with dermatoscopy or histology in the comparator arm, with one study[267] using live interactive TD as a comparator. In cases where dermatoscopy or histology was explicitly used to support the FTF evaluation, a separate label was assigned.

Modes of image acquisition varied across studies, involving different personnel such as GPs or primary care providers, nurses, trained melanographers, other clinical staff, or patients. Equipment also varied and included smartphones, digital cameras, and, where used, additional attachments to enable dermatoscopy. In 11 studies, a smartphone app was used which either allowed the user to take photos through a feature within the app, or have users upload images directly into the app which linked to a broader TD platform. Studies had different requirements for the number of images required and how to take them; details are provided in the following tables.

Table 4.3 Intervention and comparator details – suspected melanoma population

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Store-and-forward with dermatoscopy							
diStefani 2007[268]	SAF SAF_DSC	NR	NR	Digital camera and dermatoscope	▪ Digital clinical image of the back of the patient ▪ Digital dermatoscopic images of all lesions on the patients' back	FTF_DSC	NR
FazilJaber 2023[269]	SAF_DSC	NR	GP	Digital camera and dermatoscope	▪ Digital picture from a distance ▪ Dermatoscopic image	FTF_DSC Histo	NR
Ferrara 2004[270]	SAF_DSC	NR	NR	Digital camera and film camera	▪ 1 dermatoscopic image ▪ Clinical images available for 9 cases	Histo	NR
Hussain 2023[271]	SAF_DSC	NR	NR	NR	NR	FTF	NR
Piccolo 2004[272]	SAF_DSC_alone	NR	NR	Dermatoscope	▪ Dermatoscopic images	Histo	NR
Pizzichetta 2004[273]	SAF_DSC	NR	NR	Digital camera and dermatoscope	▪ Clinical and dermatoscopic images	Histo	NR
Schultz 2023[274]	SAF_DSC	NR	GP	Smartphone with dermatoscope attachment	▪ 1 overview image ▪ 1 close-up image ▪ 2 dermatoscopic images (polarised, unpolarised)	FTF	NR
Store-and-forward using an image clinic							

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Congalton 2015[275]	SAF_imageclinic_DSC_MSC	NR	Nurse	Digital camera and dermatoscope	NR	FTF	NR
Store-and-forward with macroscopic images							
Arzberger 2016[276]	SAF_MSC_DSC	Dermatology nurse or dermatology resident	Melanographer (dermatology nurse or dermatology resident)	Digital camera and dermatoscope	▪ Body-sector image and of selected skin lesions ▪ Close-up ▪ 1 dermatoscopic image	FTF_DSC_histo	NR
Ferrandiz 2012[277]	SAF_MSC	NR	GP	Digital camera	▪ 1 panoramic image of anatomic location ▪ 1 macro-photograph	FTF	NR
Store-and-forward without accompanying clinical notes							
Massone 2007[278]	SAF_withoutnotes SAF_DSC without clinical notes	NR	NR	Mobile phone and dermatoscope	▪ Image acquired under routine conditions ▪ No additional light sources	FTF	Board-certified dermatologist
Live-interactive							
Chang 2021[279]	LI	NR	NR	NR	▪ NR	FTF	NR

Key: FTF – face-to-face; FTF_DSC- face-to-face evaluation with dermatoscopy; FTF_DSC_histo – face-to-face evaluation with dermatoscopy and histology as indicated; GP – general practitioner; Histo – histology; NR – not reported; SAF – store-and-forward; SAF_DSC – store-and-forward with dermatoscopy (including clinical images); SAF_DSC_alone; SAF with only dermatoscopic images; SAF_withoutnotes – store-and-forward without notes; SAF_MSC – store-and-forward with macroscopic images; SAF_MSC_DSC – store-and-forward with macroscopic and dermatoscopic images; SAF_DSC without notes; SAF-dermatoscopy without notes

Table 4.4 Intervention and comparator details – suspected non-melanoma skin cancer population

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Standard store-and-forward							
Cheng 2022[280]	SAF	NR	NR	NR	▪ NR	FTF Histo	NR
Store-and-forward with dermatoscopy							
Ferrandiz 2017 IMPACT-TDC[281]	SAF SAF_DSC	Teledermatologist with 5-10 years experience	Staff nurse	Dermatoscope adapted to digital camera	▪ NR	FTF	Dermatologist with 13 years' skin cancer experience
Senel 2013[282]	SAF_MSC SAF_DSC	NR	Technician	Digital camera Lens attachment for dermatoscope	▪ 2 macroscopic images (distant and close-up) ▪ 7.2 megapixel resolution ▪ 1 dermatoscopic image	FTF Histo	NR
Sola-Ortigosa 2020[283]	SAF SAF_DSC	NR	PCP	Digital camera and dermatoscope	▪ 1 overview of anatomic region ▪ 1 close-up ▪ 1 non-contact dermatoscopic image (polarised light)	FTF Histo	NR

Key: FTF – face-to-face; Histo – histology; NR – not reported; PCP – primary care provided/physician; SAF – store-and-forward; SAF_DSC – store-and-forward with dermatoscopy (including clinical images); SAF_MSC – store-and-forward with macroscopic images.

Table 4.5 Intervention and comparator details – suspected cancer (mixed) population

	Intervention details					Comparator details	
Study author and Year	**Type of TD**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Standard store-and-forward							
Clarke 2021[254]	SAF	NR	NR	Digital camera	▪ Images of each lesion ▪ One distant view with at least 2 anatomical landmarks ▪ Close-up view	FTF_histo	NR
Felmingham 2023 SMARTI[284]	SAF	Teledermatologists with 9-25 years' experience	Not clear-in dermatology clinic	Digital camera	NR	FTF	NR
Hsiao 2008[285]	SAF	NR	PCP	NR	▪ Digital image of referred lesion	FTF	NR
Kahn 2013[286]	SAF	NR	PCP	NR	NR	FTF	NR
Mahendran 2005[287]	SAF	2 consultant dermatologists 1 trainee dermatologist (specialist registrar year 3)	NR	Digital camera	NR	FTF	NR
Shapiro 2004 [288]	SAF	Board-certified academic dermatologist	PCP	Digital camera	▪ Image of head and upper trunk ▪ Image of affected body part Close-up images	FTF	NR
Store-and-forward with dermatoscopy							
Börve 2013[80]	SAF_DSC	Several years of experience within the fields of skin cancer and dermatoscopy	Dermatologist with several years of experience in skin cancer and dermatoscopy	Smartphone App, with dermatoscope	▪ 1 clinical overview image under standardised conditions ▪ 1 contact dermatoscopic image (polarised light)	FTF_DSC_histo Histo	NR
Börve 2015[289]	SAF_DSC	3 dermatologists	GP	Smartphone App, with dermatoscope	▪ 1 clinical overview image under standardised conditions	FTF_DSC_histo	NR

	Intervention details					Comparator details	
Study author and Year	Type of TD	Assessor Experience	Image taker	Image equipment	Image details	Comparator (s)	Assessor Experience
		1 4th-year resident in dermatology			▪ 1 contact dermatoscopic image (polarised light)		
Bowns 2006b[290]	SAF SAF_DSC	NR	Medical photographer	NR	NR	FTF	NR
Creighton-Smith 2017[291]	SAF_DSC	NR	NR	NR	NR	FTF Histo	NR
deGiorgi 2016[292]	SAF SAF_DSC	NR	Dermatologist	Digital camera and dermatoscope	▪ Clinical digital image ▪ Dermatoscopic digital image	FTF_DSC Histo	NR
Fabbrocini 2008[293]	SAF SAF_DSC	NR	Dermatologist	Digital camera and dermatoscope	▪ Clinical image ▪ Dermatoscopic image	FTF FTF_DSC Histo	NR
Ford 2015[294]	SAF_DSC SAF_DSC_pre SAF_DSC_post	NR	Not clear	Smartphone App, with dermatoscope	NR	FTF_pre FTF_post	NR
Gao 2023[71]	SAF_DSC	NR	GP	Digital camera and dermatoscope	NR	FTF	NR
Kroemer 2011[295]	SAF SAF_DSC_alone SAF_DSC	Board-certified dermatologist	Clinician	Phone with dermatoscope attachment	▪ 3 clinical images ▪ 1 dermatoscopic image	FTF_DSC_histo	NR
Kroemer 2008[296]	SAF SAF_DSC_alone SAF_DSC	NR	NR	Phone with dermatoscope attachment	▪ Close-up clinical image ▪ 1 dermatoscopic image	FTF_DSC_histo	NR
McLaughlin 2006[297]	SAF_DSC	NR	Photographer	Digital camera and dermatoscope	▪ Images showing location and a close-up ▪ 1 digital dermatoscopy image for pigmented lesions	FTF	NR
Moreno-Ramirez 2006[298]	SAF SAF_DSC	3-5 years dermatology	GP	Digital camera and dermatoscope	NR	FTF_histo	>10 years' experience

	Intervention details					Comparator details	
Study author and Year	Type of TD	Assessor Experience	Image taker	Image equipment	Image details	Comparator (s)	Assessor Experience
		2 years TD experience					
Sahin 2024[299]	SAF_DSC	NR	NR	Dermatoscope	NR	FTF_pre	NR
Senel 2014[300]	SAF SAF_DSC	6-10 years experience	Dermatologist	Digital camera, digital microscope	▪ Clinical images according to standard guidelines ▪ Microscopic image at 30-fold magnification + focus ring + LED ring illuminator	FTF_DSC Histo	10 years dermatology experience 6 years' experience in TD
Tensen 2022[301]	SAF_DSC	NR	GP	Dermatoscope	NR	FTF	NR
Veronese 2021[302]	SAF_DSC SAF_MSC	NR	NR	Digital camera and dermatoscope The NurugoTM Derma was used for macroscopy, an amateur device consisting of a lens attached to smartphone	NR	FTF_DSC_histo	NR
Veronese 2022[303]	SAF_DSC	5–10 years' dermatology experience >10 years' dermatology experience	Medical student	Digital camera and dermatoscope	▪ Images sent to Biolab engineers for optimised cropping and colour normalisation according to pre-specified algorithms.	FTF_histo	NR
Vestergaard 2020[304]	SAF_DSC SAF_DSC_GP SAF_DSC_dermatologist	Average of six (range 1-10) years' dermatology experience	GP	Smartphone with dermatoscope attachment	▪ Overview ▪ Close-up ▪ Dermatoscopy (polarised light)	FTF_DSC FTF_DSC_histo Histo	Average of six (range 1-10) years' dermatology experience

	Intervention details					Comparator details	
Study author and Year	**Type of TD**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
		No former experience with TD					
Store-and-forward using an image clinic							
Jones 2021[305]	SAF_imageclinic_DSC_pre	NR	GP	NR includes dermatoscope	▪ Regional image ▪ Close-up image ▪ Dermatoscopic image ▪ Up to 5 lesions	SAF_imageclinic_DSC_post SAF_DSC_post Histo	NR
May 2008[306]	SAF_imageclinic_DSC	NR	Medical illustration department	Digital camera and dermatoscope	▪ Up to 3 images per patient: – Site view – Close-up – Dermatoscopic image	FTF_histo	NR
Morton 2011[307]	SAF_imageclinic_DSC	NR	Medical photographer	Dermatoscope	▪ Up to 4 high-quality images: – Regional view – Close-up – Optional angled shot – Dermatoscopic image	FTF_histo	NR
Nizar 2024[308]	SAF_imageclinic_DSC	NR	Healthcare assistant	Dermatoscope	NR	FTF	NR
Store-and-forward with macro images							
Costin 2019[112]	SAF_MSC		NR	NR	▪ Macroscopic, some including ruler in image	FTF	
Damsin 2020[51]	SAF_DSC_MSC	NR	GP	Smartphone with dermatoscope attachment	▪ Macroscopic images ▪ Dermatoscopic images	FTF_histo	NR
Damsin 2023 TELESPOT[309]	SAF_DSC_MSC	NR	NR	Smartphone App	▪ Macroscopic images ▪ Dermatoscopic images	FTF Histo	NR
Ferrandiz 2007[310]	SAF_MSC	NR	NR	Digital camera	▪ 1 panoramic view of anatomic area where lesion is located ▪ Macro image to describe morphologic features	FTF Histo	NR

	Intervention details					Comparator details	
Study author and Year	**Type of TD**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Hunt 2020[311]	SAF_DSC_MSC	NR	Photographer	NR	▪ Regional image ▪ Macroscopic image ▪ Dermatoscopic image	FTF	NR
Lim 2012[312]	SAF_MSC_DSC	NR	Melanographer (trained nurse)	Specially adapted camera	▪ Regional anatomic ▪ Macroscopic ▪ Dermatoscopic	FTF	NR
Marwaha 2019[313]	SAF_MSC_DSC	NR	PCP	Smartphone with magnifying lens or dermatoscope	▪ NR	FTF	NR
Moreno-Ramirez 2007[314]	SAF_MSC	NR	NR	Digital camera	▪ 2 digital pictures – panoramic and macro-photograph	FTF_histo	NR
Tan 2010 IMAGE-IT[315]	SAF_MSC_DSC	NR	Melanographer	Digital camera and dermatoscope	▪ Panoramic views of body ▪ Macroscopic views (30mm field of view) ▪ Dermatoscopic views (15 mm field of view) ▪ Contact fluid used to reduce glare from skin surface to increase image quality	FTF_DSC	NR
van der Heijden 2013[255]	SAF_DSC_MSC	> 5 years' experience of dermatoscopy > 3 Years' experience of TD	GP	Digital camera and dermatoscope	▪ 1 overview image ▪ 1 macroscopic image ▪ 2 dermatoscopic images	FTF	> 5 years' experience of dermatoscopy
[316, 317]Warshaw 2009	SAF_MSC SAF_MSC_DSC	>5 years' dermatoscopy experience	Research staff	Digital camera with a digital ring flash for macro images, and dermatoscope	▪ 2 macroscopic images for each lesion ▪ Lesions >2mm in height, macro-angle taken ▪ 1 dermatoscopic image (polarised light)	FTF Histo	NR

Key: FTF – face-to-face; FTF_DSC- face-to-face evaluation with dermatoscopy; FTF_DSC_histo – face-to-face evaluation with dermatoscopy and histology as indicated; FTF_histo – face-to-face evaluation with histology as indicated; FTF_pre – face-to-face evaluation pre-intervention; FTF_post – face-to-face evaluation post-intervention; GP – general practitioner; Histo – histology; NR – not reported; PCP – primary care provided/physician; SAF – store-and-forward; SAF_DSC – store-and-forward with dermatoscopy (including clinical images); SAF_DSC_alone; SAF with only dermatoscopic images; SAF_DSC_dermatologist – store-and-forward with dermatoscopy by dermatologist; SAF_DSC_GP – store-and-forward with dermatoscopy by GP; SAF_DSC_pre – store-and-forward with dermatoscopy pre-intervention; SAF_DSC_post – store-and-forward with dermatoscopy post-intervention; SAF_imageclinic_DSC – store-and-forward conducted at image clinic with dermatoscopy; SAF_imageclinic_DSC_pre – store-and-forward conducted at image clinic with dermatoscopy pre-intervention; SAF_imageclinic_DSC_post – store-and-forward conducted at image clinic with dermatoscopy post-intervention; SAF_MSC – store-and-forward with macroscopic images; SAF_MSC_DSC – store-and-forward with macroscopic and dermatoscopic images; TD – teledermatology.

Table 4.6 Intervention and comparator details – mixed dermatology population

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Standard store-and-forward							
Börve 2012[318]	SAF	6-8 years' experience including training in TD	GP	Mobile phone	▪ Controlled conditions (well-lit room, neutral background, no flash, autofocus) ▪ Appropriate distance from patient to include detail and extent of disease	FTF_histo	6-8 years' experience including training in TD
Bowns 2006a[290]	SAF	NR	Health professional	Digital camera	NR	FTF	NR
Carter 2017[319]	SAF FTF_pre	NR	Clinical staff	NR	▪ Training provided to staff	FTF_post Combined_post	NR
Ebner 2008[320]	SAF	NR	Patient (or dermatologist if unable)	Mobile phone	▪ 3 images	FTF	NR
Eminovic 2009[29]	SAF	NR	GP	Digital camera	▪ 4 images (2 close-ups, 2 overviews)	FTF	NR
Faucon 2022[321]	SAF	NR	GP	NR	▪ At least 3 images	FTF_histo	NR
Gatica 2015[322]	SAF	>5 years' physician experience	GP	NR	▪ 1 panoramic ▪ 1 close up using camera macro function	FTF	>20 years' physician experience
Holmes 2020[265]	SAF	Board-certified dermatologists	PCP	Phone or camera	NR	FTF	NR

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Jariwala 2021[323]	SAF	NR	PCP	Smartphone App	NR	FTF	NR
Joseph 2023[324]	SAF	NR	PCP	NR	▪ 3 different views	FTF	NR
Kim 2020[264]	SAF	NR	Clinical staff	Smartphone App	▪ Well-lit area + diffuse indirect light ▪ Uncluttered/ neutral background ▪ Avoid flash, autofocus on lesion ▪ Skin growth/lesion: 2 (close-up or distant images) ▪ Local rash/group of lesions: 3 (distant, medium and close-up) ▪ Rash on multiple body sites: at least 3 (distant, medium, close-up) ▪ Acne/facial rash: 5 (face straight on, left and right profile, upper chest, upper back)	FTF	NR

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Kips 2020[52]	SAF	Academic dermatologists	GP	Digital camera or smartphone	NR	FTF	NR
Knol 2006[325]	SAF	NR	GP	Digital camera	▪ 1 overview ▪ 2 close-ups	FTF	NR
Lasierra 2012[326]	SAF	NR	GP	Digital camera	▪ Recommendations from American Association of Telemedicine	FTF	NR
Massone 2005[327]	SAF	NR	Medical student	Mobile phone	▪ Routine conditions, no additional light sources ▪ Up to 3 images including overview	FTF	NR
Massone 2021[328]	SAF	NR	GP	Smartphone app	▪ 1-3 digital images	FTF	NR
McGoey 2015[329]	SAF	NR	NR	NR	NR	FTF	NR
McKoy 2004[330]	SAF	22 years' experience, no previous experience in digital imaging	Nurse	Digital camera	▪ Standard examination room with overhead fluorescent lighting, auto flash, white balance ▪ 2 images for each view from different angles and distance	FTF	22 years' experience

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
					▪ Average 6.5 images per patient		
Nami 2015[331]	SAF	NR	Final-year resident	Smartphone App	▪ Mobile camera angle perpendicular to lesion ▪ Multiple views (close-up, straight on lesion, middle field with affected area in centre, whole body or obvious region, distant if needed) ▪ Distracting jewellery/clothing removed	FTF	NR
O'Connor 2017[332]	SAF	NR	Parent	Smartphone App	▪ Photograph the primary condition of concern only	FTF	NR
Piette 2017[26]	SAF	NR	GP	Phone or camera	▪ At least 3 images	FTF	NR
Rios-Yuil 2012[333]	SAF SAF_FTF	NR	NR	Digital camera	NR	FTF Histo	NR
Ruiz 2009[334]	SAF	>10 years' experience	Residents in dermatology	Digital camera	NR	FTF	TD1: >10 years' experience

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
							TD2-4: >5 years' experience
Seiger 2020[27]	SAF	NR	Unclear - likely paediatrician	Smartphone App	▪ 3 unique images ▪ At least 1 from a distance to show distribution of rash or lesion	FTF	NR
Shin 2014[335]	SAF	NR	Paramedic	Smartphone	NR	FTF	NR
Taberner Ferrer 2009[336]	SAF	NR	PCP	Digital camera	▪ Medium resolution (1600X1200 pixels ▪ Minimum compression	FTF_DSC_histo	NR
Taslidere 2022[337]	SAF	NR	Dermatologist	Smartphone	▪ Neutral background ▪ No flash, well-lit room with autofocus	FTF	NR
Taslidere 2023[338]	SAF	NR	NR	Smartphone	▪ Neutral background ▪ No flash, well-lit room with autofocus	FTF	NR
VanDerHeijden 2011[339]	SAF	>5 years' experience	GP	Digital camera	▪ Max 4 images	FTF	NR
Vano-Galvan 2011[340]	SAF	NR	Non-dermatologist physician	Digital camera	▪ 1 or more digital images	FTF	NR
Wang 2020[341]	SAF	NR	Referring provider	Phone or camera	NR	FTF	NR

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Wu 2021[233]	SAF	NR	NR	NR	NR	FTF	NR
Zink 2017b[342]	SAF	NR	NR	Smartphone App	▪ 1 overview ▪ 1 close-up	FTF Histo	NR
Store-and-forward with dermatoscopy							
Koch 2024[263]	SAF_DSC_pre SAF_DSC_post	NR	GP	Digital camera, dermatoscope	NR	FTF_DSC_pre FTF_DSC_post	NR
Naka 2018[343]	SAF_DSC SAF	NR	PCP or medical assistant	Digital camera, dermatoscope	NR	FTF_pre FTF_post FTF_combined	NR
Papadimitriou 2021[344]	SAF_DSC SAF	NR	Basically trained dermatologists	NR	▪ At least 3 images	FTF Histo	NR
Rubegni 2011[345]	SAF_DSC	NR	Senior medical student (in the final-year course for GPs	Digital camera, dermatoscope	▪ Camera angle perpendicular to lesion ▪ Multiple views (distant, entire body/obvious region, medium with affected region in centre, close-up straight on lesion) ▪ Removal of distracting jewellery/clothing ▪ Standard background, neutral colour	FTF	NR

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
					perpendicular to camera and diffuse indirect light		
Zink 2017a[346]	SAF_DSC	NR	Doctor performing the clinical examination	Phone with dermatoscope attachment	▪ Overview ▪ Close-up	FTF_DSC Histo	5 doctors in their final year of specialist dermatology training
Store-and-forward using an image clinic							
Lopez-Liria 2022[347]	SAF_imageclinic_DSC	NR	Nurse	Dermatoscope	▪ Panoramic view (<1m away) ▪ Dermatoscopic image (polarised light) ▪ Where possible, inclusion of measurement scale	FTF_DSC	NR
Palamaras 2022[261]	SAF_imageclinic_DSC_MSC	3 teledermatologists with >5 years' experience 4 teledermatologists with <5 years' experience	Medical photographer	NR	▪ Anatomical site ▪ Macroscopic image ▪ Dermatoscopic image	FTF	NR
Store-and-forward with macro images							

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
AbdulGafoor 2024[348]	SAF_MSC_DSC	Consultants >5 years' experience	Patients	Smartphone with dermatoscope attachment	▪ 1 dermatoscopic image ▪ 1 macroscopic image	FTF_histo	Consultants
Altieri 2016[28]	SAF_MSC	Board-certified dermatologists	Unclear-Designated investigator (same for all patients)	Digital camera	▪ 3 standard images: – Medium distance away – Close-up macro-image with ruler ▪ Side view	FTF	Board-certified dermatologist
Keleshian 2017[349]	SAF_MSC	NR	Trained imager	NR	▪ Macro-images	FTF	NR
Whited 2013 [350]	SAF_MSC	NR	PCP	Digital camera with a digital ring flash for macro-images	▪ Affected anatomical area to be identifiable ▪ 1 distance/mid-range shot ▪ 1 close-up macroscopic image	FTF	NR
Live-interactive							
Baba 2005[351]	SAF SAF_LI	Dermatologist with 3 years' experience Dermatologist with 5 years' experience	Nurse	Digital camera	▪ Small lesions imaged at closest possible focal distance that included uninvolved skin ▪ Large lesions imaged in 2 or more views	FTF_histo	Dermatologist with 3 years' experience Senior dermatologist with 10 years compared

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
							diagnoses for TD vs FTF
Castillo 2022[352]	SAF LI	NR	Trained imager	NR	NR	FTF Histo	NR
Fujimoto 2024[353]	LI	6 board-certified dermatologists 6 dermatology specialty trainees 6 board-certified internists	Dermatologist	Commercial videoconferencing equipment	NR	FTF	NR
Marchell 2017[354]	SAF LI_low quality LI_high quality	Third-year dermatology residents	NR	NR	NR	FTF	Board certified dermatologist Rotating residents with variations in expertise
Mofid 2007[355]	LI	NR	N/A	Commercial videoconferencing equipment	NR	FTF	NR
Romero 2006[232]	SAF LI SAF_LI	NR	PCP	Digital camera	▪ High-quality digital images	FTF	NR
Romero 2010[356]	SAF LI SAF_LI	> 3 years' experience in telemedicine	GP	Digital camera	▪ At least 2-3 images that would enable site and distribution	FTF	> 3 years' experience in telemedicine

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
					of lesions to be discerned ▪ Close-up ▪ Well-lit room + flash		
Store-and-forward without accompanying clinical notes							
Massone 2006[357]	SAF_withoutnotes	NR	Medical student	Personal Digital assistant	▪ Image acquired under routine conditions ▪ No additional light sources ▪ Up to 3 images per patient including overview and close-up	FTF	NR
Oztas 2004[358]	SAF_withoutnotes SAF	> 3 years experience	NR	Digital camera	NR	FTF	NR
Rogers 2022[359]	SAF_withoutnotes SAF_DSC without notes	Resident 10/26 (38.5%) Attending 16/26 (61.5%) Years in practice (Attendings) 1-5 4/13 (31%) 6-10 4/13 (31%) 11-15 1/13 (8%)	Trained imagers	Images with and without dermatoscope	▪ Forest view, close-up, dermatoscopic view for each lesion and rash	FTF	NR

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
		> 15 4/13 (31%) % Clinical practice using dermatoscopy < 50% 13/26 (50%) >/= 50% 13/26 (50%)					
Store-and-forward using videos							
Ilie 2022[360]	SAFvideo	NR	Patient	Phone or camera	▪ Video application can be installed on patients phone or use web-based login if a smartphone is not owned	FTF	NR
Lepe 2004[361]	SAFvideo	NR	Medical students	Video camera	▪ Lesions recorded at distance of 2m	FTF	NR

Key: FTF – face-to-face; FTF_DSC- face-to-face evaluation with dermatoscopy; FTF_DSC_histo – face-to-face evaluation with dermatoscopy and histology as indicated; FTF_histo – face-to-face evaluation with histology as indicated; FTF_pre – face-to-face evaluation pre-intervention; FTF_post – face-to-face evaluation post-intervention; GP – general practitioner; Histo – histology; LI – live interactive; NR – not reported; PCP – primary care provided/physician; SAF – store-and-forward; SAF_DSC – store-and-forward with dermatoscopy (including clinical images); SAF_DSC_pre – store-and-forward with dermatoscopy pre-intervention; SAF_DSC_post – store-and-forward with dermatoscopy post-intervention; SAF_imageclinic_DSC – store-and-forward conducted at image clinic with dermatoscopy; SAF_imageclinic_DSC_MSC – store-and-forward conducted at image clinic with dermatoscopy and macroscopic images; SAF_LI – store-and-forward with live interactive; SAF_MSC – store-and-forward with macroscopic images; SAF_MSC_DSC – store-and-forward with macroscopic and dermatoscopic images; SAFvideo – store-and-forward with video attachment.

Table 4.7 Intervention and comparator details – inflammatory/infectious conditions population

	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Standard store-and-forward							
Armstrong 2018[362]	SAF	NR	Initial PCP or office staff, ongoing patient	NR	NR	FTF	NR
Chansky 2017[266]	SAF	NR	NR	Smartphone App	NR	FTF	NR
Kazi 2021[267]	SAF	NR	Patient	NR	▪ 3 images	LI	NR
Klaz 2005[363]	SAF	Board-certified military dermatologist	Medical staff member	Digital camera	▪ Standard protocol for dermatologic photography	FTF	NR
Marwaha 2021[364]	SAF	NR	PCP	NR	NR	FTF	NR
Shalmon 2023[365]	SAF	Experienced dermatologists and young dermatology residents	Residents	NR	NR	FTF	Attending senior physician
Store-and-forward with dermatoscopy via an image clinic							
Lowe 2021[262]	SAF_imageclinc_DSC	Consultant dermatologist	Professional photographer	NR	▪ High-quality clinical and dermatoscopic images	FTF	NR
Store-and-forward including video							
Feigenbaum 2017[366]	SAFvideo SAF	Dermatology residents – postgraduate training years 2-4	Doctor	Smartphone or camera	▪ Clinical images and videos in standard patient clinic rooms	FTF	Average of 8 years' experience
Store-and-forward with macroscopic images							

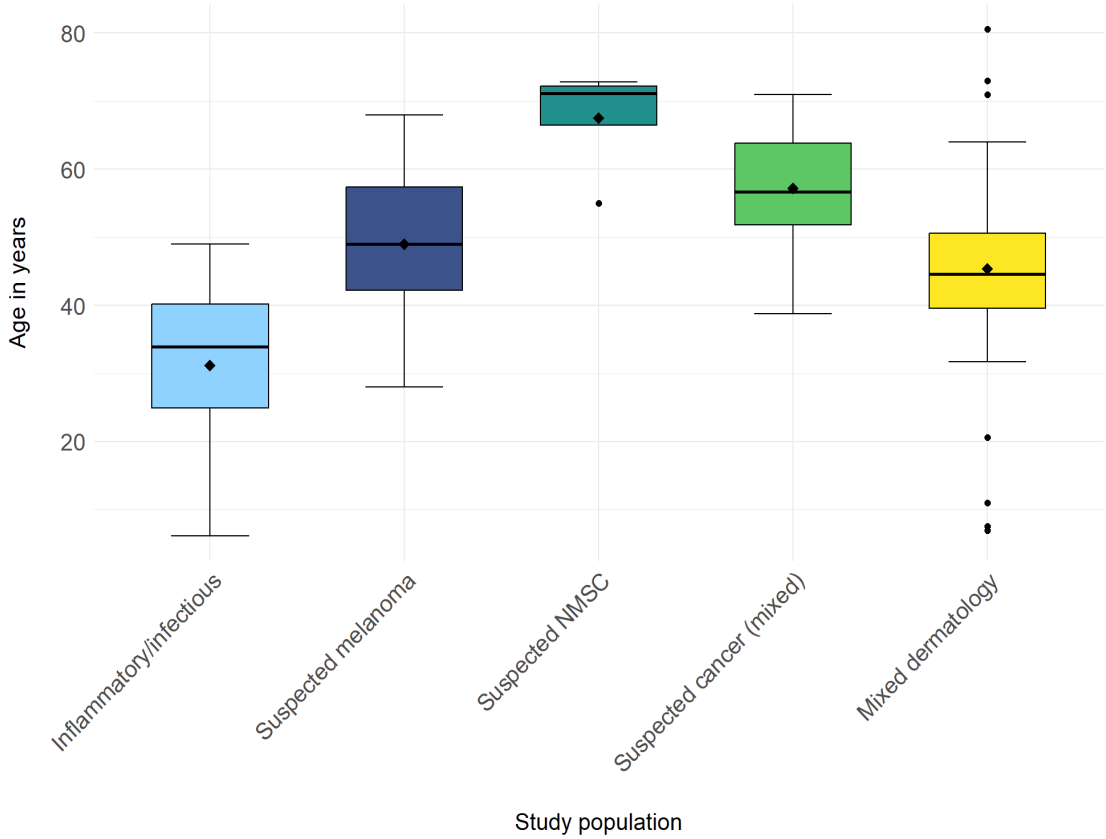
	Intervention details					Comparator details	
Study author and Year	**Type of TD label**	**Assessor Experience**	**Image taker**	**Image equipment**	**Image details**	**Comparator (s)**	**Assessor Experience**
Heffner 2009[367]	SAF_MSC	NR	Principal investigator (paediatrician)	Digital camera	▪ Fine detail image size (1200X1600 pixels) ▪ Overhead fluorescent light with some natural light through examination room	FTF	NR

Key: FTF – face-to-face; SAF – store-and-forward; SAF_imageclinic_DSC – store-and-forward conducted at image clinic with dermatoscopy (including clinical images); SAF_MSC – store-and-forward with macroscopic images; SAFvideo – store-and-forward with video attachment; PCP – primary care provided/physician.

4.3.3 Baseline characteristics

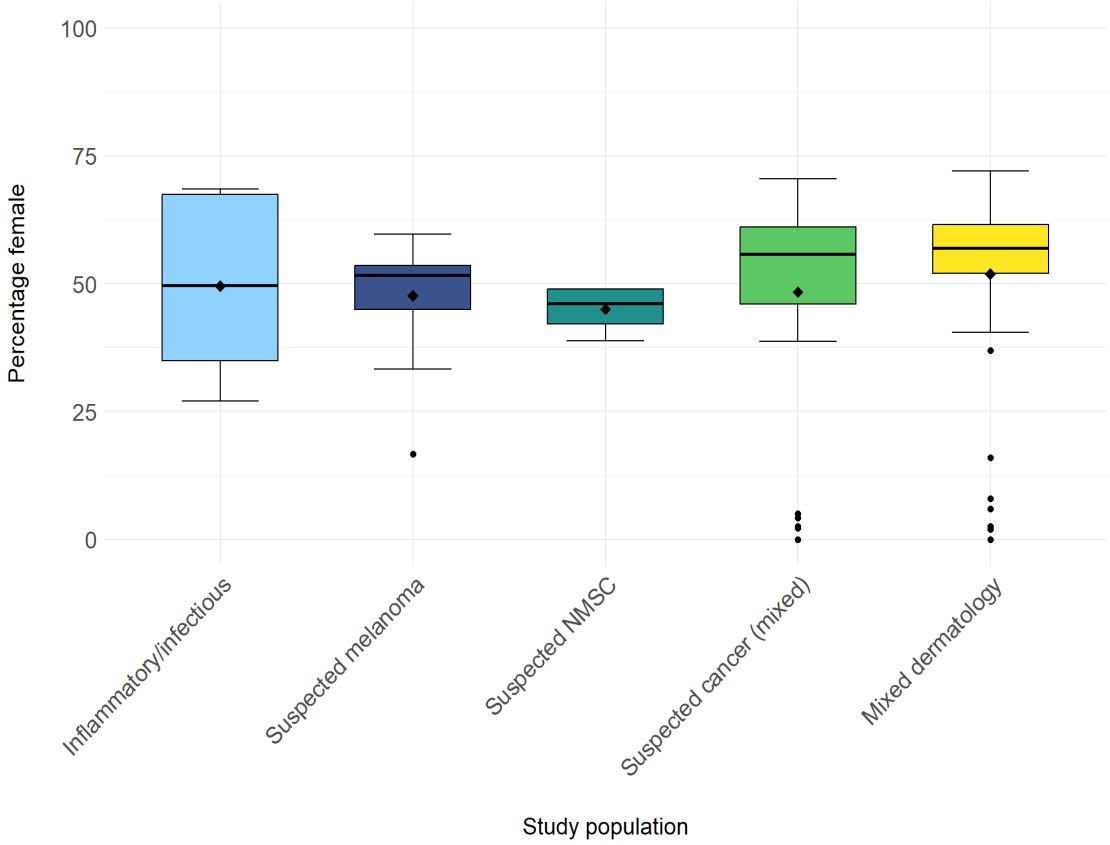
Overall, the mean age of participants was 49.8 years. The mean age of participants in suspected cancer populations (55.7 years) was notably older than the mean age of participants in mixed dermatology populations (45.1 years) and inflammatory/infectious conditions populations (31.2 years) (Figure 4.2). The studies included similar proportions of females and males, however, several studies which were conducted using data from US Veteran Affairs claims databases comprised males only (Figure 4.3). Figure 4.4 shows the number of studies by adult or paediatric population. Only five studies were limited to a paediatric population.

Figure 4.2 Boxplot of participant age by study population



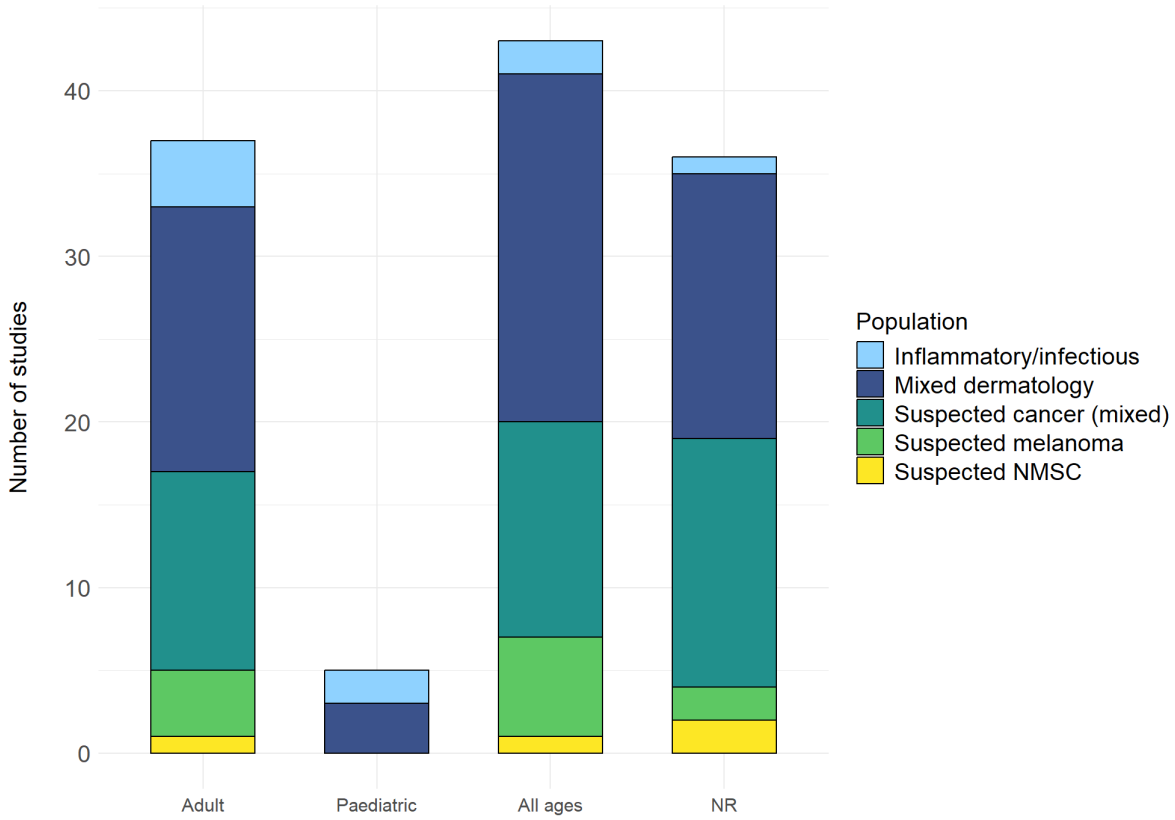
Footnote: Diamond point represents mean age, crossbar represents median age, round points represent outliers.

Figure 4.3 Percentage female participants by study population



Footnote: Diamond point represents mean age, crossbar represents median age, round points represent outliers.

Figure 4.4 Number of studies by adult or paediatric population and study population



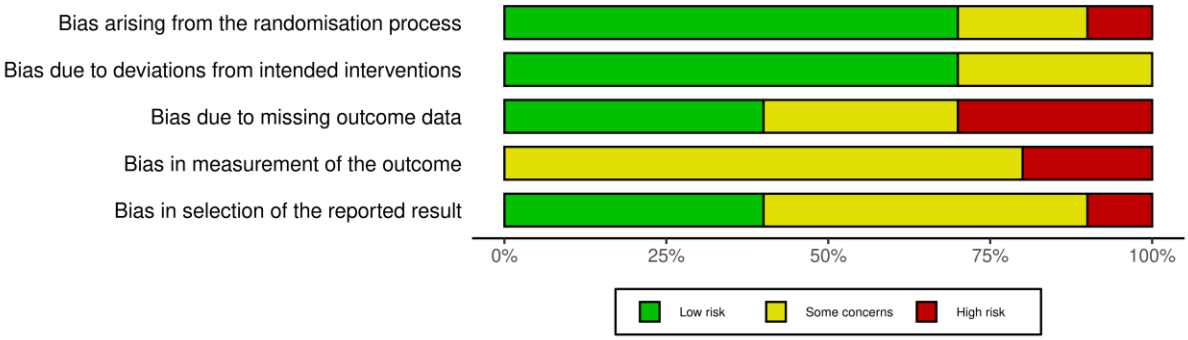
Key: NMSC – non-melanoma skin cancer; NR – not reported.

4.3.4 Risk of bias

Critical appraisal was carried out using the Risk of Bias 2 tool (RoB 2)[368] for RCTs and Risk of Bias in Non-randomised studies - of Interventions (ROBINS-I) tool [369] for non-randomised controlled trials (non-RCTs). Critical appraisal was only carried out on the primary publications and not on linked or secondary publications arising out of the same study.

Figure 4.5 and Figure A 4 in the Appendix present a summary of the risk of bias assessment of the 10 RCTs [26, 29, 232, 263, 290, 347, 356, 362, 370, 371] included in this review.

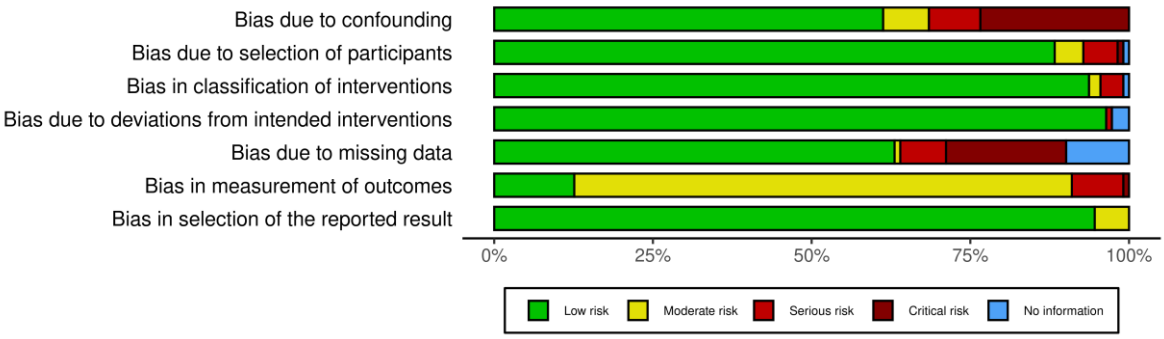
Figure 4.5 Risk of bias graph for RCTs: review authors' judgement about each risk of bias item presented as percentages across all included studies



Considering bias arising due to the randomisation process, some concerns were identified for two studies[263, 370] as there was no information to inform the bias assessment while for one study[347] the risk of bias was deemed to be high due to the differences in baseline characteristics between the two groups. Considering bias due to deviations from the intended interventions, there were some concerns relating to three studies[263, 356, 362] as the participants and the assessors were aware of the assignment to the intervention. Risk of bias due to missing outcome data was deemed to be of some concern in three studies[356, 370, 371] and high for three studies.[26, 232, 290] Studies at high risk of bias due to missing outcome data were missing data for greater than 5% of participants and lacked a clear explanation on how missing data were handled. Considering bias in measurement of the outcome, there was some concerns regarding eight studies[29, 232, 263, 290, 347, 356, 370, 371] were assessed to have some concerns regarding risk of bias in measurement of the outcome due to lack of blinding of outcome assessors, participants, and the subjective measurement of the outcome. Two studies[26, 362] were deemed to have a high risk of bias in measurement of outcome; for one study[362] there was a lack of clarity around outcome measurement for the comparator group, while for another study[26] assessing the time period between GP referral and the dermatologist's reply, it was due to the subjective nature of the outcome measurement and the likelihood of the outcome measurement being influenced by the knowledge of the intervention received. Considering bias due to selective reporting of results, there were some concerns for five studies[26, 29, 232, 356, 371] on risk of bias due to selective reporting of results; these studies as they did not provide information on a pre-existing protocol or analysis plan.

Figure 4.6 and Figure A 5 in the Appendix present a summary of the risk of bias assessment of the 110 non-randomised controlled trials[27, 28, 51, 52, 71, 80, 112, 233, 254, 255, 261, 262, 264-279, 282-316, 318-346, 348, 349, 351-355, 357-361, 363-367, 372] included in this review.

Figure 4.6 Risk of bias graph for non-RCTs: review authors' judgement about each risk of bias item presented as percentages across all included studies



Considering bias due to confounding, 26 studies were considered at critical risk of bias, nine at serious risk and eight at moderate risk. 67 studies[28, 52, 80, 112, 254, 255, 265, 268, 270, 272, 273, 276, 278, 282, 283, 287, 288, 290, 292, 293, 295-298, 300-305, 310, 314-316, 318, 320, 321, 325-328, 330-340, 342, 344-346, 348, 351, 353, 354, 357-361, 365, 367] reported on a within group comparison, the risk of bias due to confounding were deemed to be low in these studies for this reason. Considering bias due to the selection of participants into the study, one study[285] was assessed to have critical risk of bias as the study only assessed patients referred for surgical encounters. Six studies were assessed to have serious risk of bias,[262, 269, 271, 292, 306, 328] reasons being selecting specific diagnoses after start of intervention,[271, 292, 306] differing start times for follow-up and intervention, possibly allowing lesions to progress before consultation,[269, 328] and including only patients deemed unsuitable for TD in the comparator group.[262] Five studies were assessed to have moderate risk of bias,[51, 255, 297, 348, 353] primarily because participants had different start times for follow-up and intervention,[255, 297] or this information was not reported for the comparator group.[51, 348, 353] One study[261] did not have sufficient information to assess the risk of bias due to selection of participants. Considering bias in classification of interventions, four studies[51, 262, 275, 279] were reported to have serious risk of bias as the classification of intervention status was affected by the knowledge of the outcome or there was no information on how the comparator group was defined. The risk of bias due to deviation from intended interventions was serious for one study[305] as the participants were referred from the one pathway to another pathway, resulting in deviations. There was no information to assess the risk of bias due to deviation from intended interventions for three studies.[261, 266, 280] Risk of bias due to missing data was deemed to be critical in 20 studies.[27, 51, 112, 255, 273, 275, 287-289, 301, 305, 307, 313, 314, 321, 325, 330, 336, 348, 358] and serious in eight studies[267, 295, 312, 322, 323, 326, 343, 365]. For studies[27, 51, 112, 255, 273, 275, 287-289, 301, 305, 307, 313, 314, 321, 325, 330, 336, 348, 358] assessed to be at critical risk of bias, the proportion of missing data was uneven across the intervention and

comparator groups and there was no evidence for management of missing data. For studies[267, 295, 312, 322, 323, 326, 343, 365] deemed to be at serious of risk of bias due to missing outcome data, while they reported missing data for more than 5% of participants, the authors reported that the missing data from the intervention and comparator groups were proportional and in instances where missing data was not proportional across the groups, analyses were conducted to assess the impact of the missing data and to control for it. Eleven studies[71, 261, 262, 264, 266, 279, 280, 308, 349, 354, 363] did not have sufficient information to assess the risk of bias due to missing data. Considering bias in measurement of outcomes, one study[328] was assessed to be at critical risk of bias for measurement of outcome due to different methods of outcome assessment between intervention groups: the GP decided if TD consultation was needed, while a dermatologist decided if FTF consultation was needed. Nine studies[261, 262, 266, 276, 279, 303, 308, 351, 365] were assessed to have serious risk of bias for measurement of outcome, reasons being the same dermatologist evaluating diagnosis for the same participant via SAF and subsequently FTF,[351] lack of information on methods for outcome assessment and systematic errors in measurement of the outcome[261, 262, 266, 276, 279, 308] and different experience of the dermatologists providing the diagnosis for diagnostic concordance studies.[303, 365]. Eighty-six studies were assessed to be at moderate risk [27, 28, 51, 52, 71, 80, 112, 233, 255, 265, 268-270, 275, 278, 282-292, 294-296, 298, 300-302, 304, 305, 307, 309, 310, 312-316, 318-327, 330-346, 348, 349, 352-355, 357-361, 363, 364, 366, 367, 372] due to non-blinding of the outcome assessors and the subjective nature of the outcome. Six studies [51, 273, 286, 299, 348, 354] were deemed to have moderate risk of bias due to selective reporting of results, as results were deemed to be probably selected on the basis of different subgroups, [51, 273, 286, 299, 348, 354] or on the basis of multiple outcome measurements.[348]

Overall, critical risk of bias was identified in 42 non-randomised studies,[27, 51, 71, 112, 255, 261, 262, 264, 266, 273-275, 279, 284-289, 301, 305-307, 309, 311-314, 319, 321, 322, 325, 328-330, 336, 343, 348, 349, 358, 363, 366]. The critical risk of bias in a large number of non-randomised studies was driven by confounding and missing data. In 26 studies there was no attempt to control for differences between study arms, and in 20 studies there was a large proportion of missing data, the missing data was unbalanced across the groups and no methods to adjust for missing data were reported. These issues are relevant to the interpretation of study results and are discussed in the sections below, however, despite these limitations, all non-randomised were considered appropriate to include in this systematic review with caveats acknowledged in the report.

The funding source for each study was extracted (Table A 5 in the Appendix). Six studies[275, 276, 297, 328, 342, 346] were industry-funded and one was funded by a combination of industry and government funding.[284] Of the remaining studies, 46 gave no information on funding source, 45 were supported by a charitable or government grant, and 22 declared no funding source.

4.3.5 Teledermatology concordance

The following section reports on the effectiveness and reliability of TD. Outcomes include concordance between TD and routine care with respect to clinical triage, diagnosis, and management as well as diagnostic reliability of TD evaluations.

4.3.5.1 Triage concordance

4.3.5.1.1 Suspected cancer (mixed) population

Three studies evaluated triage concordance within a population with suspected cancer.[289, 298, 373] Moreno-Ramirez 2006 compared standard SAF and SAF with dermatoscopic images, and Börve 2015 and Dahlen Gyllencreutiz 2017 assessed concordance based on assigned appointment priority (high, within two weeks; medium, within four weeks; low, within 8–12 weeks; or unprioritised, no referral required). Data for the three studies are presented in Table 4.8. Due to the limited number of studies and heterogeneity between them, a meta-analysis was not deemed feasible.

In Moreno-Ramirez 2006,[298] relevant referrals were considered those in which malignant lesions were referred to FTF evaluation while irrelevant were defined as benign lesions referred to FTF evaluation. TD using dermatoscopic images resulted in more relevant referrals (20.8% versus 17.2%; $p<0.05$) and fewer irrelevant referrals (41.7% versus 58.7%; $p<0.05$) to FTF consultation compared with TD using only clinical images. No false negatives (malignant lesion not referred to FTF) were reported with either TD method. In Börve 2015, TD correctly assigned high priority to 65% of SCC cases compared with 40% of cases referred via usual care. Among the cases with SCC *in situ*, 71% were correctly assigned high or medium priority by TD compared with 44% in the usual care referral arm. For malignant melanoma, TD achieved a 100% accuracy rate in triaging all cases as high priority, and similarly, all melanoma *in situ* cases were correctly identified as medium or high priority. In contrast, in the usual referral arm, three out of four malignant melanoma cases were incorrectly given medium or low priority, and three out of five melanoma *in situ* cases were inappropriately triaged as low priority.[289] Dahlen Gyllencreutz 2017 was a retrospective study which randomly selected a sample of TD and usual care referrals from Börve 2015 covering each of the four priority groups. Referrals from each group were independently assessed by six dermatologists. Overall, the authors reported that a significantly higher proportion of assessments were assigned the completely correct priority with TD compared with assessment through usual paper referrals (51% vs 38%; $p=0.042$). Regarding malignant melanoma, a significantly higher proportion of evaluations were correctly assigned high priority using TD compared with those referred in the usual pathway (98% vs 62%; $p<0.012$). When limited to malignant and pre-malignant cases, a higher proportion

of those assessed through TD were triaged at least as high as recommended compared with the usual paper referral arm, however the difference was not statistically significant (79% vs 68%; p=0.26). Of the 318 TD evaluations of malignant or pre-malignant cases, eight (2.5%) were incorrectly referred back to primary care without a FTF dermatology appointment. Among cases with a final diagnosis of a benign condition, a significantly higher proportion of evaluations were referred back to primary care without a FTF visit in the TD arm compared with the usual paper referral arm (43% versus <1%; p<0.001).[373] The study also assessed the ability to plan for surgery first visit; among cases with a diagnosis of SCC, while a higher proportion of patients assessed by TD had their surgery planned at first visit compared with the usual care referral route, this difference was not statistically significant (58% vs 41%; p=0.33). In contrast, a significant difference was seen for melanoma cases in which 91% evaluated through TD were able to have surgery recommended for their first visit compared with only 36% referred through the usual pathway (p<0.001). Considering all the diagnoses where surgery should always be the first choice (malignant melanoma, melanoma *in situ* and SCC), TD would have resulted in a significantly higher proportion of evaluations (71%) with surgery at the first visit compared with usual referrals (39%; p<0.001).

Table 4.8 Triage concordance – suspected cancer (mixed) population

Study author and Year	Study arm	N	Comparator	Triage definition	Condition	Results	
Börve 2015	SAF_DSC	MM= 19 MM *in situ*= 16 SCC= 17 SCC *in situ*= 7 Lesions	Study hospital recommended guidelines	Appointment priority: ▪ High: within 2 weeks (high suspicion of invasive MM and SCC) ▪ Medium: within 4 weeks (suspicion of MM in situ and SCC *in situ*) ▪ Low: within 8-12 weeks (Other tumours including actinic keratosis, BCC, and atypical melanocytic lesions ▪ Unprioritised: referral sent back without FTF appointment	SCC	**MM:** 100% correctly triaged as high priority **MM *in situ*:** 100% correctly triaged as medium or high priority **SCC:** 65% correctly triaged as high priority **SCC *in situ*:** 71% correctly triaged as medium or high priority	
	Usual paper referral	MM= 4 MM *in situ*= 5 SCC= 5 SCC in situ= 9 Lesions				**MM:** 25% correctly triaged as high priority (remaining 3 given low or medium priority) **MM *in situ*:** 40% correctly triaged as medium or high priority **SCC:** 40% triaged as high priority **SCC *in situ*:** 44% triaged as medium or high priority	
Dahlen Gyllencreutz 2017	SAF_DSC	80 cases 480 evaluations	Study hospital recommended guidelines		Mixed	51% completely correct	p=0.042
	Usual paper referral	77 cases 462 evaluations			Mixed	38% completely correct	
	SAF_DSC	53 cases 318 evaluations				79% triaged at least as high as recommended	p=0.26

Study author and Year	Study arm	N	Comparator	Triage definition	Condition	Results	
	Usual paper referral	57 cases 342 evaluations			Malignant andand pre-malignant	68% triaged at least as high as recommended	
	SAF_DSC	27 cases 162 evaluations			Benign	43% unprioritised	p<0.001
	Usual paper referral	20 cases 120 evaluations				<1% unprioritised	
	SAF_DSC	9 cases 54 evaluations			Malignant melanoma	98% completely correct	p=0.012
	Usual paper referral	11 cases 66 evaluations				62% completely correct	
	SAF_DSC	11 cases 66 evaluations		Ability to plan for surgery at first visit	SCC	58%	p=0.33
	Usual paper referral	9 cases 54 evaluations				41%	
	SAF_DSC	9 cases 54 evaluations			Malignant melanoma	91%	p<0.001
	Usual paper referral	11 cases 66 evaluations				36%	
	SAF_DSC	14 cases 84 evaluations			Melanoma in situ	68%	p=0.03
	Usual paper referral	6 cases 36 evaluations				42%	
	SAF_DSC	34 cases 204 evaluations			Mixed requiring surgery	71%	p<0.001
	Usual paper referral	26 cases 156 evaluations				39%	
Moreno-Ramirez 2006	SAF_DSC	61 patients	Appropriate referral based on histology	Referral management: ▪ Relevant referral (TD refers a malignant lesion) ▪ Irrelevant referral (TD refers a benign lesion	Mixed	Relevant referral rate: 20.8% (5 true positive results from 24 referrals) Irrelevant referral rate: 41.7% (10 false	p<0.05

Study author and Year	Study arm	N	Comparator	Triage definition	Condition	Results	
				False positive: TD refers a benign lesion. False negative: TD does not refer a malignant lesion. True positive: TD refers a malignant lesion True negative: TD does not refer a benign lesion.		positive results from 24 referrals). No false negatives.	
	SAF					Relevant referral rate: 17.2% (5 true positive results from 29 referrals) Irrelevant referral rate: 58.7% (17 false positive results from 29 referrals). No false negatives.	

Key: BCC – basal cell carcinoma; FTF – face-to-face; MM – malignant melanoma; N – number of lesions, cases, evaluations, or patients; SAF – store and forward; SAF_DSC – store and forward with dermatoscopy; SCC – squamous cell carcinoma; TD – teledermatologist.
Note: Each case (n=80) in Dahlen Gyllencreutz 2017 was evaluated six times; results reported refer to the proportion relative to the number of evaluations.

4.3.5.1.2 Mixed dermatology population

Two studies reported triage concordance for a mixed population (Table 4.9).[318, 359] Börve 2012 compared the triage assessment (0-2 weeks; 2-4 weeks; 4-12 weeks; or not required) of two dermatologists using SAF clinical images with a final triage decision following FTF assessment. Both dermatologists conducted the image review first, followed by independent FTF assessment of each patient (n=40) before jointly agreeing on the final triage category. The TD triage decision was considered concordant if it was equal or higher priority to that of the final FTF decision. Overall, TD demonstrated high triage concordance with the final assessment (TD 1: 85%; TD2: 95%). Triage concordance remained high for benign (TD1: 96%; TD2: 100%) and malignant (100% for TD1 and TD2) tumours. The concordance was lower for dermatitis conditions otherwise unspecified, at 50% and 67% for TD1 and TD2, respectively.[318] While triage concordance was generally high, the study was limited by a small sample size. Additionally, the use of the same dermatologist conducting the image review and FTF consultation may have contributed to the high concordance rates. In the second study, Rogers 2022 compared 26 physicians' assessment of urgency (not urgent, urgent, or emergent) utilising 20 SAF clinical images only with the same 20 SAF images including dermatoscopy. The addition of dermatoscopic images significantly increased the proportion of physicians rating non-neoplastic lesions as non-urgent (54% vs 81%, $p<0.0001$). The study also reported increases in the proportion of physicians rating benign neoplastic conditions as non-urgent (69% to 78%) and malignant neoplastic lesions as urgent (44% to 58%); however, no statistical significance is provided for these changes.[359] The study had a small sample size and was not conducted under routine clinical conditions which pose limitations for the generalisability of the results and conclusions that can be drawn from it.

Table 4.9 Triage concordance – mixed dermatology population

Study author	Study arm	N	Comparator	Condition	Triage definition	Results
Börve 2012	SAF	40 patients	Triage decision with an equal or higher priority given to the patient after assessment of the SAF referral in comparison to the final triage decision as agreed upon by both dermatologists after the FTF visit.	Mixed	FTF visit required within: 0-2 weeks 2-4 weeks 4-12 weeks Not required	TD1: 85% TD2: 95%
	SAF	26 patients		Benign tumours		TD1: 96% TD2: 100%
	SAF	6 patients		Malignant tumour		TD1: 100% TD2: 100%
	SAF	6 patients		Dermatitis not otherwise specified		TD1: 50% TD2: 67%
Rogers 2022	SAF	6 images	SAF vs SAF_DSC	Malignant neoplasms	Level of urgency: Non- urgent Urgent Emergent	Urgent/emergent: 44%
	SAF_DSC	6 images		Malignant neoplasms		Urgent/emergent: 58%
	SAF	3 images		Non-neoplastic lesions		Non-urgent: 54%
	SAF_DSC	3 images		Non-neoplastic lesions		Non-urgent: 81%
	SAF	11 images		Benign neoplastic		Non-urgent: 69%
	SAF_DSC	11 images		Benign neoplastic		Non-urgent: 78%

Key: FTF - face-to-face; N – number of images or patients; SAF – store and forward; SAF_DSC - store and forward with dermatoscopy; TD – teledermatologist.

4.3.6 Diagnostic concordance

This section examines the diagnostic concordance between TD and traditional diagnostic methods, including FTF clinical evaluations and histology when indicated. Where studies provided comparative data between TD and usual care cohorts, a meta-analysis of risk ratios (RR) was conducted. Additionally, where appropriate, a meta-analysis of percentage concordance was conducted focusing on the agreement between the teledermatologist's primary diagnosis and the final FTF diagnosis. When data were available, further analyses were conducted to explore percentage concordance considering differential diagnoses, as well as TD's ability to distinguish between malignant and benign lesions. To better understand sources of variation in diagnostic performance, potential effect modifiers reported in the studies are also presented, including image quality, diagnostic confidence, and the years of experience of the teledermatologist. Importantly, in a real-world setting where TD is used in a referral management model, it is expected that patients with an unclear or

uncertain diagnosis would be referred for FTF consultation. Therefore, the results in this section should be interpreted with caution.

4.3.6.1 Suspected melanoma population

Three studies[269, 270, 278] provided diagnostic concordance data for populations with suspected melanoma. The study sizes ranged from 12 to 250 participants. Due to clinical heterogeneity among the studies, pooling the percentage concordance results was not feasible. Instead, individual study results are presented in Table 4.10. Two studies assessed percentage concordance for the overall study population. One[278] reported 89% concordance using standard SAF TD compared with FTF consultation, and 91.5% concordance when dermatoscopic images were added. Another study[270] compared SAF with dermatoscopic images against final histology and reported 83% concordance. The third study[269] evaluated percentage concordance for both SAF with dermatoscopy and FTF diagnoses against histology across specific disease categories. In this study, TD appeared to perform better than FTF consultation, with RRs for an incorrect diagnosis of 0.67 (95% CI: 0.39 to 1.14) for malignant melanoma, 0.77 (95% CI: 0.45 to 1.31) for atypical melanocytic lesions, and 0.72 (95% CI: 0.49 to 1.07) for distinguishing malignant from benign lesions. However, results were not statistically significant and the study did not find a statistically significant difference in the frequency of correctly diagnosed malignant melanoma between the TD and FTF groups (Chi-square test, p= 0.109; Fisher test, p= 0.15), suggesting that TD and FTF examinations were equivalent in detecting malignant melanoma.

Table 4.10 Diagnostic concordance - suspected melanoma population

Study author	Study arm	Comparator	N-patients	Concordance
Fazil Jaber 2023	SAF_DSC	Histo	101	Malignant melanoma (n=40): 75% Atypical melanocytic lesion (n=61): 82% Malignant vs benign (n=101): 80.2%
	FTF	Histo	134	Malignant melanoma (n=38): 57% Atypical melanocytic lesion (n=96): 75% Malignant vs benign (n=134): 69.9%
	SAF_DSC vs FTF	Histo	134	Malignant melanoma: RR= 0.67 (95% CI: 0.39 to 1.14) Atypical melanocytic lesion: RR= 0.77 (95% CI: 0.45 to 1.31) Malignant vs benign: RR= 0.72 (95% CI: 0.49 to 1.07)
Ferrara 2004	SAF_DSC	Histo	12	83%
Massone 2007	SAF	FTF	18	TD1: 89% TD2: 89% Average: 89%
	SAF_DSC	FTF	18	TD1: 89% TD2: 94% Average: 91.5%

Key: CI – confidence interval; FTF – face-to-face; Histo – histology; RR – risk ratio; SAF – store and forward; SAF_DSC – store and forward with dermatoscopy; TD – teledermatologist.

4.3.6.2 Suspected NMSC population

Two studies[280, 283] provided concordance data for a suspected NMSC population Table 4.11. In one study,[280] diagnostic concordance between TD and histopathology was 65%, while it was 83% between FTF diagnosis and histopathology. This resulted in a RR of 1.51 (95% CI: 0.99 to 2.31) for an incorrect diagnosis with TD, suggesting that FTF evaluation may have performed better than TD, although the difference was not statistically significant. In the second study,[283] standard SAF TD was concordant with FTF evaluation in 93% of cases, and in 98% of cases when dermatoscopic images were included.

Table 4.11 TD concordance – suspected NMSC population

Study author	Study arm	Comparator	N - patients	Concordance
Cheng 2022	SAF	Histo	37	Percentage concordance: 65%
	FTF	Histo	35	Percentage concordance: 83% RR of incorrect diagnosis between TD and FTF: 1.51 (95% CI: 0.99 to 2.31)
Sola-Ortigosa 2020	SAF	FTF	747	Percentage concordance: 93%
	SAF_DSC	FTF	747	Percentage concordance: 98%

Key: CI – confidence interval; FTF – face-to-face; Histo – histology; NMSC – non-melanoma skin cancer; SAF – store-and-forward; SAF_DSC – store-and-forward with dermatoscopy; TD – teledermatology.

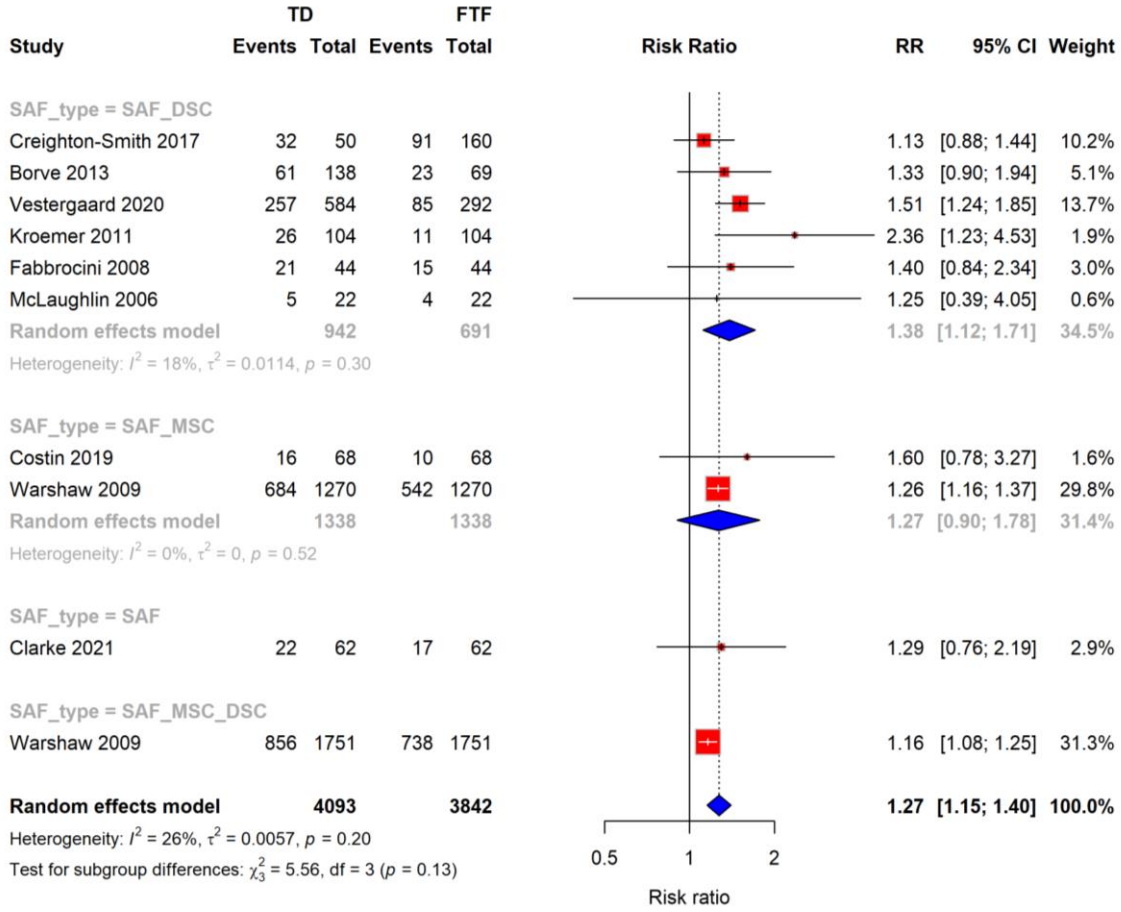
4.3.6.3 Suspected cancer (mixed) population

Nine studies[80, 112, 254, 291, 293, 295, 297, 304, 316] provided comparative diagnostic concordance data between TD and FTF evaluations with respect to the final histopathology-confirmed diagnosis.

Overall, the pooled RR across all types of TD compared with FTF consultation was 1.27 (95% CI: 1.15 to 1.40) suggesting that FTF consultations resulted in a higher proportion of diagnoses matching the histopathology-confirmed diagnosis (Figure 4.7). The pooled RR varied when considering the type of TD ranging from 1.38 (95% CI: 1.12 to 1.71) for SAF with dermatoscopy, 1.27 (95% CI 0.90 to 1.78) for SAF with macroscopic images, 1.16 (95% CI: 1.08 to 1.25) for SAF with macroscopic and dermatoscopic images, and 1.29 (95% CI: 0.76 to 2.19) with the use of standard SAF methods. In interpreting the results, it is important to consider that the

RR in the analysis reflects a single diagnostic assessment, rather than a complete diagnostic pathway seen in clinical practice. In real-world circumstances, it is expected that a suspected cancer diagnosis made through TD would often prompt referral for FTF consultation or histology for confirmation. The RR therefore represents a single point of comparison between TD and FTF consultation, rather than accounting for the comprehensive diagnostic process.

Figure 4.7 Risk ratio of incorrect primary diagnosis with TD compared with FTF consultation - suspected cancer (mixed) population



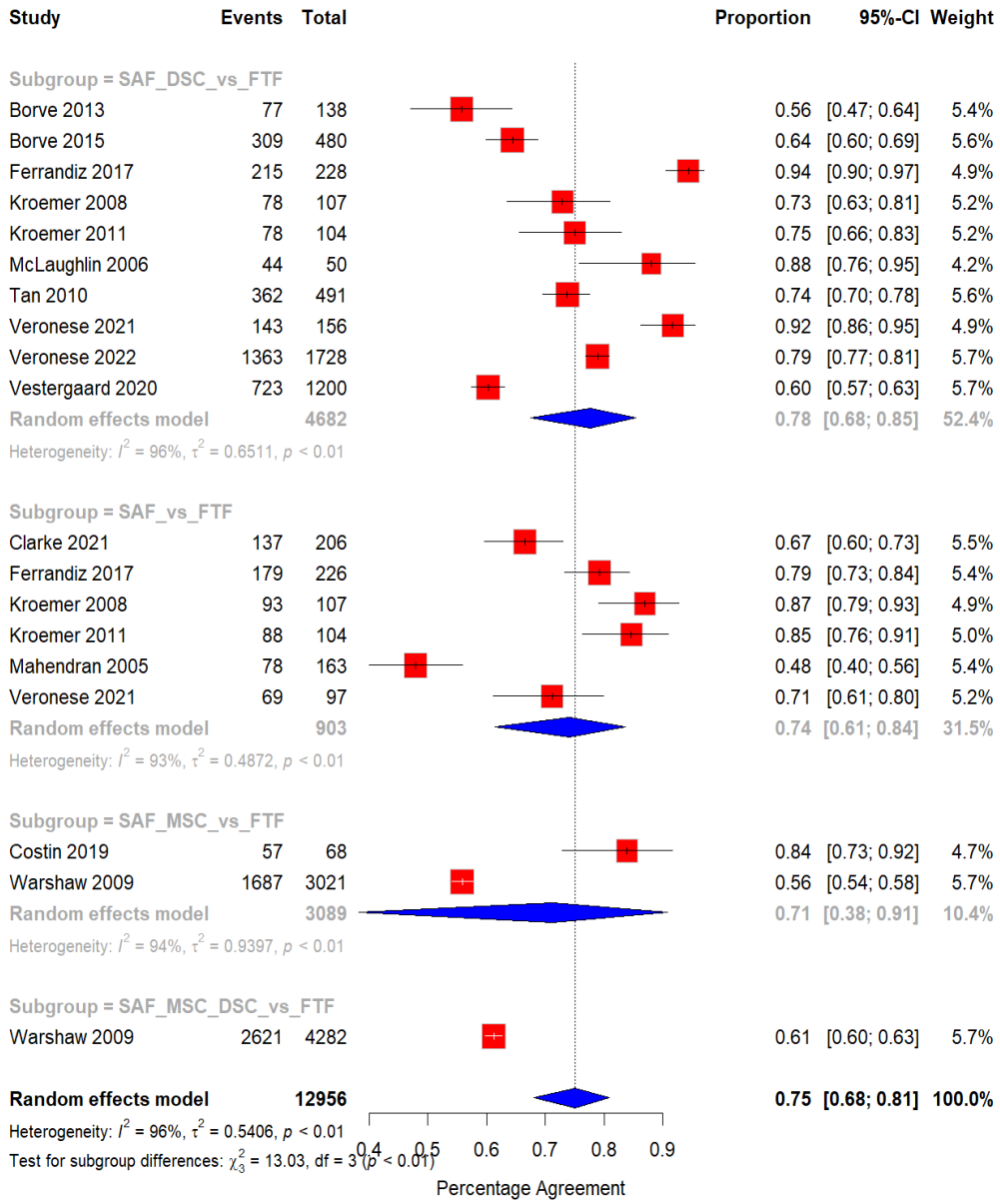
Key: CI – confidence interval; FTF - face-to-face; RR – risk ratio; SAF – store and forward; SAF_DSC - store and forward with dermatoscopy; SAF_MSC – store and forward with macroscopic image; TD – teledermatology.

Figure 4.8 presents analysis of percentage concordance between TD and the FTF diagnosis. For this analysis, concordance is based on the teledermatologist primary diagnosis only. Studies used different designs to capture the percentage concordance between the teledermatologist and FTF dermatologist diagnosis. In nine studies,[80, 112, 287, 289, 296, 297, 302, 316, 370] concordance was measured using the exact diagnosis provided by each dermatologist while in five studies,[254, 295, 303, 304, 315] diagnostic categories were used to measure percentage concordance. The

diagnostic categories varied across studies and therefore results should be interpreted with caution.

For standard SAF evaluations compared with FTF, the pooled concordance was 74% (95% CI: 61% to 84%), with the concordance for individual studies ranging from 48% to 87% and showing high heterogeneity (I^2 = 93%). Mahendran 2005 reported the lowest percentage concordance; however, the authors highlighted that in 15% of cases, the digital image was of insufficient quality for assessment and documented as discordant.[287] When SAF included dermatoscopy, the pooled concordance was 78% (95% CI: 68% to 85%), with study-specific concordance spanning from 56% to 94% and similarly high heterogeneity (I^2 = 96%). SAF using macroscopic images demonstrated 71% concordance (95% CI: 38% to 91%) across two studies. One study used SAF of macroscopic and dermatoscopic images; percentage concordance was 61% (95% CI: 60% to 63%). The overall pooled concordance across all SAF approaches was 75% (95% CI: 68% to 81%), with high heterogeneity (I^2 = 96%), indicating variability in agreement across studies.

Figure 4.8 Primary diagnosis percentage concordance – suspected cancer (mixed) population



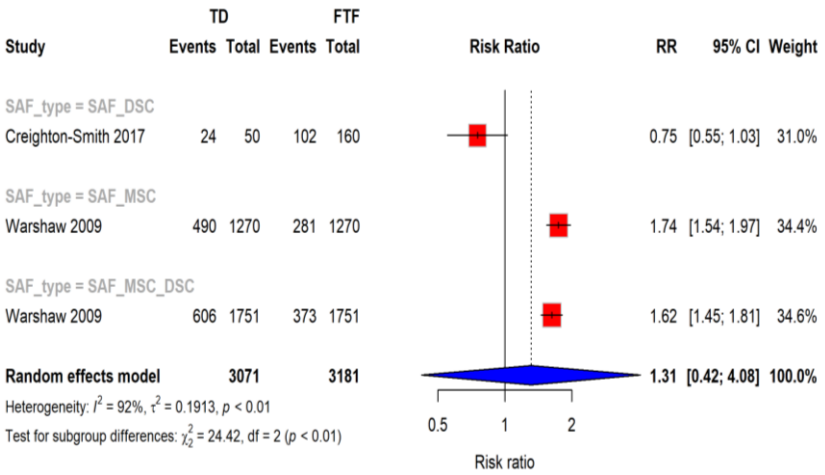
Key: CI – confidence interval; FTF - face-to-face; SAF – store and forward; SAF_DSC - store and forward with dermatoscopy; SAF_MSC – store and forward with macroscopic image.

4.3.6.3.1 Percentage concordance including differential diagnoses

Only two studies reported data that enabled calculation of the RR for an incorrect diagnosis with TD compared with FTF evaluation when differential diagnoses were also considered. The findings were mixed: one study[291] reported better diagnostic performance with TD, while the other[316] favoured FTF evaluation. The pooled RR was 1.31 (95% CI: 0.42 to 4.08) (Figure 4.9), indicating no statistically significant difference. Interpretation of this estimate however is challenging; the small number of studies and substantial differences in sample sizes reduces the reliability of the pooled estimate. Additionally, the use of the Hartung-Knapp method in combination with a random-effects model, while appropriate for accounting for between study heterogeneity, may further widen confidence intervals in meta-analyses with few studies, reflecting additional uncertainty. These factors mean that the true effect could differ markedly from the pooled estimate, and certainty in the direction and magnitude of effect is therefore low.

Additionally, one[316] of these studies reported percentage concordance between TD and FTF evaluation across different imaging approaches. When using SAF with macroscopic images alone, diagnostic concordance was 84.5%. When macroscopic and dermatoscopic images were used, percentage concordance was 88.5%. Notably, these figures were 28.5% and 27.5% higher, respectively, than when only the primary diagnosis was considered. Another study[287] demonstrated percentage concordance of 65% between TD and FTF when considering differential diagnoses, 17 percentage points higher than when assessing only the primary diagnosis.

Figure 4.9 Risk ratio of incorrect diagnosis with TD compared with FTF when including differential diagnoses – suspected cancer (mixed) population



Key: FTF – face-to-face; TD – teledermatology.

4.3.6.3.2 Potential effect modifiers

Two studies[304, 316] explored the influence of potential effect modifiers on diagnostic concordance in TD, including image quality, diagnostic confidence, and clinician experience. One study[316] demonstrated a positive association between image quality and diagnostic concordance. For both pigmented and non-pigmented lesions, concordance rates increased progressively from low to high image quality. Using SAF with macroscopic images, high-quality images yielded concordance rates of 82.2% for pigmented lesions (compared with 52.3% for low-quality) and 62.6% for non-pigmented lesions (compared with 38.1% for low-quality). Similar trends were observed when both macroscopic and dermatoscopic images were used. The same study also examined diagnostic confidence, showing that higher confidence levels resulted in higher concordance rates. For instance, in cases where clinicians reported high diagnostic confidence, concordance reached 77.6% for pigmented lesions using macroscopic images alone, compared with 41.7% when diagnostic confidence was low. Another study[304] investigated the impact of teledermatologist experience and found a notable increase in concordance with greater years of practice. Diagnostic concordance was 69.1% with a dermatologist with one year of experience and 87.5% with a dermatologist with 10 years' experience. Full details are shown in Table 4.12.

Table 4.12 Impact of image quality, diagnostic confidence, and teledermatologist experience on percentage concordance – suspected cancer (mixed) population

Study ID	N	TD type	Comparator	Percentage concordance
Image quality				
Warshaw 2009	3,021 lesions	SAF_MSC	FTF	**Low (n=556):** Pigmented - 52.3% Non-pigmented - 38.1%
				Moderate (n=1,836): Pigmented - 62.9% Non-pigmented - 45.7%
				High (n=629): Pigmented - 82.2% Non-pigmented - 62.6%
	4,063 lesions	SAF_MSC_DSC	FTF	**Low (n=517):** Pigmented - 44% Non-pigmented - 37.7%
				Moderate (n=2,302): Pigmented - 64.5% Non-pigmented - 48.5%
				High (n=1,244): Pigmented - 79.2% Non-pigmented - 62.6%
Diagnostic confidence				
Warshaw 2009	3,021 lesions	SAF_MSC	FTF	**Low (n=304):** Pigmented - 41.7% Non-pigmented - 29.1%
				Moderate (n=1,430): Pigmented - 57.8% Non-pigmented - 43%
				High (n=1,287): Pigmented - 77.6% Non-pigmented - 58.2%
	4,063 lesions	SAF_MSC_DSC	FTF	**Low (n=332):** Pigmented - 32.2% Non-pigmented - 27.5%
				Moderate (n=1,710): Pigmented - 57.5% Non-pigmented - 44%
				High (n=2,021): Pigmented - 79.4% Non-pigmented - 61.9%
Teledermatologist years of experience*				
Vestergaard 2020	584 patients	SAF_DSC	FTF	TD 1 (1 year): 69.1% TD 2 (4 years): 79.4% TD 3 (9 years): 79.6% TD 4 (10 years): 87.5%

Key: FTF - face-to-face; N – no. of patients; RR – risk ratio; SAF – store and forward; SAF_MSC – store and forward with macroscopic images; SAF_DSC - store and forward with dermatoscopy; SAF_MSC_DSC - store and forward with macroscopic images and dermatoscopy; TD – teledermatology.

Footnotes: *Relates to the teledermatologists general dermatology experience and presents concordance on determining malignant from benign lesions.

4.3.6.4 Mixed dermatology population

Three studies provided comparative data for a mixed population.[290, 333, 342] Two studies compared the TD and FTF diagnosis to the final histological diagnosis,[333, 346] and one compared against an independent second FTF consultation.[290] Due to the differences in the comparator, results were not pooled. Individual RRs of an incorrect diagnosis with TD compared with FTF consultation are presented in Table 4.13.

In two studies, FTF consultation performed better than TD with RRs of 1.30 (95% CI: 0.91 to 1.86) and 1.43 (95% CI: 1.15 to 1.78). In one study, TD performed better than FTF consultation (RR: 0.85 (95% CI: 0.57 to 1.27).

Table 4.13 Risk ratio of incorrect diagnosis with TD compared with FTF consultation – mixed dermatology population

Study author	Type of TD	Comparator	TD – correct diagnoses	TD – N	FTF- correct diagnoses	FTF – N	RR (95% CI)
Bowns 2006a	SAF	FTF*	51	92	58	73	1.43 (1.15 to 1.78)
Rios-Yuil 2012	SAF	Histo	20	30	17	30	0.85 (0.57 to 1.27)
Zink 2017b	SAF	Histo	20	36	26	36	1.30 (0.91 to 1.86)

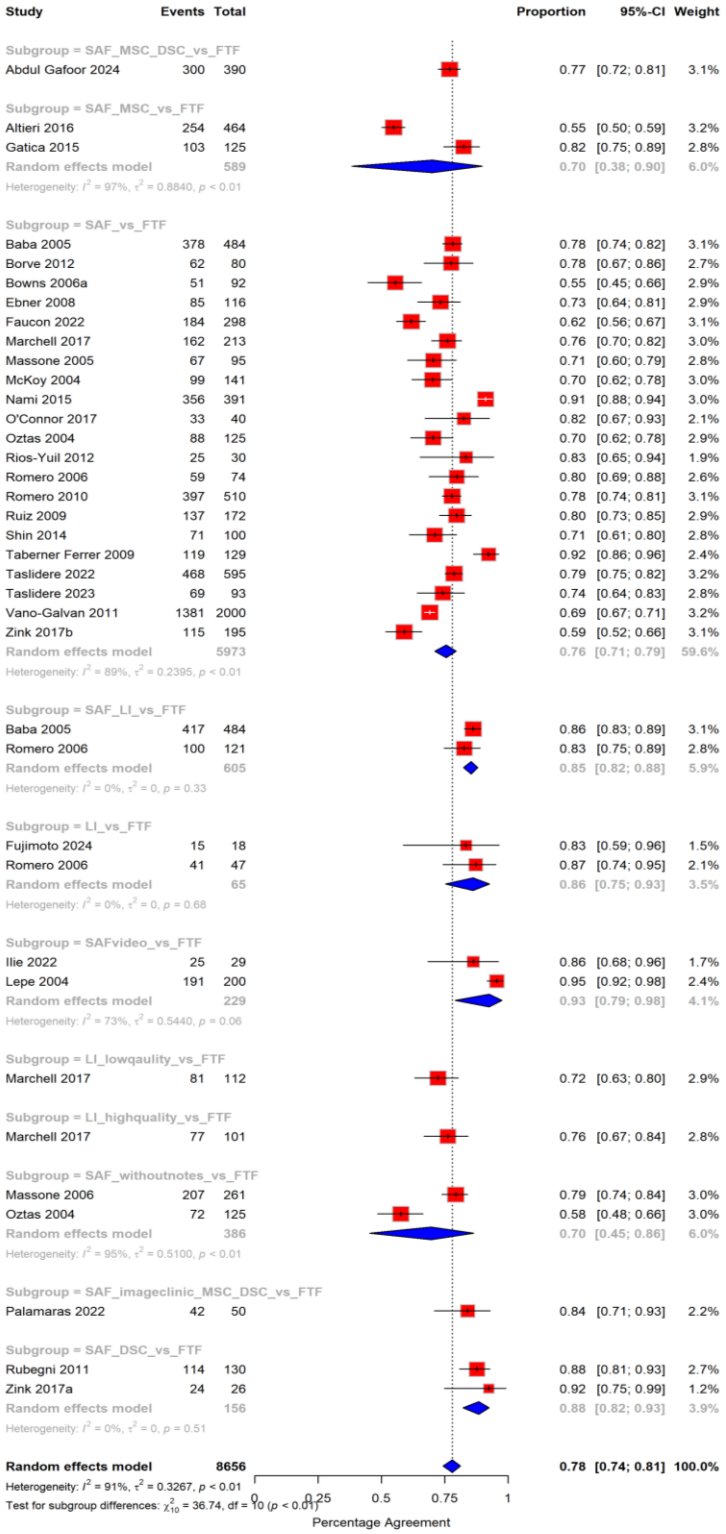
Key: CI – confidence interval; FTF - face-to-face; N – no. of patients; RR – risk ratio; SAF – store and forward; SAF_DSC - store and forward with dermatoscopy; TD – teledermatology.
Footnote: *A third senior dermatologist provided a final diagnosis. The SAF and primary FTF diagnosis are compared against the final FTF diagnosis.

Thirty-one studies reported percentage concordance between the TD primary diagnosis and the final FTF diagnosis.[28, 232, 261, 290, 318, 320-322, 327, 330-338, 340, 342, 345, 346, 348, 351, 353, 354, 356-358, 360, 361] Twenty-seven of the studies[28, 232, 261, 290, 318, 320-322, 327, 330, 332-334, 337, 340, 342, 345, 346, 348, 351, 353, 354, 356-358, 360, 361] measured concordance based on the exact diagnosis provided by the teledermatologist and FTF diagnosis and four[331, 335, 336, 338] measured concordance using diagnostic categories. As shown in Figure 4.10, for standard SAF evaluations, the pooled percentage concordance was 76% (95% CI: 71% to 79%) across studies with individual concordance rates ranging from 55% to 92% (I^2 = 89%). While the majority of the remaining studies included low-quality images in their analysis, nine did not report how low-quality images were handled, three excluded images deemed insufficient to facilitate a diagnosis, and one documented images of insufficient quality as discordant.

In studies that did not provide the teledermatologist with clinical notes alongside the image, the pooled percentage concordance was 70% (95% CI: 45% to 86%) with high heterogeneity (I^2 = 95%).[357, 358] When dermatoscopy was added to standard SAF, the pooled concordance was 88% (95% CI: 82% to 93%) across two studies

(I^2 = 0%).[342, 345] One study[348] reported percentage concordance of 77% (95% CI: 72% to 81%) using SAF with macroscopic and dermatoscopic images. Other approaches showed high concordance levels: SAF using a video attachment (SAFVideo) achieved 93% (95% CI: 79% to 98%) concordance reported across two studies.[360, 361] Two studies used a combination of SAF and LI TD which had a pooled concordance of 85% (95% CI: 82% to 88%) and no heterogeneity between the two studies (I^2 = 0%).[232, 351] Two studies reported diagnostic concordance using LI TD only which yielded pooled percentage concordance of 86% (95% CI: 75% to 93%) with the FTF diagnosis.[232, 353] Another study compared both LI uncompressed (high quality) and compressed video (low quality) with the final FTF diagnosis and showed percentage concordance of 76% (95% CI: 67% to 84%) and 72% (95% CI: 63% to 80%), respectively.[354] Overall, results indicate that enhanced TD such as SAF including dermatoscopy, SAF with video attachment, or LI assessment yield higher percentage concordance with the final FTF diagnosis than standard SAF or SAF where clinical notes are not included. However, there are few studies assessing these enhanced methods.

Figure 4.10 Primary diagnosis percentage concordance – mixed dermatology population

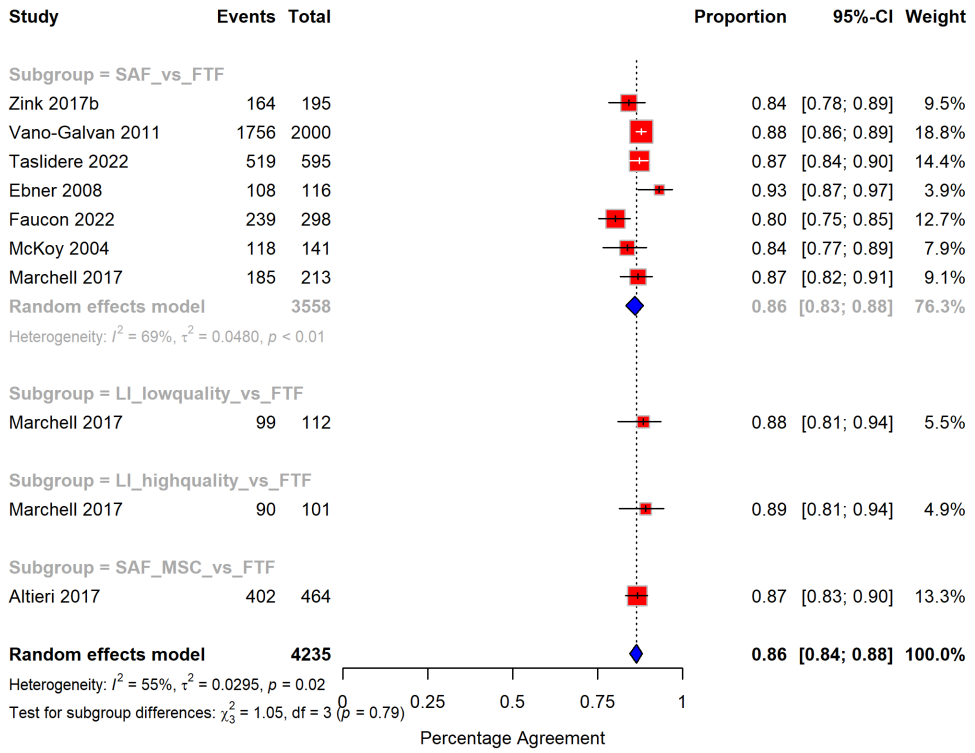


Key: CI – confidence interval; FTF - face-to-face; LI – live interactive; SAF – store and forward; SAF_DSC - store and forward with dermatoscopy; SAF_MSC – store and forward with macroscopic image; SAF_MSC_DSC – store and forward with macroscopic and dermatoscopic images; SAFvideo – store and forward with video.

4.3.6.4.1 Differential diagnoses percentage concordance

Eight studies[28, 320, 321, 330, 337, 340, 342, 354] reported on percentage concordance including differential diagnoses between TD and FTF evaluation (Figure 4.11). The pooled concordance across studies using standard SAF methods was 86% (95% CI: 83% to 88%). One study[28] using SAF with macroscopic images reported concordance of 87% (95% CI: 83% to 90%), while another study[354] using LI TD reported concordance of 88% (95% CI: 81% to 94%) with low-quality video and 89% (95% CI: 81% to 94%) with high-quality video. Overall, the pooled concordance across studies was 86% (95% CI: 85% to 88%), and moderate heterogeneity (I^2=55%).

Figure 4.11 Differential diagnoses percentage concordance - mixed dermatology population



Key: CI – confidence interval; FTF – face-to-face; LI – live interactive; MSC – macroscopic; SAF – store-and-forward.

4.3.6.4.2 Potential effect modifiers

Four studies[321, 330, 351, 356] assessed the impact of image quality on percentage concordance between TD and FTF consultation. While different measures were used to assess image quality, all studies consistently reported higher diagnostic concordance rates when images were rated as high quality rather than low quality. In one study,[321] the odds of making an accurate diagnosis were nearly three times higher when images were rated as high quality compared to low quality. Three of the studies[330, 351, 356] also explored the influence of diagnostic confidence on

concordance. One study[351] demonstrated a statistically significant increase in concordance when teledermatologists rated their diagnostic confidence at three or higher on a five-point scale, where one indicated being unsure and five indicated full confidence. Although the remaining two studies[330, 356] did not statistically test the difference, both reported higher concordance when teledermatologists rated their diagnostic confidence as high rather than low. Full details are presented in Table 4.14.

Table 4.14 Impact of image quality and diagnostic confidence, on percentage concordance - mixed dermatology population

Study ID	N	TD type	Comparator	Impact on concordance	Significance
Image quality					
Baba 2005*	242 lesions	SAF	FTF_histo	Score = 1: 66%	P<0.001
				Score ≥ 2: 78%	
	242 lesions	SAF_LI	FTF_histo	Score = 1: 87%	P<0.001
				Score ≥ 2: 92%	
Faucon 2022	298 patients	SAF	FTF	Good quality pictures significantly higher for patients with an accurate diagnosis compared to wrong diagnosis: 95% vs 86%	OR: 2.95 95% CI: (1.15 to 7.60); p=0.03
McKoy 2004	52 patients	SAF	FTF	Adequate images: 72%	
Romero 2010	368 patients	SAF or LI	FTF	Poor: 69.5%	
				Good: 90.7%	
Diagnostic confidence					
Baba 2005†	242 lesions	SAF	FTF_histo	Score <3: 39%	p<0.001
				Score ≥3: 89%	
	242 lesions	SAF_LI	FTF_histo	Score <3: 61%	p<0.001
				Score ≥3: 93%	
McKoy 2004	52 patients	SAF	FTF	Moderate or high: 76%	
Romero 2010	368 patients	SAF	FTF	Low: 51.4%	
				High: 91.1%	

Key: CI – confidence interval; FTF – face-to-face; FTF_histo – face-to-face with histology; LI – live interactive; N – number of patients or lesions; SAF – store and forward; SAF_LI – store and forward with live interactive.

Footnotes: *Image quality judged on three-point scale from 1 (poor) to 3 (excellent). †Rated on a scale from 1 (unsure) to 5 (100% confident).

4.3.6.5 Inflammatory/infectious conditions population

Two studies reported diagnostic concordance for non-cancer populations; data are shown in Table 4.15.[365, 367] Teledermatology concordance ranged from 62% to 70% across the studies.

Table 4.15 Percentage concordance – inflammatory/infectious conditions population

Study author	Study arm	Comparator	N - patients	Concordance
Heffner 2009	SAF_MSC	FTF	135	70% (95% CI: 60% to 77%) Kappa: 0.65 (95% CI: 0.58 to 0.73)
Shalmon 2023	SAF	FTF_histo	95	TD1: 67% TD2: 57% Average: 62%

Key: CI – confidence interval; FTF – face-to-face; FTF_histo – face-to-face with or without histology; N – number of patients; SAF – store and forward; SAF_MSC – store and forward with macroscopic image; TD – teledermatologist.

4.3.6.6 TD ability to distinguish between benign and malignant lesions

Four studies, three in a suspected cancer (mixed) population[80, 304, 305] and one[331] in a mixed dermatology population, evaluated the ability of TD to distinguish between benign and malignant lesions. Due to differences in study design and comparators, the data could not be pooled in a meta-analysis. As shown in Table 4.16, when compared with histology, diagnostic concordance using SAF TD with dermatoscopic images ranged from 70% to 79%. When compared with FTF evaluation, concordance ranged from 78% to 91%. These findings suggest reasonably high agreement between TD and both reference standards in distinguishing lesion type, although variation across studies limits generalisability.

Table 4.16 Percentage concordance in distinguishing between benign and malignant lesions

Study ID	N - patients	Study arm	Comparator	Percentage concordant
Börve 2013	138	SAF_DSC	Histo	78
	69	FTF	Histo	87
	138	SAF_DSC	FTF	78
Jones 2021	114	SAF_DSC	Histo	70
Vestergaard 2020	584	SAF_DSC	Histo	79
	292	FTF	Histo	87
	1,200	SAF_DSC	FTF	83
Nami 2015	108	SAF	FTF	91

Key: FTF – face-to-face; Histo – histology; N – number of patients; SAF – store and forward; SAF_DSC – store and forward with dermatoscopy; TD – teledermatology.

4.3.7 Diagnostic reliability

This section reports on the diagnostic reliability of TD compared with traditional FTF evaluations utilising kappa coefficients. Diagnostic reliability in this context refers to the degree of consistency between TD and FTF evaluation. The kappa coefficient, which measures agreement beyond chance, is distinct from simple proportion agreement; high kappa values require high observed agreement between raters.

Kappa can be interpreted using the ranges suggested by McHugh 2012: values ≤0 to 20 indicate no agreement, 0.21 to 0.39 indicate minimal agreement, 0.40 to 0.59 weak agreement, 0.60 to 0.79 moderate agreement, 0.80 to 0.90 strong agreement, and above 0.90 almost perfect agreement.[374] A limitation of kappa coefficients is its sensitivity to the prevalence of the condition being assessed; a low prevalence can underestimate or overestimate the level of agreement. Pooling of kappa coefficients provides more robust results when studies are homogenous. The studies included in this analysis are heterogeneous in terms of study design, prevalence of the conditions being assessed, and the method of TD used. Therefore, while the data provides an indication of the overall reliability of TD compared with FTF evaluation, it does not support the ability to make definitive conclusions on the differences between TD modalities.

4.3.7.1 Suspected NMSC population

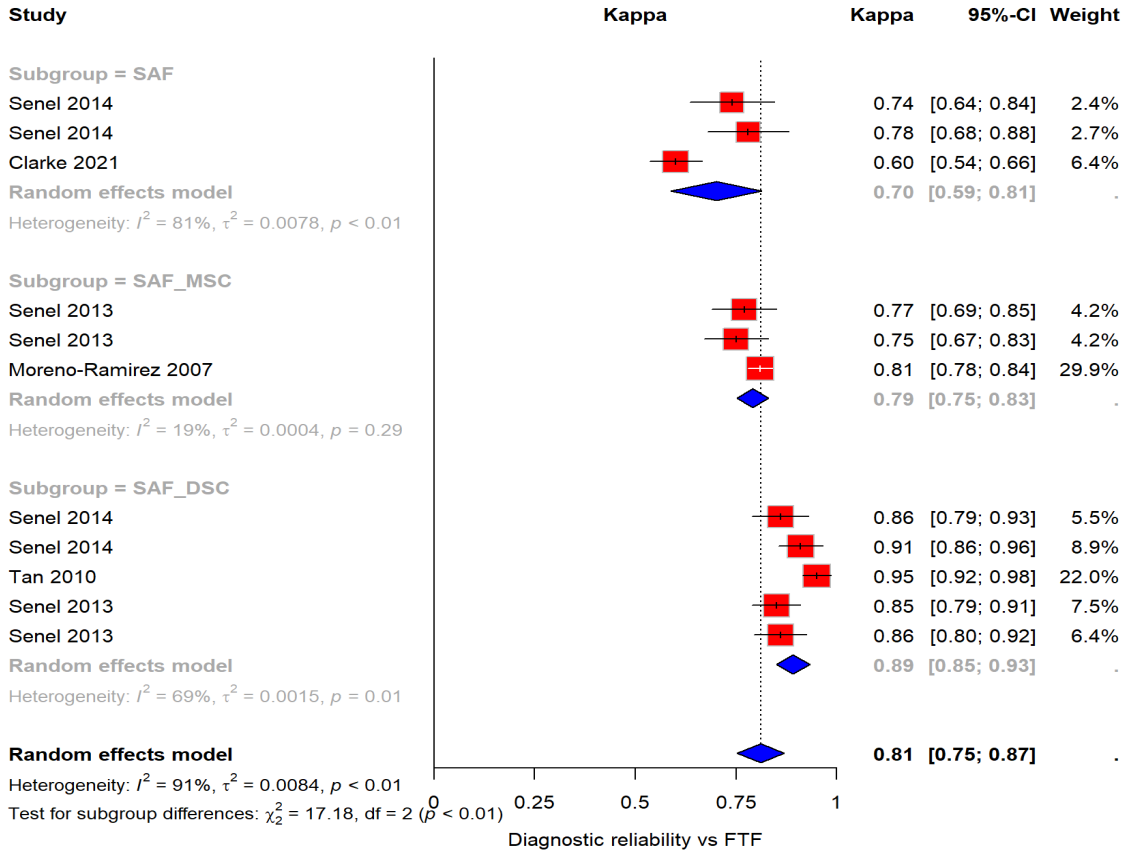
One study[310] assessed the reliability of SAF TD with macroscopic images compared with FTF evaluation. The study reported a kappa coefficient of 0.86 (95% CI: 0.83 to 0.89), indicating strong agreement between the two methods.

4.3.7.2 Suspected cancer (mixed) population

Five studies reported reliability data which could be included in the meta-analysis (Figure 4.12).[254, 282, 300, 314, 315] Two of the studies compared different types of TD with FTF consultation; one compared SAF and SAF with macroscopic images with FTF consultation and the other compared SAF and SAF with dermatoscopy with FTF consultation. Both of these studies also included more than one teledermatologist.[282, 300] Overall, TD and FTF evaluations demonstrated strong agreement with a pooled kappa coefficient of 0.81 (95% CI: 0.75 to 0.87) suggesting that TD achieved a high level of consistency with FTF evaluations. Studies using SAF alone or SAF with macroscopic images (n=4) reported kappa values from 0.60 to 0.81,[282, 300, 310, 314] while those incorporating dermatoscopy (n=3) yielded higher kappa values ranging from 0.85 to 0.95.[282, 300, 315] Among the two studies with multiple teledermatologists, results remained consistent.[282, 300]

Three studies[80, 255, 295] did not report confidence intervals alongside the kappa estimate and so it was not possible to include them in the meta-analysis. In these studies, kappa for TD with dermatoscopic images compared with FTF evaluation was 0.48 (weak agreement) in one study,[80] 0.55 to 0.73 (moderate agreement) in the second[295], and 0.84 (strong agreement) in the third.[255]

Figure 4.12 Diagnostic reliability – suspected cancer (mixed) population



Key: FTF – face-to-face; SAF – store and forward; SAF_DSC – store and forward with dermatoscopy; TD – teledermatology.

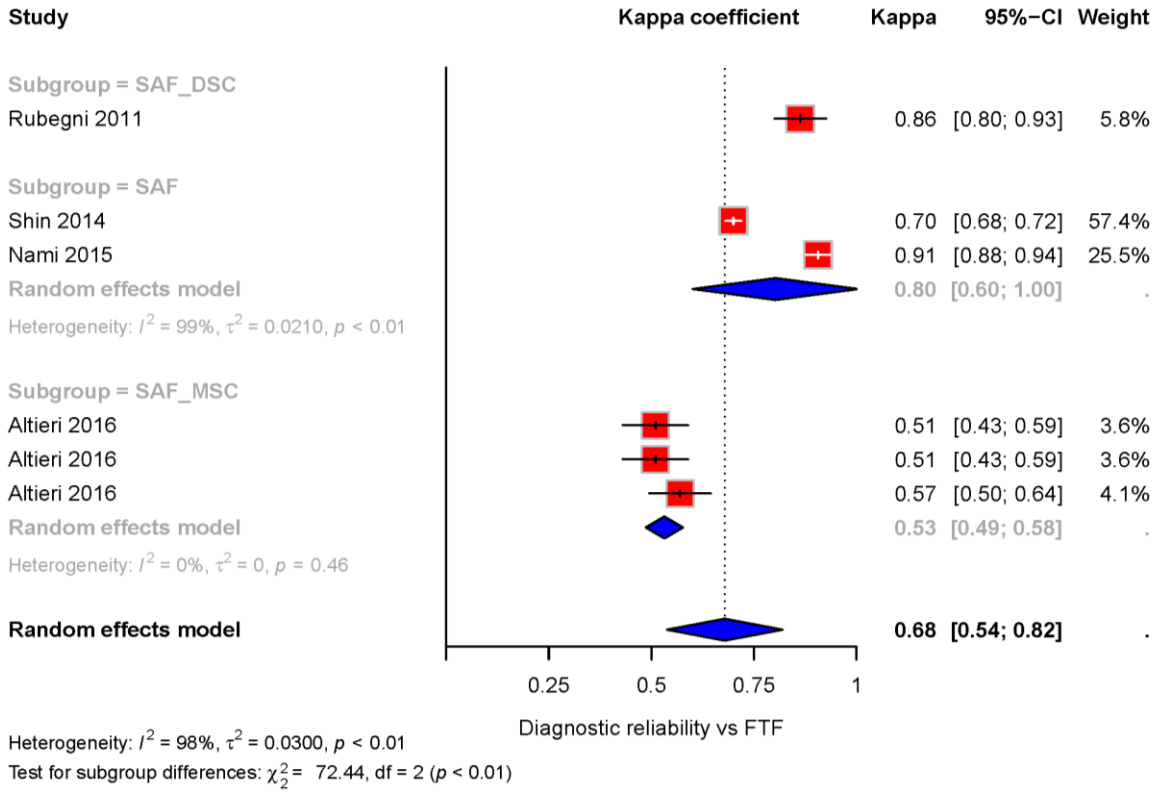
Note: Where studies are reported twice, these refer to the individual teledermatologist result.

4.3.7.3 Mixed dermatology population

Four studies reported diagnostic reliability in a mixed population (Figure 4.13).[28, 331, 335, 345] One study used SAF with dermatoscopy,[345] one used SAF with macroscopic images,[28] and two used standard SAF methods.[331, 335] The pooled kappa of 0.68 (95% CI: 0.54 to 0.82) indicates moderate agreement between TD and FTF evaluations. Studies utilising SAF without dermatoscopy showed kappa values ranging widely from 0.51 to 0.91 showing variability across studies. Some of the variation across studies may be due to study design differences. For example, Shin 2014 only computed kappa coefficients for the top three commonly diagnosed conditions in the study which reduced the sample size to 48 and may not provide a true reflection of TD reliability across a broad range of conditions. Altieri 2016, which reported low kappa coefficients attributed the scores to the limitations of the digital camera used, which lacked the advanced optics available in other TD studies. This equipment difference may have impacted image quality and, consequently, diagnostic reliability. In contrast, the study which used dermatoscopy, reported a kappa of 0.86 (95% CI: 0.80 to 0.93). These factors illustrate the challenges with comparing results across studies and underscores the importance of interpreting the results with caution.

Two studies reported kappa coefficients without accompanying confidence intervals. In one study[232] using SAF with LI TD, the kappa was 0.81. In another study[328] using standard SAF TD, the kappa was 0.92.

Figure 4.13 Diagnostic reliability – mixed dermatology population



Key: FTF – face-to-face; SAF – store and forward; SAF_DSC – store and forward with dermatoscopy; TD – teledermatology.
Note: Where studies are reported more than once refers to the individual teledermatologist result.

4.3.7.4 Inflammatory/infectious conditions population

One study provided data for diagnostic reliability in a non-cancer population.[367] Data are included in Table 4.15. The kappa coefficient was 0.65 (95% CI: 0.58 to 0.73) indicating moderate reliability between SAF using macroscopic images and FTF consultation in the study.

4.3.8 Management concordance

The following section examines management concordance and reliability of TD compared with traditional FTF evaluation. Management concordance refers to the percentage agreement between TD and traditional FTF evaluations in determining appropriate management plans, such as treatments, diagnostic testing, and follow-up recommendations. Management reliability assesses agreement between the teledermatologist and FTF evaluation beyond chance.

4.3.8.1 Suspected melanoma population

One study[268] (Table 4.17) reported management concordance and reliability between TD and FTF evaluation within a suspected melanoma population. The study[268] which evaluated 465 pigmented skin lesions reported percentage concordance of 88.5% (kappa=0.55) between standard SAF TD and FTF for identifying lesions that require additional dermatoscopic examination. When dermatoscopic images were included, concordance for the final management decision improved to 95.9% (kappa=0.69). The study highlights the added value of dermatoscopic imaging for suspected melanoma lesions. However, as this is the only study evaluating management concordance in this population, generalisability is limited.

Table 4.17 Management concordance – suspected melanoma population

Study author	Study arm	N	Definition	Results
diStefani 2007	SAF	465 lesions	Concordance in selection of additional lesions for dermatoscopic examination.	TD1: 87.3% (K= 0.53) TD2: 89.7% (K= 0.565) Combined TD: 88.5% (K= 0.5475)
	SAF_DSC	465 lesions	Concordance in final management recommendation. The options for management recommendation were: "annual clinic dermatoscopic follow-up", "short-term dermatoscopic follow-up" (in 3- or 6-month interval), or "surgical excision".	TD1: 95.9% (K= 0.681) TD2: 95.9% (K= 0.703) Combined TD: 95.9% (K= 0.692)

Key: FTF - face-to-face; K – kappa coefficient; NR – not reported; SAF_DSC_MSC - store and forward with macro image and dermatoscopy; TD – teledermatologist.

4.1.1.1 Suspected NMSC population

One study[310] assessed the agreement between the surgical technique recommendations made by SAF TD with macroscopic images and the final surgical techniques performed. The study reported a kappa coefficient of 0.75 (95% CI: 0.71 to 0.79), indicating moderate agreement between the two recommendations.

Table 4.18 Management concordance – suspected NMSC population

Study author	Study arm	N	Definition	Results	Significance	Notes
Ferrandiz 2007	SAF_MSC	134 patients	Agreement on planned surgical technique recommended by TD and technique finally performed.	Kappa: 0.75 (95% CI: 0.71 to 0.79)	NR	

Key: CI – confidence interval; NR – not reported; SAF_MSC - store and forward with macro image; TD – teledermatologist

4.1.1.2 Suspected cancer (mixed) population

Ten studies reported management concordance or reliability between TD and FTF evaluation or recommended management guidelines within a suspected cancer population.[80, 254, 255, 284, 287, 300, 303, 304, 310, 316] Three studies presented on management reliability using kappa coefficients,[255, 284, 300] four used percentage concordance,[80, 287, 288, 316] two reported both,[254, 303] and one study used Gwet's coefficient.[304] In all studies, the teledermatologist was requested to document their proposed management plan, chosen from a list of pre-defined categories, which was compared with the FTF recommended plan. There were variations among the studies regarding whether FTF consultations were restricted to the same categories. Moreover, these categories differed across studies and therefore pooling of results was not possible. Data are presented in Table 4.19.

In studies reporting on management reliability, the kappa coefficient ranged from 0.51 to 0.76 using standard SAF methods, and up to 0.87 with the addition of dermatoscopy. One study demonstrated that reliability between the TD management decisions increased significantly with the use of dermatoscopy.[300] Another study using SAF TD with macroscopic and dermatoscopic images reported minimal agreement between TD and FTF evaluation (kappa= 0.19 to 0.29). However, when assessment was limited to good quality images only, reliability improved (kappa= 0.34 to 0.47).[255] The study generally reported much lower management reliability data compared with other studies and noted that the analysis may have been limited by incomplete FTF follow-up in 30% of participants who did not attend the assessment, potentially because their complaints had ceased or were adequately

reassured through TD; this increased the risk of bias and potentially underestimated overall management accuracy. In the study using Gwet's coefficient, agreement was considered 'fair' between the teledermatologist and FTF dermatologist.[304] For studies reporting percentage concordance between TD and FTF or recommended guidelines, values ranged from 55% up to 100%. Three studies demonstrated percentage concordance greater than 85%; in one, the teledermatologists were not fully blinded to the FTF dermatologists' management decision which could account for the nearly perfect concordance (98.6% to 100.0%),[80] while in the others, the management decision was limited to a decision that the patient required surgery or not (87.5% to 94.4% across four teledermatologists),[303] and the need for a skin biopsy (100% concordance).[288]

Overall, the studies suggest that TD, especially when supported by dermatoscopy, is comparable to FTF evaluation for management decisions. However, it is important to note that variability exists and higher concordance is seen in studies with focused management categories compared with those with broader categories.

Table 4.19 Management concordance – suspected cancer (mixed) population

Study author	Study arm	N	Definition	Results	Significance	Notes
Börve 2013	SAF_DSC	62 patients	Management decision (excision, biopsy, follow-up digital DSC, no treatment). Adequate decisions defined as: ▪ Malignant melanocytic lesions: excise ▪ Malignant non-melanocytic lesions: biopsy or excision ▪ Benign lesions: any alternative.	TD1: Adequate management decisions in 68 cases (98.6%) TD2: 100%	NR	TDs not fully blinded from FTF dermatologist management decision as they knew that all lesions were going to be either biopsied or excised, but they still elected follow-up with digital dermatoscopy or no treatment for some cases.
Clarke 2021	SAF	308 lesions	Decision to biopsy.	82.5% (Kappa= 0.51 (0.39-0.63)	NR	
	SAF	253 lesions	Decision to biopsy excluding lesions identified as melanocytic in FTF.	Kappa: 0.54 (95% CI: 0.42–0.67)	NR	
Felmingham 2023	SAF	403 lesions	▪ Leave: Reassure patient and take no further action. ▪ Manage – monitor: Reassessment of lesion at later time point according to Australian Guidelines. ▪ Manage – biopsy: Partial or complete biopsy of the	Kappa: 0.69 (95% CI: 0.61 to 0.76)	NR	Resident management decision (TD) compared with the treating dermatologist decision.

Study author	Study arm	N	Definition	Results	Significance	Notes
			lesion required to confirm diagnosis. ▪ Treat – elective: Benign or pre-cancerous lesion where treatment ▪ is not essential. ▪ Treat – essential: Malignancy requiring non-surgical intervention.			
Mahendran 2005	SAF	163 patients	Hypothetical management plan	Overall appropriate management plan: 55% Action proposed using TD and its concordance compared with FTF: **Reassured: 13%** ▪ Correct 13% ▪ Incorrect 0% **Booked direct for minor operation: 43%** ▪ Correct 33% – excision 21% – biopsy 5% – curettage 5% – cryotherapy 2% ▪ Incorrect 10% **No action at present but requires further review appointment: 9%** ▪ Correct 9% Incorrect 0%	NR	

Study author	Study arm	N	Definition	Results	Significance	Notes
Senel 2014	SAF	120 patients	Reliability (kappa) of management plans. If same, accepted as agreement. Three major management plans could be chosen: ▪ Lesion destruction (excision of the lesion, cryotherapy or electro-cauterisation); ▪ Medical therapy (antibacterial, antiviral or anti-fungal treatment); ▪ Follow-up.	TD1: 0.69 (0.58–0.80) TD2: 0.76 (0.66–0.87)	P<0.001	Reliability of TD management plans did not statistically differ from FTF examination. Reliability significantly increased with addition of DSC.
	SAF_DSC	120 patients		TD1: 0.74 (0.64–0.84) TD2: 0.83 (0.74–0.92)	P<0.001	
Shapiro 2004	SAF	49 patients	Decision to perform a biopsy.	100% agreement regarding need for skin biopsy.	NR	
van der Heijden 2013	SAF_MSC_DSC	76 lesions	Agreement between teledermatoscopy management plan and FTF management.	Kappa: 0.19-0.29	NR	
	SAF_MSC_DSC	27 lesions		Kappa: 0.34-0.47	NR	Good quality images only.
Veronese 2022	SAF_DSC	144 lesions	Surgical removal (yes/no).	TD1: 87.5% (K = 0.69 (0.56–0.82)) TD2: 90.3% (K= 0.79 (0.69–0.89)) TD3: 86.8% (K= 0.67 (0.54–0.80)) TD4: 94.4% (K= 0.87 (0.79–0.96))	NR	
Vestergaard 2020	SAF_DSC	519 patients	▪ Return to GP	TD1: 0.37 TD2: 0.36	NR	Gwet's coefficient: 0.81-1 – almost perfect 0.61-0.8 – substantial

Study author	Study arm	N	Definition	Results	Significance	Notes
			▪ Clinical follow-up/ sequential digital dermatoscopy ▪ Biopsy ▪ Excision ▪ Cryotherapy/topical ▪ Other			0.41-0.60 – moderate 0.21-0.40 – fair 0.00-0.2 – slight <0 – poor
Warshaw 2009	SAF_MSC	728 lesions	Appropriate management of non-pigmented lesions: ▪ Remove/biopsy/destroy ▪ Observe/ reassure ▪ Antifungal treatment ▪ Antibiotic treatment ▪ Anti-inflammatory treatment.	78.79%	Difference (SE), 95% CI: -4.68 (1.25), -7.13 to -2.23*	
	FTF_DSC			83.47%		
	SAF_MSC_DSC	716 lesions		79.83%	Difference (SE), 95% CI: : -3.78 (1.21), -6.14 to -1.42*	
	FTF_DSC			83.61%		
	SAF_MSC	542 lesions	Appropriate management of pigmented biopsied index lesions: ▪ Remove/biopsy/destroy ▪ Observe/ reassure ▪ Antifungal treatment ▪ Antibiotic treatment ▪ Anti-inflammatory treatment.	70.5%	Difference (SE), 95% CI: 4.80 (2.09), 0.69 to 8.90*	
	FTF_DSC			65.7%		
	SAF_DSC_MSC	541 lesions		70.1%	Difference (SE), 95% CI: 4.44 (1.98), 0.55 to 8.32*	Polarised light dermatoscopy.
	FTF_DSC			65.6%		
	SAF_DSC_MSC	494 lesions		73.9%	Difference (SE), 95% CI: 7.89 (2.12), 3.74 to 12.05*	Contact immersion dermatoscopy.
	FTF_DSC			66%		

Key: CI – confidence interval; FTF - face-to-face; K – kappa coefficient; NR – not reported; SAF – store and forward; SAF_DSC - store and forward with dermatoscopy; SAF_DSC_MSC - store and forward with macro image and dermatoscopy; SE – standard error; TD – teledermatologist.
Footnote: * TD statistically significantly worse than clinical dermatology (if CI lies below zero); equivalent, CI lies wholly within +/- 10%.

4.1.1.3 Mixed dermatology population

Eleven studies reported on percentage concordance and two reported on both percentage concordance and agreement (kappa coefficient) between TD and FTF evaluation within a mixed population.[28, 290, 320-322, 342, 345, 346, 356, 359, 375] There was substantial variation between the studies in terms of how management decisions were assessed and so data are summarised in Table 4.20.

The percentage concordance between TD and FTF evaluation for overall management plans ranged from 55%[290] to 81%[321] with variation across management categories. In one study with high overall management concordance (81%), agreement between TD and FTF evaluation was moderate on specific actions such as skin biopsies (kappa: 0.60) and weak for infection samples (kappa: 0.55). One RCT compared the TD management and FTF evaluation to a second FTF evaluation. Concordance was statistically significantly higher in the FTF arm than the TD arm when compared against management decisions at the second FTF evaluation (84% versus 55%, $p<0.0001$).[290] One study reported some alignment across different recommendation categories, with 68.3% concordance for medical therapy, 59.3% for diagnostic testing, and 79.5% for clinic-based therapies.[28] One study considered also the addition of dermatoscopic images to traditional SAF noting that its use led to significantly improved management concordance, particularly for non-neoplastic lesions, but that it did not lead to significant changes in management for benign or malignant neoplastic lesions.

Overall, when considering specific management decisions (for example, surgery, biopsy, medical therapy, diagnostic testing), reported levels of concordance varied, although typically concordance levels were higher for surgery and biopsy-related decisions.

Table 4.20 Management concordance – mixed dermatology population

Study author	Study arm	N	Definition	Results	Significance
Altieri 2016	SAF	232 patients	Identical medical therapy recommendations, diagnostic testing recommendations, and clinic based therapy recommendations given by a FTF dermatologist and two TDs.	**Concordance:** Medical treatment: 68.3% Diagnostic testing: 59.3% Clinic-based therapy: 79.5%	NR
Bowns 2006a*	SAF	92 patients	Concordance of the clinical management decision (management equivalence). Management decisions were compared with a second FTF evaluation with an independent dermatologist.	**Concordance:** 55% of cases	**Null hypothesis:** management in SAF and FTF groups were not equivalent (FTF would result in superior clinical treatment and management **Difference:** -28%, 95% CI: –40 to–14%; p = 0.0001 Lower bound of CI is outside of clinical equivalence range (0 to -10%), cannot reject null hypothesis
	FTF	73 patients		**Concordance:** 84% of cases	
Ebner 2008	SAF	58 patients	Management groups defined in FTF consultation: 1. **FTF-standard** (diagnosed and treated in FTF consultation: 83% 2. **FTF-admission** (immediately admitted to dermatology unit): 10%	**Concordance:** Teledermatologist 1: **FTF- standard:** 65% telediagnosed; 29% recommended to FTF; 4% immediate admission to dermatology unit. **FTF-admission:** 100% concordance **FTF-surgery:** 100% concordance Teledermatologist 2:	NR

Study author	Study arm	N	Definition	Results	Significance
			3. **FTF-surgery** (return for surgery): 7%	**FTF- standard:** 71% telediagnosed; 21% recommended to FTF; 8% immediate admission to dermatology unit. **FTF-admission:** 100% concordance **FTF-surgery:** 100% concordance	
Faucon 2022	SAF	298 patients	Prescription of similar treatment by TD and FTF	**Concordance:** 81% **Agreement between TD and FTF regarding prescription of:** Skin biopsy – K: 0.60 (0.49–0.71) Infection sample – K: 0.55 (0.39–0.72) Blood sample – K: 0.34 (0.17–0.51)	NR
Gatica 2015	SAF	125 patients	1. Treatment concordance 2. Diagnosis and treatment concordance 3. Specialist referral or patient management concordance	**Concordance:** 1. 75.2% 2. 71.2% 3. 73.6%	NR
Rogers 2022	SAF vs SAF_DSC	26 participants	Recommended therapeutic management.	Significantly more providers opted to provide reassurance (14/26) rather than interventions (0/26) for non-neoplastic lesions following the addition of dermatoscopic images. The addition of dermatoscopy did not lead to significant changes in management for benign or malignant neoplastic lesions.	P < 0.0001

Study author	Study arm	N	Definition	Results	Significance
Romero 2010	SAF	170 patients	1. Recommended diagnostic tests, including biopsy, microbiology, analytical and other tests concordance. 2. Recommended treatment concordance.	**Concordance:** 1. Request for diagnostic test: 95.9% 2. Treatment: 85.3%	No significant difference between LI and SAF (p=0.27)
	SAF_LI	158 patients		**Concordance:** 1. Request for diagnostic test: 90.5% 2. Treatment: 78.5%	
Romero Aguilera 2014 (linked to Romero 2010)	SAF	170 patients		**Concordance:** Treatment: 69.4% (95% CI: 74.1-81.4)	NR
Rubegni 2011	SAF_DSC	130 patients	**Concordance of therapy categories:** ▪ Systemic ▪ Local ▪ Surgical **Agreement of whether any therapy was prescribed**: Yes/no	**Concordance:** Systemic: 15/30 (50%); K= 0.40 (95% CI: 0.19–0.61) Local: 33/ 47 (70.2%); K= 0.59 (95% CI: 0.42–0.77) Surgical: 44/51 (86.3%); K=0.70 (95% CI: 0.49-0.91) All: 72/102 (69.6%); K=0.64 (95%CI: 0.54-0.75) **Agreement:** Yes/no: 128/130 (98.5%); K=0.96 (0.89-1.00)	NR
Zink 2017a	SAF_DSC	26 patients	Suggested therapy	**Concordance in treatment recommendations:** 76.9%	NR
Zink 2017b	SAF	195 patients	Therapeutic recommendations	Recommendations provided by TD in 89.3% of patients and 86.4% for FTF. **Concordance:** 60.4%	NR

Key: CI – confidence interval; FTF - face-to-face; K – kappa coefficient; NR – not reported; SAF – store and forward; SAF_DSC - store and forward with dermatoscopy; SAF_DSC_MSC - store and forward with macro image and dermatoscopy; SE – standard error; TD – teledermatologist.
Footnote: *Compared against second opinion FTF evaluation.

4.4 Teledermatology safety

Assessing safety in TD studies presents unique challenges. The design of TD studies, typically observational or retrospective, may not fully capture all safety-related outcomes due to inherent limitations. For example, study settings often lack the dynamic feedback loop present in routine care. Additionally, safety endpoints such as incidental lesion detection and long-term patient outcomes are difficult to track comprehensively, as TD evaluations are generally episodic and may not include longitudinal follow-up. This limitation means that while studies can provide insight into immediate diagnostic and management concordance, they may not fully account for delayed diagnoses or missed lesions that could emerge outside the study's scope.

Despite the limitations in assessing TD safety, the following sections report various outcomes explored by the studies, including incidental detection rates of malignant lesions, misdiagnosis frequencies, missed diagnoses, and the clinical impact of incorrect diagnoses (where reported). The terminology used in these sections reflect those of the studies and may not reflect the function of a TD-supported referral management system.

4.4.1 Suspected melanoma population

Safety outcomes were reported in three studies[269, 273, 278] that included patients referred with suspected melanoma, encompassing misdiagnosis rates, and overdiagnosis. Details are shown in Table 4.21. Misdiagnosis was reported in three studies. In one study[273] of 37 histologically-confirmed melanomas, 13 (35%) were misdiagnosed, most commonly as benign melanocytic lesions, BCC, or Bowen's disease. The study also found that 8 of 10 amelanotic melanomas were misclassified using standard images compared with 6 out of 10 using dermatoscopic images. Similarly, another study (n= 18 patients)[278] reported one melanoma that was underdiagnosed as seborrheic keratosis and three cases of overdiagnosis where benign or non-malignant lesions were classified as melanoma. The third study[269] found that the proportion of clinically misdiagnosed atypical melanocytic lesions later confirmed as melanoma or severe dysplastic naevi was higher in the FTF group (25%) than in the TD assessed group (18%), though this difference was not statistically significant, suggesting comparability between the two groups.

Collectively, these data suggest that while TD can provide a diagnostic safety profile comparable to in-person assessments for a suspected melanoma population, especially when dermatoscopic images are included, there remains a risk of both overdiagnosis and underdiagnoses. There is a potential for missed melanomas, particularly in amelanotic or atypical cases.

Table 4.21 TD safety outcomes - suspected melanoma population

Study ID	Study arm	N	Safety outcome assessed	Key safety points
Fazil Jaber 2023	SAF_DSC	TD: 112 FTF: 138 patients	▪ Misdiagnosis	▪ Proportion of clinically misdiagnosed AML, in which histopathology showed malignant melanoma or severe dysplastic naevi, was higher in the FTF group (25%) than the TD group (18%). – However, the difference was not statistically significant (Chi-square test, p= 1.19; Fisher test, p= 0.24).
Massone 2007	SAF	18 patients	▪ Misdiagnosis ▪ Overdiagnosis	▪ Two dysplastic nevi were overdiagnosed as melanomas. ▪ A dermatofibroma was diagnosed as dysplastic naevi. ▪ A melanoma was underdiagnosed as seborrheic keratosis.
	SAF_DSC	18 patients		▪ A dysplastic nevus and congenital nevus was overdiagnosed as melanomas.
Pizzichetta 2004	SAF	151 lesions	▪ Misdiagnosis	▪ Of 37 melanomas, 13 were misdiagnosed as benign melanocytic lesions (8), BCC (4), and Bowen's disease (1). – Sensitivity and specificity of melanoma diagnosis were 65% and 88% respectively compared with 89% and 96% when using dermatoscopic images. ▪ Of 10 'true' amelanotic melanomas, 8 were misdiagnosed as benign melanocytic lesions (5) or BCC (3).
	SAF_DSC			▪ Of 10 'true' amelanotic melanomas, 6 were misdiagnosed as benign melanocytic lesions (4) or BCC (2).

Key: BCC – basal cell carcinoma; FTF - face-to-face; SAF – store and forward; PSL – pigmented skin lesions; SAF_DSC - store and forward with dermatoscopy; TD – teledermatologist.

4.4.2 Suspected cancer (mixed) population

In total, fourteen studies reported safety information for TD in a suspected cancer population, full details are presented in Table 4.22.[254, 287, 289, 291, 292, 295, 303-305, 313, 315, 316, 318, 376] Four studies reported on incidental detection rates.[291, 304, 305, 314] Moreno-Ramirez 2007 reported detection rates (defined as the number of lesion types diagnosed among patients seen at FTF after TD triage) for melanoma and NMSC of 2.0% and 13.7%, respectively. Another study performed total body skin examinations at all subsequent FTF consultations and found that 15.1% of TD-evaluated patients presented incidental melanomas. However, most of the patients with incidental malignancies had a photographed lesion that raised suspicions during the TD evaluation and prompted referral for a FTF consultation. Nine studies reported various details relating to misdiagnosis, over-diagnosis, under-diagnosis, or mismanagement and the associated clinical impact.[80, 287, 289, 292, 295, 303, 304, 315, 316] Kroemer 2011 noted that 25% of lesions were misdiagnosed by TD, though no malignant melanocytic tumours were overlooked, and TD occasionally overdiagnosed benign lesions as malignant.[295] Börve 2013 also documented a case where a benign nevus was misinterpreted as melanoma *in situ*, illustrating occasional risks in TD assessments.[80] Veronese 2022 reported serious diagnostic errors ranged between 9% and 27% across four teledermatologists, where malignant lesions were classified as benign, impacting surgical planning.[303] One study[254] assessed 'true misdiagnoses', defined as the teledermatologist not recommending a biopsy or not including skin cancer in their differential diagnosis. Of 308 lesions assessed, one BCC and one SCC in situ with unusual clinical features were missed by TD. Two studies compared safety outcomes between TD and FTF evaluation.[315, 316] Warshaw 2009 quantified the clinical significance of mismanaged non-pigmented lesions; the rate of moderate or major management errors was significantly higher with standard SAF TD than FTF evaluation (3.9% vs 1.1%; $p<0.001$). However when considering major errors only, these were rare, with no significant difference between the arms (0.6% vs 0.1%; $p=0.18$). Adding dermatoscopic images for TD review led to a reduction in the rate of moderate/major errors, but this rate was still higher compared with FTF evaluation (3.2% vs 1.1%; $p=0.0027$), with no significant difference between the arms in terms of the rate of major errors (0.7% vs 0.1%; $p=0.10$). When assessing pigmented lesions, FTF evaluation led to two major instances of inappropriate management out of 542 lesions assessed (one melanoma, one SCC), while SAF with macroscopic images resulted in 12 such cases (seven melanoma, five SCC). When dermatoscopic images were added, there were 15 major management errors out of 1,035 lesions (nine melanoma, eight SCC) with TD, while four such errors (two melanoma, two SCC) were documented with FTF using dermatoscopy.[316] Tan 2010 also compared TD to FTF, finding 12 out of 491 lesions initially considered benign by TD, but later diagnosed as malignant during FTF evaluation.[315] However, based on

histology only one of these cases (a basal cell carcinoma) was confirmed to be malignant, indicating a high specificity for TD, but also occasional false negatives.[315] One study compared the risk of biopsy and cancer diagnosis among different TD and FTF workflows. Four TD systems (Stentor, Cortext, Haiku, and a patient portal)[2] were used in the study as well as a direct referral workflow to a FTF dermatology consultation. The study found that the workflow utilising dermatoscopy was associated with a 9% greater probability of cancer detection, and a 4% lower probability of biopsy compared with the direct referral workflow.

[2]Stentor = SAF_DSC; Cortext and Haiku = SAF_MSC

Table 4.22 TD safety outcomes – suspected cancer (mixed) population

Study ID	Study arm	N	Safety outcome assessed	Key safety points
Börve 2013	SAF_DSC	62 patients	▪ Misdiagnosis leading to incorrect management	▪ One case, a patient would have received 'no treatment' for melanoma in situ given a primary diagnosis of benign nevus.
Börve 2015	SAF_DSC	816 lesions	▪ Misdiagnosis (benign vs malignant vs unclear)	▪ Of 346 lesions assessed as benign without a differential diagnosis by TD, 343 had a final clinical of histopathological diagnosis as benign. In a real-world setting, if TD chose not to call those patients for FTF consultation, 3 actinic keratosis lesions would have been missed. ▪ TD assessed 196 (24%) of the 816 lesions as malignant without any differential diagnosis. In 146 (74%), the final clinical or histopathological diagnosis was also malignant.
Creighton-Smith 2017	SAF_DSC	434 patients	▪ Skin cancer detection rate	▪ Unadjusted skin cancer detection rate: 5.8% SAF_DSC vs 9.5% FTF (P<0.05). ▪ When adjusted for effects of age, prior skin cancer history, family history of skin cancer, and history of immunosuppression, observed difference is statistically insignificant (adjusted p=0.3). ▪ No significant difference between detection rate of melanoma or keratinocytic carcinoma.
	FTF	587 patients		
Clarke 2021	SAF	308 lesions	▪ 'True misses' defined as the teledermatologist not recommending a biopsy or not including skin cancer in their differential diagnosis.	▪ Two true misses: a BCC and SCC in situ which had unusual clinical features.
de Giorgi 2016	SAF_DSC	10 lesions	▪ Overdiagnosis ▪ Underdiagnosis	▪ One atypical lentiginous nevus diagnosed as malignant melanoma by 7/10 TDs. ▪ One Spitz naevus diagnosed as malignant melanoma by 9/10 TDs. ▪ One compound melanocytic nevus with atypia diagnosed as malignant melanoma by 8/10 TDs. ▪ One melanoma in situ diagnosed as naevus by 9/10 TDs.

Study ID	Study arm	N	Safety outcome assessed	Key safety points
Jones 2021	SAF_DSC	156 patients	▪ Incidental lesions of concern identified at FTF appointment.	Mean number of incidental lesions of concern identified within each study cohort: ▪ SAF_DSC: 0.2 (8/11 were malignant on histology) ▪ SAF_imageclinic_DSC_pre: 0.2 (6/16 malignant on histology) ▪ SAF_imageclinic_DSC_post: 0.0.
Kroemer 2011	SAF or SAF_DSC	104 lesions	▪ Misdiagnoses ▪ Underdiagnoses ▪ Overdiagnosis	▪ 25% of lesions misdiagnosed during TD.* ▪ 3 lesions underdiagnosed by TD*: – SAF: Two actinic keratosis interpreted as seborrhoeic keratosis – SAF_DSC: One actinic keratosis interpreted as seborrhoeic keratosis; one BCC interpreted as solar lentigo. ▪ No malignant melanocytic skin tumours missed by TD.* ▪ Overdiagnosis of benign melanocytic skin tumours: – SAF: one as melanoma – SAF_DSC: one as melanoma in situ. ▪ Overdiagnosis of benign non-melanocytic skin tumours: – SAF: six as either BCC, SCC, actinic keratosis, lentigo maligna, melanoma. ▪ SAF: six as either BCC, SCC, actinic keratosis, lentigo maligna, melanoma.
	FTF			▪ 11% of lesions misdiagnosed during FTF examination.
Mahendran 2005	SAF	163 lesions	▪ Misdiagnosis ▪ Incorrectly managed cases	▪ Misdiagnosis: 20% of cases either incorrect or diagnosis could not be made ▪ Incorrect management: 10% of cases would have been inappropriately booked directly for surgery from TD: – wrong diagnosis thus wrong procedure: 5% – excision not required: 4% ▪ complex surgery required: 1%.
Marwaha 2019	SAF_MSC_DSC*	59,279 patients	▪ RR of detecting cancer	**RR of detecting cancer compared with direct referral workflow:** ▪ SAF_DSC: RR – 1.09 (95%CI: 1.02 to 1.16)

Study ID	Study arm	N	Safety outcome assessed	Key safety points
			▪ RR of referring for biopsy	▪ SAF_MSC: RR – 0.83 (95%CI: 0.48 to 1.42); RR – 0.73 (95%CI: 0.33 to 1.75) ▪ SAF: RR – 0.75 (95%CI: 0.60 to 0.93); RR – 0.92 (95%CI: 0.75 to 1.13) ▪ Patient portal: RR – 0.70 (95%CI: 0.58 to 0.83). **RR referring for biopsy compared with direct referral workflow:** ▪ SAF_DSC: RR – 0.96 (95%CI: 0.93 to 0.99) ▪ SAF_MSC: RR – 0.71 (95%CI: 0.52 to 0.97); RR – 0.75 (95%CI: 0.51 to 1.11) ▪ SAF: RR – 0.79 (95%CI: 0.71 to 0.88); RR – 0.88 (95%CI: 0.80 to 0.98) ▪ Patient portal: RR – 0.69 (95%CI: 0.63 to 0.76).
Moreno-Ramirez 2007	SAF_MSC	2,009 patients	▪ Melanoma, non-melanoma, category 1 lesions (pre-malignant and malignant) pick-up/detection rate. *Definition: number of lesion types diagnosed among patients seen at FTF after TD triage.*	▪ Melanoma pick-up rate: 2.02% (95% CI, 1.10%-2.94%). ▪ NMSC pick-up rate: 13.56% (95% CI, 11.30%-15.82%). ▪ Category 1 lesions pick-up rate: 27.94% (95% CI, 24.98-30.90).
Tan 2010	SAF_DSC	200 patients	▪ Number of lesions missed by TD: A malignant lesion on FTF diagnosed as benign by TD or vice versa.	▪ 12/491 lesions considered benign by TD but diagnosed as malignant during FTF evaluations. However, based on histology, only one (a BCC) was found to be malignant. ▪ TD1 correctly diagnosed two benign naevi and one seborrhoeic keratosis (initially diagnosed as melanoma on FTF). ▪ TD 2 correctly distinguished benign from malignant lesions (two atypical naevi needing excision, three seborrhoeic keratoses and two benign naevi).

Study ID	Study arm	N	Safety outcome assessed	Key safety points	
Veronese 2022	SAF_DSC	144 lesions	▪ Serious diagnostic errors: the number of malignant lesions classified as benign which should be surgically removed but without correct diagnosis, only a follow-up visit was planned.	Absolute number and relative percentage of serious diagnostic errors: ▪ TD1: 8 (24.24%) ▪ TD2: 3 (9.09%) ▪ TD3: 9 (27.27%) ▪ TD4: 4 (12.12%). Note: percentage calculated on total number of malignant lesions in the study (6 melanomas + 27 BCCs = 33 total).	
Vestergaard 2020	SAF_DSC	600 lesions	▪ Misdiagnosis leading to mismanagement. ▪ Incidental suspicious findings.	▪ Considering management plans suggested by TD, 3 BCCs, 1 melanoma in situ and 1 malignant melanoma would have been returned to the GP by one of the two TDs. ▪ Another malignant melanoma would have been returned to the GP by both TDs. ▪ If TDs reported being "completely confident" in their suggested TD diagnoses, no malignant melanoma/melanoma in situ or invasive skin cancers were mismanaged. ▪ Incidental suspicious findings: – 15.1% of patients had an incidental malignant melanoma – 3.2% had one or more biopsy proven incidental BCCs – No incidental SCCs found – Most incidental malignancies had a photographed lesion that raised suspicion with the TD, prompting FTF consultation – Three and four patients respectively, with one or more incidental BCCs/actinic keratosis, would have been returned to GP on TD 1 and TD 2 evaluation.	
Warshaw 2009	SAF_MSC	726 lesions	▪ Clinical significance of inappropriate management plans	▪ Minor: 126 ▪ Moderate: 24 ▪ Major: 4	▪ TD vs FTF (none/minor vs moderate/major): 3.9% vs 1.1%; p<0.001

Study ID	Study arm	N	Safety outcome assessed	Key safety points	
(non-pigmented lesions)	FTF	726 lesions	compared with gold standard management: – Minor (non-life-threatening; no delay in treatment – Moderate (non-life-threatening; possible delay in treatment) – Major (potentially life-threatening)	▪ Minor: 112 ▪ Moderate: 7 ▪ Major: 1	▪ TD vs FTF (none/minor/ moderate vs major): 0.6% vs 0.1%; p=0.18
	SAF_MSC_DSC	714 lesions		▪ Minor: 121 ▪ Moderate: 18 ▪ Major: 5	▪ TD vs FTF (none/minor vs moderate/major): 3.2% vs 1.1%; p=0.0027 ▪ TD vs FTF (none/minor/ moderate vs major): 0.7% vs 0.1%; p=0.1025
	FTF_DSC	714 lesions		▪ Minor: 109 ▪ Moderate: 7 ▪ Major: 1	
Warshaw 2009 (pigmented lesions)	SAF_MSC	542 lesions		▪ Minor: 137 ▪ Moderate: 11 ▪ Major: 7 MM; 5 SCC	
	FTF	542 lesions		▪ Minor: 177 ▪ Moderate: 7 ▪ Major: 1 MM; 1 SCC	
	SAF_MSC_DSC	1,035 lesions		▪ Minor: 250 ▪ Moderate: 24 ▪ Major: 9 MM; 8 SCC	
	FTF_DSC	1,035 lesions		▪ Minor: 338 ▪ Moderate: 12 ▪ Major: 2 MM; 2 SCC	

Key: BCC – basal cell carcinoma; CI – confidence interval; FTF - face-to-face; GP – general practitioner; NMSC – non-melanoma skin cancer; NR – not reported; SAF – store and forward; SAF_DSC - store and forward with dermatoscopy; SAF_DSC_MSC - store and forward with macro image and dermatoscopy; SAF_imageclinic – imaging conducted at image clinic; SCC – squamous cell carcinoma; SE – standard error; TD – teledermatologist.
Footnote: *Includes SAF, SAF_DSC_alone, and SAF_DSC.

4.4.3 Mixed dermatology population

In total, 11 studies reported on TD in the context of misdiagnosis, incidental findings, re-referrals, and serious errors (as defined by the studies) for a mixed population.[27, 232, 261, 318, 321, 330, 331, 339, 349, 356, 358] Full details and definitions of safety outcomes are presented in Table 4.23.

Misdiagnosis rates varied across studies with rates as low <10% up to 25-30%, which could be explained by the difference in study designs and expected heterogeneity in a mixed study population.[232, 331] Several studies highlighted the incidence of missed diagnoses and subsequent clinical implications. For example, Börve 2012 documented cases where certain conditions were missed with TD, including Bowen's disease and dermatitis, yet all missed malignant cases were ultimately referred for FTF follow-up as the correct diagnosis was included in the TD differential.[318] Similarly in Romero 2010,[356] while only one out of three teledermatologists identified a tongue carcinoma during standard SAF review, all recommended that the patient be seen FTF and a biopsy be performed. Two studies reported on re-referral rates. One observed a 4.6% re-referral rate, indicating that some TD-discharged patients were later referred for FTF.[339] Similarly, the other study noted a low re-referral rate of 0.06% for the same lesion.[261] One study reported that among included 52 patients, two unnecessary biopsies were recommended by TD.[330] One study reported incidental malignancy rates of 3.6% in TD-evaluated patients and 2.5% in FTF evaluation.[349] Eight of the nine total patients with incidental malignancies were referred by the primary care provider for a different neoplasm. Another study found that TD had higher error rates with inflammatory and infectious pathologies than with tumour-related conditions, indicating that TD's visual limitations may pose challenges for non-tumour conditions.[232] For instance, Romero 2010 described a serious error where a herpes simplex diagnosis by TD was corrected to pemphigus vulgaris after FTF consultation.[356] Overall, however, the rates of serious errors and incorrect management were low.

Table 4.23 Teledermatology safety – mixed dermatology population

Study ID	Study arm	N	Safety outcome assessed	Key safety points
Börve 2012	SAF	40 patients	▪ Missed diagnosis ▪ Incorrect triage	▪ TD1 misdiagnosed one patient with a malignant tumour (Bowen's disease) as psoriasis. Bowen's disease was suggested as a differential diagnosis and patients was triaged for FTF visit (patient was adequately managed). ▪ Three patients were not initially triaged for FTF evaluation by TD1: – One was diagnosed with urticaria and dry skin and would theoretically have been recommended treatment via the GP with a topical steroid. – One would have been recommended a topical steroid for a dermatitis, which was assessed as a drug-induced rash. – One had a Borrelia infection which was a differential diagnosis who would have ordered serology testing via the GP. – Therefore, only one patient with urticaria would have received incorrect management. ▪ Two patients with a final diagnosis of a malignant tumour were misdiagnosed by TD2 as having dermatitis and BCC. – Despite incorrect diagnoses, both patients would have been referred for FTF evaluation. ▪ TD2 also misdiagnosed two patients without recommending FTF: – One patient had a benign nevus diagnosed as seborrhoeic keratosis. – One was the same urticaria patient misdiagnosed by TD1.
Faucon 2022	SAF	59 lesions	▪ Incorrect diagnosis	▪ 14 (24%) incorrect diagnoses: – One SCC was mistaken for seborrhoeic keratosis.
Keleshian 2017	SAF_MSC	286 patients	▪ Incidental skin malignancies	▪ TD cohort: 3/165 (3.6%) had incidental skin malignancy. ▪ FTF cohort: 3/121 (2.5%) had incidental skin malignancy.

Study ID	Study arm	N	Safety outcome assessed	Key safety points
				▪ Eight out of the nine patients with incidental malignancy were referred for a different neoplasm found during the initial primary care evaluation.
McKoy 2004	SAF	52 patients	▪ Unnecessary biopsy recommendation	▪ Unnecessary biopsy recommended in TD consultation for one case with adequate images and two cases overall.
Nami 2015	SAF	391 patients	▪ Diagnostic disagreement between TD and FTF	▪ Most frequent diagnostic disagreements were for psoriasis with 4/14 cases incorrectly diagnosed (28.6%) by TD. ▪ Similarly for other skin neoplasms such as fibroma molle, lipomas, and dermatofibromas which together reached a discordant rate of 27.3% (3/11 cases).
Oztas 2004	SAF_withoutnotes	125 patients	▪ Misdiagnosis by all 3 TDs	▪ 27 (22%) cases
	SAF			▪ 14 (11%) cases
Palamaras 2022	SAF_DSC_MSC	3,050 patients	▪ GP re-referral rate: TD patients discharged from outpatient clinic and re-referred ▪ Missed diagnosis	▪ Of 3,050 discharged and referred within 12 months over 14 month period, 32 patients re-referred. Two (0.06%) for same lesion: – One as lesion had grown in previous six months; one because GP had not received TD correspondence. ▪ 16% misdiagnosed – all benign with no change in management.
Romero 2006	SAF LI	121 patients	▪ Serious errors: unrelated diagnoses or not contemplated in differential	▪ SAF: 6.8% ▪ LI: 4.3% ▪ Errors were more frequent in inflammatory pathology than in tumoural pathology (Chi squared 6.1765 p=0.0129) or infectious (Chi squared 5.6138 p=0.0178).
Romero 2010	SAF SAF_LI	328 patients	▪ Serious errors: unrelated diagnoses or not contemplated in differential	▪ Only 1 important diagnosis went unsuspected from a total of 328 teleconsultations (SAF and SAF_LI): – a diagnosis of herpes simplex was made for a case presenting with sores on the lower lip of only 5 days' duration. During the

Study ID	Study arm	N	Safety outcome assessed	Key safety points
				conventional FTF consultation, a more widespread oral presentation was identified as pemphigus vulgaris. ▪ Among SAF only consultations (n=170) only 1/3 teledermatologists correctly diagnosed a tongue carcinoma in the teleconsultation. However all 3 recommended FTF evaluation and biopsy.
Seiger 2020	SAF	128 lesions	▪ Proportion of patients not recommended for FTF evaluation by TD with subsequent dermatology clinic visit or procedure within 90 days of teleconsultation.	▪ 21.1% (27/128) of cases not recommended for FTF evaluation attended a dermatology clinic. ▪ Five cases received procedures (tissue culture, KOH prep, or biopsy).
van der Heijden 2011	SAF	37,207 patients	▪ GP re-referral rate	▪ Re-referred to FTF after TD discharge: 4.6% of patients.

Key: BCC – basal cell carcinoma; CI – confidence interval; FTF - face-to-face; GP – general practitioner; K – kappa coefficient; LI – live interactive; NMSC – non-melanoma skin cancer; NR – not reported; RR – relative risk; SAF – store and forward; SAF_DSC - store and forward with dermatoscopy; SAF_DSC_MSC - store and forward with macro image and dermatoscopy; SAF_imageclinic – imaging conducted at image clinic; SCC – squamous cell carcinoma; SE – standard error; TD – teledermatology.
Footnote: *Marwaha 2019 used multiple types of TD workflows within the study.

4.4.4 Inflammatory/infectious conditions population

Three studies reported on the safety of TD in a population with inflammatory/infectious conditions.[262, 362, 367] One study considered re-referral rates following initial TD advice; 13% of patients were re-referred.[262] One study evaluated disagreement and explored the potential reason for this. Of the 24 cases with disagreement, teledermatologists reported that in six, whole-body photographs would have been more beneficial and in one case determined that the poor quality photo may have caused the incorrect diagnosis.[367] Lastly, Armstrong 2018 was an RCT of patients with psoriasis and evaluated the difference in adverse events experienced by patients in the TD cohort and the FTF evaluation cohort. The study used TD for both initial referral management and ongoing management.[362] Patients in the TD cohort experienced numerically fewer adverse events, serious adverse events, and deaths compared with those in the FTF cohort; however, the difference between the two cohorts was not tested statistically. Full details are presented in Table 4.24.

Table 4.24 TD safety – inflammatory/infectious conditions population

Study ID	Study arm	N	Safety outcome assessed	Key safety points
Lowe 2021	SAF_DSC	2,096 patients	▪ Re-referral rate	▪ 13% of the cohort charged with TD advice re-referred from primary care.
Heffner 2009	SAF	135 patients	▪ Diagnostic disagreement ▪ Clinically relevant disagreement (where a change in management was required)	▪ 24 cases of diagnostic disagreement: – In 6, whole-body photographs instead of close ups would have made diagnosis easier – In 1 case, poor photo quality was considered reason for incorrect diagnosis. ▪ Clinically relevant disagreement occurred in 12% of cases.
Armstrong 2018	SAF	148 patients	▪ Adverse events ▪ Serious adverse events Note: study reports on a psoriasis population treatment and management.	Any AE: 28.4% Serious AE: 8.8% Internal malignant neoplasm (excluding skin cancer): 1.4% NMSC: 0.7% Exacerbation of arthritis: 3.4% Surgery: 2.7% Death: 0.7%
	FTF	148 patients		Any AE: 34.5% Serious AE: 14.9% Internal malignant neoplasm (excluding skin cancer): 1.4% NMSC: 2.7% Exacerbation of arthritis: 2.0% Surgery: 4.1% Death: 1%

Key: AE – adverse event; FTF - face-to-face; NMSC – non-melanoma skin cancer; SAF – store and forward; SAF_DSC – store and forward with dermatoscopy; TD – teledermatologist.

4.5 Clinical efficacy of teledermatology-supported referral management

Long-term data on patient outcomes in TD studies are scarce with few studies investigating its impact on disease progression, recurrence rates, or quality of life over time compared with traditional FTF evaluation. Assessing the clinical impact of TD-supported referral management poses challenges due to inherent confounding within studies concerning the differences, and often lack of clarity regarding the ongoing management of patients and treatments received. Results should therefore be interpreted with caution. Six studies[261, 277, 311, 319, 350, 362] included in this review provided data relating to clinical course outcomes, three studies reported on health-related quality of life (HRQoL)[347, 350, 362], and twenty two documented clinical

management.[254, 267, 268, 271, 280, 282, 291, 294, 300, 304, 306, 307, 312, 315, 316, 319, 340, 342, 349, 352, 354, 362] Results are presented in Table 4.25, Table 4.26, and Table 4.27, respectively.

4.5.1 Clinical course outcomes

Seven studies reported clinical course outcomes, (Table 4.25) all of which measured the clinical course outcomes differently. Whited 2013 evaluated TD-evaluated (n=191) and FTF-evaluated (n=190) outcomes over nine months.[350] In the study, the teledermatologist was not responsible for ongoing management of the patient; instead, the teledermatologist discharged the patient back to the referring provider with a diagnosis and management plan if appropriate to implement, or if further investigation was required, referred the patient to a FTF clinic visit. All patients in the study underwent a final FTF evaluation after nine months. The cohorts (those initially triaged by TD and those referred through usual care) reported similar rates of condition resolution and improvement. Specifically, by nine months, 25% of patient conditions had resolved, while 46% had improved among TD-assessed patients, compared with 26% resolved and 46% improved in the FTF group. No significant differences in overall outcomes between TD and FTF cohorts were observed (p=0.88), suggesting comparable clinical effectiveness.[350]

Palamaras (2022) compared TD to FTF evaluations by retrospectively sharing 10 case images with five consultants. The evaluation found that most TD outcomes aligned with those of in-person care, with no discrepancies posing safety concerns. The TD service evaluated did not provide ongoing management for patients but rather referred patients onward for FTF evaluation, provided the referring GP with reassurance or a treatment plan, or referred patients directly to surgery. Differences between TD and FTF care primarily related to the pathways of care delivery, such as whether patients were referred for surgery directly.[261]

Carter (2017) investigated outcomes for patients initially treated or triaged via TD (n=79). Similar to other studies, TD did not provide ongoing management of patients, rather it provided management recommendations for the referring provider including any prescriptions required, or documented the need for a traditional FTF evaluation. Overall, 72% of TD-assessed patients' demonstrated self-reported or physician-reported improvement at follow-up during the eight month study review period. The study also noted no significant difference in emergency department visits, primary care practitioner visits, or hospital admissions related to dermatologic referrals between TD and FTF groups (p=0.44).[319] However, the number of patients with long-term data was small (n=18).

Armstrong (2018) was the only study where TD was used for ongoing management of patients after initial SAF referral management (n=148 in each cohort). The study focused on patients with psoriasis and assessed clinical outcomes using PASI

(Psoriasis Area and Severity Index), BSA (Body Surface Area), and PtGA (Patient Global Assessment). There were no differences in any psoriasis severity measures between the two groups at baseline. Improvements in these scores over four follow-up visits in a 12 month period demonstrated equivalence between TD and FTF care. Differences in the mean change in PASI, BSA, and PtGA in the TD group and the FTF all fell within pre-specified equivalence margins.[362]

Ferrándiz (2012)[277] compared initial prognosis outcomes of patients referred from local primary care centres to a regional specialist dermatology unit, triaged using either TD (n=67) or the conventional referral pathway (n=134). The study compared differences in three initial prognosis outcomes for patients with cutaneous melanoma between the two referral pathways. Breslow thickness is a measure of how deep a melanoma has grown into the layers of skin and is used to stage melanoma skin cancer. The mean Breslow thickness was significantly less among patients in the TD group compared with patients in the non-TD group (mean, 1.06 vs 1.64 mm, p=0.03). The frequency of melanoma with a favourable initial prognosis (tumour stages Tis and T1a) was significantly higher in the TD group than in the non-TD group (70.1% vs 56.9%, p=0.03). The odds ratio of having a cutaneous melanoma with a favourable initial prognosis in the TD group was 1.96 (95% CI, 1.14-3.50; p=0.04). The authors attributed these differences in initial prognosis to reduced waiting times for referral to specialist dermatology assessment using TD. They also highlighted an increased knowledge of suspected melanoma management in primary care practitioners in the TD group along with a lower barrier for referral of suspected melanoma cases using TD.

Arzberger (2016)[276] conducted a retrospective chart review of follow-up dermatologic visits, examinations, biopsies or excision reports four years after initial TD and FTF examination. Among 35 patients with complete data (covering 968 lesions), eight additional melanocytic naevi were excised in three patients. For six of these lesions, no recommendation for short-term monitoring or excision had been documented at baseline TD assessment. For the remaining two lesions, recommendations included short-term follow-up or excision by one or more teledermatologists. In a second group of 35 patients with incomplete clinic follow-up, retrospective review identified one superficial spreading melanoma diagnosed 15 months after initial assessment. Baseline images of this lesion had been evaluated by all teledermatologists and FTF assessors, who had all described the lesion as clinically unremarkable.

Hunt (2020)[311] carried out service evaluation on two pathways for adult patients referred by GPs for suspected skin cancer seen in conventional FTF appointments at the dermatology centre (n=75), or by a medical photographer taking regional, macroscopic and dermatoscopic images at a local hospital (n=75). The study found

no significant difference in either diagnostic therapeutic biopsy/excision rate (FTF: 38.7% vs TD: 50.7% respectively; p=0.19) or in the proportions of benign, dysplastic and malignant lesions biopsied (p=0.86).

Table 4.25 Clinical efficacy outcomes

Study author	Population	Study arm	N - patients	Outcome definitions	Results	Significance
Armstrong 2018	Inflammatory/ infectious conditions	SAF	148	**PASI:** validated instrument that combines the assessment of lesion severity and the affected surface area into a single score ranging from 0 (no disease) to 72 (maximal disease). Mean score improvement across 4 follow-up periods assessed. **BSA:** Body surface areas affected by psoriasis. Range from 0-100%. **PtGA:** validated instrument that measures overall psoriasis severity from a patients' perspective. Uses an ordinal 6-point scale ranging from 0 (clear) to 5 (severe).	Mean change from baseline across all follow-up visits: ▪ **PASI:** -1.37 (3.33). ▪ **BSA: -**3.38% (11.08%) ▪ **PtGA:** −0.37 (1.00).	• **Difference in mean follow-up change in PASI score between the SAF and FTF:** -0.27 (95%CI, -0.85 to 0.31); within the pre-specified equivalence margin (±6.5). • **Difference in mean follow-up change in BSA score between the SAF and FTF:** -0.05% (95%CI, −1.58%to 1.48%); within the pre-specified equivalence margin (±6.5). • **Difference in mean follow-up change in PtGA score between the SAF and FTF:** −0.11 (95%CI, −0.32 to 0.10); exceeded the pre-specified equivalence margin (±0.25).
		FTF	148		Mean change from baseline across all follow-up visits: ▪ **PASI:** -0.82 (3.43) ▪ **BSA:** -1.55% (8.87%) ▪ **PtGA:** −0.22 (1.26).	

Study author	Population	Study arm	N - patients	Outcome definitions	Results	Significance
Arzberger 2016	Suspected melanoma	SAF_MSC_DSC (Study included total-body photography).	35	▪ Retrospective chart review of follow-up dermatologic visits, examinations, biopsies or excision reports four years after initial TD by 4 teledermatologists and 1 FTF examination.	▪ 8 additional lesions (melanocytic naevi) were excised from 3 patients during 4-year monitoring period. – For 6 lesions, no TD recommendation was made for short-term follow-up or excision. – One lesion was recommended by TD3 for short-term follow-up. – 1 lesion was recommended for short-term following up by TD1 and TD4 and excision by TD2 and TD3. ▪ During follow-up period, one melanoma detected 15 months after FTF and TD evaluation. New onset of pruritus prompted excision. Study was unable to confirm if the lesion was already an amelanotic melanoma at time of initial review.	NR
Carter 2017	Mixed dermatology	SAF	79	▪ Number of patients treated by TD with subsequent FTF due to failure to improve.	▪ **FTF visit after TD due to lack of improvement:** 64.6% initially treated by TD alone, of which 5 failed to	• No significant difference in ED/PCP visit/ hospital admission

Study author	Population	Study arm	N - patients	Outcome definitions	Results	Significance
				▪ Proportion of TD-treated patients with self-reported or physician-reported improvement at their subsequent clinical encounter. ▪ Number of ED visits, PCP visits, and hospital admissions related to the dermatologic referral that occurred prior to patients seen in clinic, or definitive treatment recommended by TD.	improve with initial treatment and had subsequent FTF visit. ▪ **Long term outcome data:** available in only 18/79 patients of which 13 (72%) had self-reported or physician-reported improvement. – ED/PCP visit, hospital admission related to dermatologic referral: – FTF period pre-TD: 1 ED visit, 8 additional PCP visits; 0 hospital admissions. – TD cohort: 1 ED visit, 0 additional PCP visits, 0 hospital admissions.	between TD group and FTF referral group (p=0.44).
Ferrándiz 2012	Melanoma	SAF_MSC	67	**Breslow Thickness:** A measure of how deeply a melanoma tumour has grown into the skin. **Favourable Prognosis Frequency**: frequency of melanoma with a favourable initial prognosis (tumour stages Tis and T1a). **Favourable Prognosis Odds ratio:** Odds ratio	▪ **Breslow Thickness:** - Mean 1.06mm, median 0.55 mm. ▪ **Favourable Prognosis Frequency:** 70.1%. ▪ **Odds Ratio:** 1.96 (95% CI, 1.14 - 3.50).	• Breslow thickness (mean value) *P*=0.03 • Favourable Prognosis *P*=0.03 • Odds ratio: *P*=0.04
		FTF	134		▪ **Breslow Thickness:** - Mean 1.64mm, median 0.75 mm. ▪ **Favourable Prognosis**: 56.9%.	

Study author	Population	Study arm	N - patients	Outcome definitions	Results	Significance
				of having a cutaneous melanoma with a favourable initial prognosis in the SAF_MSC group.		
Hunt 2020	Suspected cancer (mixed)	SAF_imageclinic_DSC_MSC	75	Diagnostic/ therapeutic biopsy/excision rate. Proportions of benign, dysplastic and malignant lesions biopsied.	Diagnostic/ therapeutic biopsy/excision rate: ▪ 29/75 (38.7%).	Diagnostic/ therapeutic biopsy/excision rate: P = 0.19. Proportions of benign, dysplastic and malignant lesions biopsied: P = 0.86.
		FTF	75		Diagnostic/ therapeutic biopsy/excision rate: ▪ 38/75 (50.7%).	
Palamaras 2022	Mixed dermatology	SAF_imageclinic_DSC_MSC	10	Images shared with 5 consultants to review without knowing the outcome to compare between clinicians, pathology outcome, and FTF appointment outcome.	▪ Majority of outcomes in TD matched those as in clinic. ▪ Where discrepancies were evident, nothing was deemed unsafe, and differences were whether patients were offered surgery directly versus FTF.	NR

Whited 2013	Mixed dermatology	SAF_MSC	191	**Resolved:** skin condition replaced by normal skin or normally-healing skin after surgical/therapeutic intervention. **Improved:** Does not meet guideline for resolved but, in aggregate, has shown improvement deemed relevant to reviewers (such as size, distribution, colour, spatial orientation). **Unchanged (not clinically relevant):** skin condition is unchanged but unlikely to affect mortality, morbidity, or response to treatment. **Unchanged (clinically relevant):** skin condition is unchanged and likely to affect mortality, morbidity, or response to treatment. **Worse:** skin condition, in aggregate, has shown worsening or progression in metrics deemed relevant (such as size, distribution, colour, spatial orientation).	**Baseline to 1st clinic visit (n=94):** ▪ Resolved: 2% ▪ Improved: 23% ▪ Unchanged (not clinically relevant): 12% ▪ Unchanged (clinically relevant): 57% ▪ Worse: 6% **Baseline to 9 months (n=125):** ▪ Resolved: 25% ▪ Improved: 46% ▪ Unchanged (not clinically relevant): 10% ▪ Unchanged (clinically relevant): 10% ▪ Worse: 8% **Rating for patients with and without dermatology clinic visits, baseline to 9 months:** **No clinic visit:** ▪ Resolved: 14% ▪ Improved: 43% ▪ Unchanged (not clinically relevant): 17% ▪ Unchanged (clinically relevant): 9% ▪ Worse: 17% **One/more clinic visits:** ▪ Resolved: 29% ▪ Improved: 49%	**Difference between TD and usual care at baseline to 1st clinic visit:** p=0.65. **Difference between TD and usual care at baseline to 9 months:** p=0.88. **Among TD referrals, subsequent presentation for FTF visit was significantly correlated with clinical course:** p=0.023.

Study author	Population	Study arm	N - patients	Outcome definitions	Results	Significance
					▪ Unchanged (not clinically relevant): 8% ▪ Unchanged (clinically relevant): 11% ▪ Worse: 3%	
		Conventional care (FTF)	190		**Baseline to 1st clinic visit (n=137):** ▪ Resolved: 2% ▪ Improved: 21% ▪ Unchanged (not clinically relevant): 15% ▪ Unchanged (clinically relevant): 51% ▪ Worse: 11% **Baseline to 9 months (n=136):** ▪ Resolved: 26% ▪ Improved: 46% ▪ Unchanged (not clinically relevant): 11% ▪ Unchanged (clinically relevant): 13% ▪ Worse: 4%	

Key: BSA – body surface area; CI – confidence interval; ED – emergency department; FTF – face-to-face; NR – not reported; PASI – Psoriasis Area and Severity Index; PtGA – Patient Global Assessment; PCP – primary care provider; SAF – store-and-forward; SAF_imageclinic_DSC_MSC – store-and-forward conducted at image clinic with dermatoscopy and macroscopic images; SAF_MSC – store-and-forward with macroscopic images; TD – teledermatology.

4.5.2 Health related-quality of life (HRQoL)

Three studies (RCTs) reported on HRQoL outcomes, one focused on a non-cancer (psoriasis) population[362] and two on a mixed population.[347, 371] Various tools were used across the studies; full details are presented in Table 4.26.

4.5.2.1 EQ-5D-5L and EQ VAS

Two studies reported on HRQoL using the 5-level EuroQol-5 Dimensions index (EQ-5D-5L) and the EQ visual analogue scale (VAS) measured at baseline and follow-up.[347, 371] Armstrong 2018 measured HRQoL of all patients at three-month intervals over the 12-month study period. Over the course of the study, both the TD-managed patients and FTF group experienced a small average increase in scores. The between-group difference was negligible, with values falling within the predefined equivalence margin (±0.1).[362] In Lopez-Liria 2022, patients in the TD group demonstrated small but statistically significant improvements in EQ-5D scores (+0.04; $p<0.05$), showing enhanced HRQoL over the six month evaluation period. Although the FTF group had slightly greater improvement (+0.1; $p<0.05$), these patients had a lower starting score. At baseline, statistically significant differences were observed between the groups in all the items measured (the FTF group had worse quality of life overall). After six months, differences disappeared only for the pain/discomfort item, as similar improvements for this item were noted for both groups. The study did not explicitly report if TD was used to provide ongoing management of patients, however, all patients received a minimum of two assessments either FTF and or through telephone (at study start, and after six months).[347]

Concerning the EQ VAS scores, which capture patients' subjective assessment of their overall health, a similar pattern of improvement was observed, with both TD and FTF-managed patients reporting improvements in their overall health between the baseline and follow-up assessments. In Armstrong 2018, TD-managed patients reported an average increase of 1.30 (SD: 13.68), while FTF-managed patients reported an average improvement of 2.90 (SD: 15.46). Despite slightly greater gains in EQ VAS scores in the FTF cohort, the between-group difference of -0.002 fell within the equivalence margin of ±8.[362] In Lopez-Liria 2022, TD-assessed patients reported a significant within-group improvement (+2.30; $p<0.05$), albeit slightly smaller than that observed in the FTF group (+5.08; $p<0.05$).[347] Baseline HRQoL of in this study differed between the groups with the FTF cohort having worse starting scores.

4.5.2.2 Skindex-16 and Skindex-29

Two studies used Skindex-16 and one used Skindex-29. Both versions of the tool are designed to measure dermatology-specific quality of life across the domains of symptoms, emotions, and functioning.[362, 371] Both tools use a scoring system of zero to 100 with higher scores indicating worse HRQoL. Therefore, a negative change (namely a reduction) in score suggests improvement in quality of life. In one study, clinically significant improvements were reported for symptoms, emotions and composite score for both the TD and traditional FTF evaluation cohorts. The TD group (initially managed or triaged) experienced a change in composite score of -12 (SD: 24.5), which was comparable to the FTF cohort change of -13.2 (SD: 21.6).[371] While both groups showed improvement, there was no statistically significant difference in the change in scores between them. Similarly in another study, among patients with psoriasis who experienced ongoing management through TD or traditional FTF evaluation, minor reductions in Skindex-16 scores were observed over the 12-month study period in both groups. All between group differences showed equivalent impact regardless of management through TD or conventional FTF appointments.[362]

Lopez-Liria 2022 used the Skindex-29 tool; greater reductions in scores from baseline to six months were observed in the FTF cohort compared with the TD cohort; differences between the groups were not tested statistically. However, the improvements within each group were statistically significant across all domains at six months compared with baseline.[347]

4.5.2.3 Dermatology Life Quality Index (DLQI)

One study reported HRQoL using the DLQI tool which measures the impact of skin conditions on patients' lives.[362] The tool has 10 items, each scored from zero (no impact) to three (maximum impact). In the study, which included patients with psoriasis, those with ongoing management through TD reported an unadjusted mean decline (therefore improvement) in DLQI score of 1.64 (SD: 4.34), similar to the traditional FTF management cohort's reduction of 1.18 (SD: 4.77) over the 12-month study period. In an adjusted model using repeated measures analysis, the mean difference between the two groups was -0.45 (95% CI: -1.29 to 0.38), which was within the predefined equivalence margin of ±2.5, suggesting equivalence of the two care modalities.[362]

4.5.2.4 Patient Health Questionnaire (PHQ-9)

One study also used the PHQ-9 tool to assess depression among patients with psoriasis fully managed through TD versus traditional FTF consultation.[362] Reductions in PHQ-9 scores, and therefore improvement in symptoms, were

reported for both cohorts, with a mean reduction of 0.4 (SD: 3.94) in the TD group and 0.76 (SD: 4.66) in the FTF group. The adjusted between-group difference of -0.33 (95% CI: -1.20 to 0.55) was within the predefined equivalence margin of ±3, indicating no significant impact on depression.[362]

Table 4.26 Health-related quality of life

			EQ-5D-5L			EQ VAS		
Study author (population)	**Study arm**	**N-patients**	**Baseline**	**Follow-up**	**Difference**	**Baseline**	**Follow-up**	**Difference**
Armstrong 2018 (Inflammatory/ infectious conditions)	SAF	148	0.83 (0.16)	Average increase: 0.01 (0.10)	**Between groups:** 0 (-0.003 to 0.003); within equivalence margin of ±0.1	77 (18)	Average increase: 1.30 (13.68)	**Between groups:** -0.002 (-2.749 to 2.745); within equivalence margin of ±8
	FTF	148	0.79 (SD, 0.17)	Average increase: 0.03 (0.13)		74 (20)	Average increase: 2.90 (15.46)	
Lopez-Liria 2022 (Mixed dermatology)	SAF_imageclinic_DSC	225	0.89 [0.87;0.91] **Individual domains:** Mobility: 1.06 [1.02;1.10] Usual activities: 1.11 [1.05;1.17] Self-care: 1.12 [1.06;1.18] Pain/discomfort: 1.77 [1.64;1.90] Anxiety/depression: 1.37 [1.26;1.48]	0.93 [0.92;0.94] **Individual domains:** Mobility: 1.04 [1.01;1.07] Usual activities: 1.08 [1.04;1.12] Self-care: 1.04 [1.02;1.07] Pain/discomfort: 1.46 [1.37;1.55] Anxiety/depression: 1.31 [1.23;1.39]	**Within group:** +0.04 [0.03;0.05]; p<0.01 **Between group:** all p<0.05 except pain/discomfort domain (p=0.32)	76.22 [73.29; 79.15]	78.52 [75.68; 81.36]	**Within group:** +2.30 [1.43;3.18]; p<0.01
	FTF_DSC	225	0.77 (0.74;0.81) **Individual domains:** Mobility: 1.55 (1.43 to 1.67) Usual activities: 1.60 [1.48;1.73]	0.87 [0.85;0.90] **Individual domains:** Mobility: 1.30 [1.21;1.39] Usual activities: 1.31 [1.22;1.39]	**Within group:** +0.1 (0.08; 0.12); p<0.01	68.24 (65.10; 71.38)	73.32 [70.18; 76.46]	**Within group:** +5.08 (3.78; 6.38); p<0.01

			Self-care: 1.48 [1.36;1.60] Pain/discomfort: 1.96 [1.82;2.09] Anxiety/depression: 1.77 [1.64;1.90]	Self-care: 1.29 [1.20;1.38] Pain/discomfort: 1.40 [1.32;1.48] Anxiety/depression: 1.54 [1.45;1.62]					
Skindex-16/ Skindex-29									
Study author (population)	**Study arm**	**N-patients**	**Mean change (SD) or difference (95% CI) in score from baseline to follow-up**						**Significance**
			Symptoms	**Emotions**	**Functioning**	**Composite**			
Whited 2013 (Mixed dermatology) Skindex-16	SAF_MSC	195	Baseline to 9 months: -10.3 (30.36)	Baseline to 9 months: -19.7 (30.7)	Baseline to 9 months: -6.0 (24.5)	Baseline to 9 months: -12 (24.5)			Between groups: p>0.05
	FTF	196	Baseline to 9 months: -14.4 (28.2)	Baseline to 9 months: -18.1 (25.1)	Baseline to 9 months: -6.9 (22.3)	Baseline to 9 months: -13.2 (21.6)			
Armstrong 2018 (Inflammatory/ infectious conditions) Skindex-16	SAF	148	Baseline to 12 months: -1.79 (5.92)	Baseline to 12 months: -4.75 (10.18)	Baseline to 12 months: -2.48 (7.02)	NR			All between group differences showed equivalent impact regardless of intervention
	FTF	148	Baseline to 12 months: -2.63 (7.32)	Baseline to 12 months: -5.04 (11.54)	Baseline to 12 months: -3.04 (7.65)	NR			
Lopez-Liria 2022 (Mixed dermatology) Skindex-29	SAF_imageclinic_DSC	225	Baseline to 6 months: ↓1.05 (0.85- 1.25)	Baseline to 6 months: ↓1.31 (1.06-1.56)	Baseline to 6 months: ↓0.54 (0.34-0.74)	Baseline to 6 months: ↓2.90 (2.46-3.33)			Within groups: P<0.05
	FTF_DSC	225	Baseline to 6 months: ↓2 (1.76-2.25)	Baseline to 6 months: ↓2.57 (2.25-2.88)	Baseline to 6 months: ↓1.71 (1.36-2.05)	Baseline to 6 months: ↓6.28 (4.59-5.60)			

Dermatology Life Quality Index				
Study author (population)	**Study arm**	**N-patients**	**Unadjusted mean (SD) decline from baseline to follow-up**	**Adjusted difference between groups**
Armstrong 2018 (Inflammatory/ infectious conditions)	SAF	148	1.64 (4.34)	-0.45 (95% CI: -1.29-0.38); within pre-specified equivalence margin of ±2.5
	FTF	148	1.18 (4.77)	
Patient Health Questionnaire (PHQ-9) for depression				
Study author (population)	**Study arm**	**N-patients**	**Mean (SD) reduction in score from baseline**	**Difference between groups**
Armstrong 2018 (Inflammatory/ infectious conditions)	SAF	148	0.4 (3.94)	-0.33 (95% CI: -1.20 – 0.55); within pre-specified equivalence margin of ±3
	FTF	148	0.76 (4.66)	

Key: BSA – body surface area; CI – confidence interval; ED – emergency department; FTF – face-to-face; NR – not reported; PASI – Psoriasis Area and Severity Index; PtGA – Patient Global Assessment; PCP – primary care provider; SAF – store-and-forward; SAF_imageclinic_DSC_MSC – store-and-forward conducted at image clinic with dermatoscopy and macroscopic images; SAF_MSC – store-and-forward with macroscopic images; SD – standard deviation; TD – teledermatology.

Note: ↓ indicates a reduction in score from baseline to follow-up.

4.5.3 Clinical management in TD

Twenty-two studies (10 in a suspected cancer (mixed) population, six in a mixed dermatology population, two in an inflammatory/infectious conditions population, two in a suspected NMSC population and three in a suspected melanoma population) reported on the clinical management of patients advised through TD or traditional FTF evaluation.[254, 267, 268, 271, 276, 280, 282, 285, 291, 294, 300, 304, 306, 307, 312, 315, 319, 340, 342, 349, 352, 354, 362] The studies heterogeneously reported on a range of outcomes including treatment prescribed or recommended, recommendations for biopsy or excision, the need for follow-up appointments, changes in treatment, and primary healthcare provider adherence to TD recommendations. The majority of studies (n=14)[267, 268, 282, 294, 300, 306, 307, 312, 315, 319, 340, 342, 349, 362] reported results descriptively only; nine[254, 271, 280, 285, 291, 304, 316, 352, 354] investigated differences in clinical management between TD and traditional FTF evaluation or different types of TD. All studies are presented in Table 4.27 and those exploring statistical differences between groups are also described narratively below.

Across three suspected melanoma population studies, the frequency that excision was recommended varied between TD and FTF evaluation. In one study of 221 patients,[271] the number needed to biopsy to detect a melanoma was statistically greater in the TD group versus the FTF group (20.1 vs 9.6, p=0.03). The higher number needed to biopsy in the TD group may suggest a more conservative approach or reduced specificity in remote melanoma assessment. Similarly, in a study[276] of 70 patients with 1,922 lesions assessed through TD using SAF macroscopic and dermatoscopic images and through FTF evaluation with a dermatoscope, it was recommended that 51 lesions should be excised following TD assessement compared with 23 lesions recommended following FTF evaluation. Of these 23 lesions, all were recommended for excision or follow-up by at least one of four teledermatologists included in the study. In contrast in another study,[268] excision outcome data showed that one teledermatologist had a malignant-to-benign excision ratio of 1:2, and another had a ratio of 1:3, meaning that for every melanoma excised, two to three benign lesions were also excised. The FTF dermatologist had a ratio of 1:3.5, indicating an even higher number of benign lesions excised per melanoma. This may suggest that the FTF dermatologist adopted a more conservative or less specific excision approach relative to the teledermatologists. In a suspected NMSC population, one study (n=68) demonstrated similar rates of biopsy referrals (26% versus 24%, p=0.846) and excision referrals (32% versus 43%, p=0.288) between TD and FTF cohorts. However, there was a statistically significant difference in follow-up recommendations, with the FTF cohort requiring follow-up less frequently than the TD cohort (3% versus 28%, p<0.0001).[280]

In another study on a suspected cancer (mixed) population, the yield of malignant tumours from biopsies was statistically equivalent between the FTF and TD groups (43.8% versus 50%, p=0.4). In the FTF cohort, more biopsies were requested which subsequently were confirmed as benign non-melanocytic lesions (11.3% versus 0%, p<0.01).[291] Moreover, in a different study involving primary care providers, there was a significant difference in the percentage of patients referred as priority to FTF consultations compared with TD assessment, with 41.6% of FTF cases referred as priority versus only 9.8% to TD (p<0.0001).[285]

In mixed dermatology populations, one study assessed clinical outcomes using TD with dermatoscopic images taken by GPs versus dermatologists. The difference in suggested management between the two sets of images was statistically significant (p<0.01). For example, clinical follow-up or sequential dermatoscopy was suggested more frequently and return to GP less frequently when reviewing images acquired in general practice compared with those acquired in a dermatology department.[304] Another study highlighted a difference in recommendations for medication and biopsies between standard SAF and LI TD, with SAF consultations leading to significantly fewer medication recommendations (37% vs 78%, p<0.001) and significantly more biopsy recommendations l (23% vs 2% p<0.001) compared with LI TD.[352] Another study focused on biopsy recommendations, noting significantly lower rates in FTF consultations compared with SAF using images, and LI using high and low quality video (4% versus 8 to 12%, p=0.001).[354]

Table 4.27 Clinical management

Study author	Study arm	N	Results	
Suspected melanoma population				
Arzberger 2016	SAF_MSC_DSC	1,922 lesions 70 patients	**Self-monitoring:** 1,787 benign lesions. **Short term monitoring:** 84 lesions. **Excision:** 51 lesions including 9 melanomas and 1 BCC.	
	FTF_DSC	1,922 lesions 70 patients	**Self-monitoring:** 48 patients. **Short term monitoring:** 2 patients. **Excision:** 50 patients. FTF_DSC evaluation recommended excision of 23 lesions; of these all were recommended for excision or follow-up by at least one of the 4 TDs.	
diStefani 2007	SAF_DSC	465 lesions	**Ratios of excised malignant to benign pigmented skin lesions:** ▪ TD expert 1 – 1:2 ▪ TD expert 2 – 1:3	
	FTF_DSC	465 lesions	**Ratio of excised malignant to benign pigmented skin lesions**: ▪ FTF Expert – 1:3.5	
Hussain 2023	SAF_DSC	221 patients	**Number needed to biopsy to detect a melanoma**: ▪ 20.1	p=0.03 compared to SAF_DSC
	FTF	221 patients	**Number needed to biopsy to detect a melanoma**: ▪ 9.6	
Suspected non-melanoma skin cancer				

Study author	Study arm	N	Results	
Cheng 2022	SAF	68 patients	▪ Biopsy referral: 26% ▪ Excision referral: 32% ▪ FTF follow-up requested: 28%	Biopsy referral: p=0.846 Excision referral: p=0.288 FTF follow-up: p<0.0001
	FTF	68 patients	▪ Biopsy referral: 24% ▪ Excision referral: 43% ▪ FTF follow-up requested: 3%	
Senel 2013	Total population	150 patients	▪ Follow-up: 63% ▪ Lesion destruction: 37%	
Suspected cancer (mixed) population				
Clarke 2021	TD	308 lesions	**Recommended biopsy:** n=80 of 308 (26%)	p = 0.02
	FTF	308 lesions	**Recommended biopsy:** n = 62 of 308 (20%)	
Creighton-Smith 2017	SAF_DSC	434 patients	▪ More FTF patients received biopsies (27.2% (160/587) vs 11.5% (50/434), p<0.001. ▪ Yield of malignant tumours from biopsies were statistically equivalent between cohorts- 43.8% (70/160) vs 50% (25/50), p=0.4. ▪ Distribution of pre-biopsy diagnostic categories (benign or malignant melanocytic vs nonmelanocytic) was also similar except that FTF cohort had a higher proportion of biopsies for benign non-melanocytic lesions, 11.3% (18/160) vs 0% (0/50), p<0.01.	
	FTF	587 patients		
Ford 2015	SAF_DSC	195 patients	▪ Urgent referral to secondary care specialist: 33% ▪ No action required: 27% ▪ No action required – watch and wait: 17% ▪ Management per local guidelines: 8% ▪ Routine referral to primary/secondary care specialist: 5% ▪ Routine referral to secondary care specialist: 5% ▪ Re-image and re-submit: 4% ▪ Dermatoscopic diagnosis not possible due to lesion location/size: 2%	
Hsiao 2008	SAF	92 encounters	**Urgency of consult (suggested by PCP):** ▪ Priority: 9.8% ▪ Routine: 90.2%	p<0.0001

Study author	Study arm	N	Results
	FTF	77 encounters	**Urgency of consult (suggested by PCP):** ▪ Priority: 41.6% ▪ Routine: 58.4%
Lim 2012	SAF_imageclinic_DSC_MSC	200 patients	**Treatment recommendations:** ▪ No treatment required: 117 ▪ Cryotherapy: 29 ▪ Topical treatment: 20 ▪ Surgery: 41 **Biopsy required to establish diagnosis:** 5%
	FTF	100 patients	**Treatment recommendations:** ▪ No treatment required: 40 ▪ Cryotherapy: 15 ▪ Topical treatment: 26 ▪ Surgery: 29 **Biopsy required to establish diagnosis:** 8%
May 2008	SAF_DSC	20 patients	**Comparison of Consultant Dermatologist assigned case priority vs GP assigned case priority where cases rated as Routine, Soon or Urgent:** ▪ All patients with malignant lesions referred with a photograph, except one, were prioritised as urgent by dermatologist (n=19), irrespective of the priority given by the GP (n=14).
	FTF	76 patients	**Comparison of Consultant Dermatologist assigned case priority vs GP assigned case priority where cases rated as Routine, Soon or Urgent:** ▪ Cases prioritised as urgent by dermatologist (n=41), irrespective of the priority given by the GP (n=31) ▪ Seven patients with malignant lesions were not upgraded ▪ Priority was downgraded in six cases. Overall, only 41 of 76 patients (54%) were seen urgently.
Morton 2011	SAF_imageclinic_DSC	289 patients	▪ Referred to consultant diagnostic clinic: 28.4% ▪ Reassurance: 19.4%

Study author	Study arm	N	Results	
			▪ Cryotherapy: 3.8% ▪ Referred to surgery: 4.8% ▪ Referred to nurse-led clinic for topicals: 0.3%	
	FTF	188 patients	▪ Reassurance: 48.9% ▪ Cryotherapy: 27% ▪ Referred to surgery: 34% ▪ Referred to nurse-led clinic for topicals: 2.7% ▪ Referred for photodynamic therapy: 1.1%	
Senel 2014	Total population	120 patients	▪ Follow-up: 58% ▪ Lesion destruction: 42%	
Tan 2010	SAF_MSC_DSC	491 lesions	▪ No reason for concern: 234 lesions in 95 patients (TD1); 256 lesions in 96 patients (TD2). ▪ Cryotherapy/5-flourouacil cream/simple excision in GP setting: 126 and 102 lesions in 41 patients and 39 patients, respectively for TD1 and TD2.	
Vestergaard 2020	SAF_DSC_GP	192 patients	▪ Return to GP: 19% ▪ Clinical follow-up/ sequential dermatoscopy: 28% ▪ Biopsy: 24% ▪ Excision: 21% ▪ Cryotherapy/ topical/photodynamic therapy: 6% ▪ Other: 3%	p<0.01
	SAF_DSC_dermatologist	192 patients	▪ Return to GP: 31% ▪ Clinical follow-up/ sequential dermatoscopy: 22% ▪ Biopsy: 24% ▪ Excision: 22% ▪ Cryotherapy/ topical/photodynamic therapy: 1% ▪ Other: 0%	
Mixed dermatology population				
Carter 2017	SAF	79 patients	**Treatment prescribed:** ▪ Education/observation: 8% ▪ Medication initiation/discontinuation: 74%	

Study author	Study arm	N	Results	
			▪ Laboratory testing: 4% ▪ Procedural intervention: 14% ▪ Referral to another service: 0% ▪ Change in medication dosage/vehicle: 0% **PCP adherence to TD recommendations:** ▪ Adherence documented in 55/59 cases (93%) through either electronic prescriptions or telephone encounters. ▪ In 4/33 cases referred for FTF visit, PCP did not carry out recommendation because patient improved with treatment, couldn't be contacted, or were treated by the PCP.	
Castillo 2022	SAF	470 encounters	**Medication recommended:** 37% ▪ Prescribed by referring medical doctor: 83% **Biopsy recommended:** 23% ▪ Biopsy performed: 61%	p<0.001
	LI	347 encounters	**Medication recommended:** 78% ▪ Prescribed by referring medical doctor: N/A **Biopsy recommended:** 2% ▪ Biopsy performed: 57%	
Keleshian 2017	SAF_MSC	350 patients	**Biopsy required:** 23%	
	FTF	121 patients	**Biopsy required:** 25%	
Marchell 2017	SAF	209 patients	**Mean proportion of cases with biopsy recommendation:** 11%	
	LI_highquality	112 patients	**Mean proportion of cases with biopsy recommendation:** 8%	
	LI_lowquality	98 patients	**Mean proportion of cases with biopsy recommendation:** 12%	
	FTF	207 patients	**Mean proportion of cases with biopsy recommendation:** 4%	Significantly lower than SAF (p=0.001) and LI_lowquality (p=0.04).
Vano-Galvan 2011	SAF	100 patients	**Majority decision by observers (n=20) for the 100 patients:** ▪ Discharge patient: 21% ▪ Review by MAP: 15%	

Study author	Study arm	N	Results
			▪ New TD review: 4% ▪ Non-preferential referral to FTF dermatologist: 37% ▪ Preferential referral to FTF dermatologist: 23%
Zink 2017b	SAF	195 patients	Further diagnostic procedures requested in 57.4% of all cases.
	FTF	195 patients	Further diagnostic procedures requested in 65.7% of all cases.
Inflammatory/infectious conditions population			
Armstrong 2018	SAF	148 patients	**Treatment prescribed:** ▪ Topical treatment alone: 43.2% ▪ Phototherapy: 4.7% ▪ Oral therapies: 12.2% ▪ Biologic therapies: 37.8% ▪ Systemic therapies: 2% **Treatment changes:** ▪ 78.9% of visits (n=161) resulted in treatment changes with dose changes being most frequent.
	FTF	148 patients	**Treatment prescribed:** ▪ Topical treatment alone: 45.3% ▪ Phototherapy: 6.1% ▪ Oral therapies: 10.1% ▪ Biologic therapies: 35.8% ▪ Systemic therapies: 2.7% **Treatment changes:** 81.9% of visits (n=315) resulted in treatment changes with dose changes being most frequent.
Kazi 2021	SAF	951 visits	**Treatment prescribed:** ▪ Non-retinoids: 39.1% ▪ Steroids: 27.6% ▪ Retinoid: 16.1% ▪ Antibiotics: 4.1% ▪ Topical: 3.3% ▪ Nonsteroidal antipruritics: 4.1% ▪ Antivirals: 2.9%

Study author	Study arm	N	Results
			▪ Biologics: 1.5% ▪ Immunomodulators: 0.3% ▪ Other: 1.1% **Number of prescriptions per visit:** ▪ 1.39 (±0.06); significantly more than through LI.
	LI	1,672 visits	**Treatment prescribed:** ▪ Non-retinoids: 28.6% ▪ Steroids: 28.4% ▪ Retinoid: 15.7% ▪ Antibiotics: 3.6% ▪ Topical: 4.0% ▪ Nonsteroidal antipruritics: 5.1% ▪ Antivirals: 4.1% ▪ Biologics: 4.1% ▪ Immunomodulators: 2.8% ▪ Other: 3.5% **Number of prescriptions per visit:** ▪ 1.01 (±0.04)

Key: FTF – face-to-face; FTF_DSC – face-to-face with dermatoscopy; GP – general practitioner; LI – live interactive; N/A – not applicable; PCP – primary care provider; SAF – store-and-forward; SAF_DSC – store-and-forward with dermatoscopy; SAF_DSC_dermatologist – store-and-forward with dermatoscopic image taken by dermatologist; SAF_DSC_GP – store-and-forward with dermatoscopic image taken by GP; SAF_imageclinic_DSC – store-and-forward conducted at image clinic with dermatoscopy; SAF_imageclinic_DSC_MSC – store-and-forward conducted at image clinic with dermatoscopy and macroscopic images; SAF_MSC – store-and-forward with macroscopic images; SAFvideo_highquality – store-and-forward with high quality video attachment; SAFvideo_lowquality – store-and-forward with low quality video attachment; SD – standard deviation; TD – teledermatologist.

4.6 Patient satisfaction with teledermatology-supported referral management

Two studies in a suspected cancer population[311, 312] and five[26, 29, 347, 350, 354] in a mixed dermatology population provided comparative evidence of patient satisfaction between TD and traditional FTF evaluation. Overall, studies measured patient satisfaction heterogeneously using different questionnaires assessing various components of satisfaction. Full details are shown in Table 4.28.

In the suspected cancer population, satisfaction was measured by one study on a 5-point Likert scale (1= poor, 5= excellent).[312] Patients evaluated through TD assigned higher numerical scores (4.5 for overall experience and 4.0 for appointment wait times) compared with those assessed by traditional FTF evaluation (3.8 for overall experience and 2.9 for appointment wait times). Among the TD cohort, 73% expressed a preference for TD consultations, whereas only 33% of the FTF cohort indicated the same preference, however, these patients were not exposed to TD during the study. Another study by Hunt 2020[311] used the 'NHS Friends and Family Test' to rate the likelihood of patients recommending use of either FTF or TD services to others. They found comparable percentages of patients willing to recommend either FTF (n=40) or TD services (n=34) to friends and family, with 80% (FTF) and 88.2% (TD) 'extremely likely' to do so.

In studies focusing on a mixed population, TD generally showed similar outcomes in satisfaction compared with FTF evaluation, although results varied across studies and specific domains. In Piette 2017, global satisfaction was high in both groups with 84.9% and 94% of TD-assessed and FTF-evaluated patients, respectively, reporting they were very satisfied or satisfied.[26] However, TD was more favourable when patients were asked about their satisfaction with the delay before treatment, with 71.7% and 26% of TD and FTF patients, respectively expressing satisfaction. Although the differences between the two groups were not statistically significant, there was variation in time to treatment for the cohorts. The median delay from GP consultation to treatment initiation was 40 days for the FTF cohort, and four days for the TD cohort. In another study examining satisfaction with wait times, the mean wait for a first appointment was 144 days in the FTF cohort and 59 days in the TD cohort. Satisfaction, measured on a 5-point Likert scale (with five being excellent), averaged 2.9 for the FTF cohort and 4.0 for patients evaluated via TD. Whited 2013 measured overall satisfaction with care received using a single statement: 'Overall, I am satisfied with the care that I received for my skin problem'.[350] The proportion strongly agreeing with the statement was similar in the FTF evaluated cohort (71.5%) compared with the TD group (66.7%). Neutral and agreement responses were similar, and dissatisfaction rates were low across both groups. Using a 5-point Likert scale, Marchell 2017 assessed patient satisfaction between LI (low- and high-

quality video), SAF, and FTF evaluation; all patients were assessed with each method during the study.[354] High mean satisfaction scores were observed across all modalities (range 4.66 to 4.75), however differences were observed. LI TD scored significantly lower than standard SAF TD ($p<0.001$ for both low and high quality video). Similarly, LI TD was assessed significantly lower compared with traditional FTF evaluation ($p=0.0001$ and $p=0.004$ for low and high quality video, respectively). No significant difference was observed between the patient's ratings of standard SAF and FTF evaluation. Eminovic 2009 used a validated tool to measure patient satisfaction. Results supported the comparability of TD and FTF evaluation reporting no significant differences between the groups at an individual question level.[29] Lopez-Liria 2022 also used validated tools, namely the 'Generic Short Patient Experiences Questionnaire' (GS-PEQ) to assess patients' experiences, and the Healthcare Communication Questionnaire (HCCQ) to measure the communication of patients with healthcare professionals. According to the GS-PEQ, TD-assessed patients had greater confidence in the professional skills of the doctors ($p<0.01$). However, the FTF evaluated cohort indicated having received more adequate information about their diagnosis ($p<0.01$), were more involved in the decisions related to their treatment ($p<0.01$), and more satisfied with the help and treatment received ($p<0.01$). Regarding the HCCQ, the TD-assessed cohort obtained better assessments with respect to if the patients had been treated in a rude and hasty manner, if the health professionals had addressed them with a smile, and if the provider could adequately manage the reason for the consultation ($p<0.01$).[347]

Table 4.28 Patient satisfaction with TD versus FTF evaluation

Study Author and Year	N – patients	Satisfaction measurement	Domain	Results - TD	Results – FTF evaluation	
Suspected cancer (mixed) population						
Hunt 2020	SAF_MSC _DSC: 34 FTF: 40	NHS Friends and family test Likelihood to recommend service 3-option postal questionnaire	Extremely likely	88.2% (30/34)	80.0% (32/40)	
			Likely	8.8% (3/34)	15.0% (6/40)	
			Neither likely nor unlikely	2.9% (1/34)	5.0% (2/40)	
Lim 2012	SAF_MSC _DSC: 108 FTF: 40	5-point Likert scale 1= poor to 5= excellent	Overall experience	4.5	3.8	
			Wait time for appointment	4.0	2.9	
			Convenience and wait time at clinic	4.1-4.7	3.3-3.8	
			Time spent with health professional and explanation provided	4.1	4.5	
			Preference for TD over FTF	73%	33%	
Mixed dermatology population						
Eminovic 2009	SAF: 191 FTF: 159	Patient Satisfaction Questionnaire III (20 of 43 items)	Mean (SD) regarding interpersonal aspects	4.13 (0.62)	4.15 (0.73)	
			Mean (SD) score for general satisfaction	3.8 (0.59)	3.8 (0.59)	
			Individual question level	No significant differences between groups		
Lopez-Liria 2022	SAF_imageclinic _DSC: 225 FTF: 225	Generic Short Patient Experiences Questionnaire' (GS-PEQ) and Healthcare Communication Questionnaire (HCCQ)	Did the clinicians talk to you in a way that was easy to understand?	4.37	4.47	p=0.20
			Do you have confidence in the clinicians' professional skills?	4.49	4.34	p<0.01 ES: 0.11
			Did you get sufficient information about your diagnosis/afflictions?	4.36	4.59	p<0.01 ES: 0.16
			Did you perceive the treatment as adapted to your situation?	4.36	4.28	p=0.60
			Were you involved in decisions	3.66	4.58	p<0.01

Study Author and Year	N – patients	Satisfaction measurement	Domain	Results - TD	Results – FTF evaluation	
		Results report mean score on a scale of 1-5 (1= not at all; 5= to a very large extent) and p-value for difference between groups. Effect size for significant differences is reported where appropriate	regarding your treatment?			ES: 0.42
			Did you perceive the institution's work as well organised?	3.60	2.86	p<0.01 ES: 0.31
			Did you have to wait before you were admitted for services at the institution?	4.33	4.31	p=0.65
			Overall, was the help and treatment you received at the institution satisfactory?	2.69	4.42	p<0.01 ES: 0.55
			Overall, what benefit have you had from the care at the institution?	1.20	1.12	p=0.07
			Do you believe that you were in any way given incorrect treatment?*	2.81	1.24	p<0.01 ES: 0.53
			I was asked questions in an aggressive manner*	1.00	1.00	p=1.00
			I was given answers in an aggressive manner*	1.00	1.00	p=1.00
			I was treated with kindness	4.50	4.12	p<0.01 ES: 0.26
			I was treated in a rude and hasty manner*	1.45	1.51	p<0.01 ES: 0.04
			The healthcare provider addressed me with a smile	3.90	2.70	p<0.01 ES: 0.69
			The healthcare provider was able to manage the consultation	3.69	3.28	p<0.01 ES: 0.28
			Did the clinicians talk to you in a way that was easy to understand?	4.97	5.0	p<0.014 ES: 0.11
	LI_lowquality: 112	5-point Likert scale	Mean (SD) satisfaction	LI_low quality: 4.66 (0.80)	4.75 (0.81)	

Study Author and Year	N – patients	Satisfaction measurement	Domain	Results - TD	Results – FTF evaluation	
Marchell 2017	LI_highquality: 97 SAF: 209 FTF: 206	1= strongly disagree 5= strongly agree		LI_high quality: 4.68 (0.73) SAF: 4.74 (0.86)	Low and high quality LI rated significantly lower than SAF (p=0.0008; Uncompressed p=0.0006). Low and high quality LI rated significantly lower than FTF (p=0.0001; p=0.004). No significant differences between SAF and FTF	
Piette 2017	SAF: 53 FTF: 50	2-option questionnaire	Global satisfaction: % very satisfied or satisfied	84.9%	9%	p=0.99
			Global satisfaction: % unsatisfied or very unsatisfied	15.1%	6%	
			Delay before care: % very satisfied or satisfied	71.7%	26%	p=0.20
			Delay before care: % unsatisfied or very unsatisfied	28.3%	74%	
Whited 2013	SAF_MSC: 159 FTF: 166	Single question: Overall, I am satisfied with the care that I received for my skin problem	Strongly agree	66.7%	71.5%	
			Agree	20.1%	20.6%	
			Neutral	8.8%	6.7%	
			Disagree	2.5%	1.2%	
			Strongly disagree	1.9%	0%	

Key: ES: effect size; FTF – face-to-face; LI_highquality – live interactive video on high quality; LI_lowquality – live interactive video on low quality; SAF – store-and-forward; SAF_MSC_DSC – store-and-forward with macroscopic and dermatoscopic images; SD – standard deviation; TD – teledermatology.
Footnotes: *Negative items.

4.7 Health service utilisation

The reported impact on health service utilisation of implementing a TD service for triage and diagnosis of dermatological conditions compared with routine FTF consultation is described in the following section. Outcomes include the various wait times experienced along the patient pathway from referral to treatment, the proportion of appointments which could be dealt with by TD and not require FTF consultation, the change in referrals in both dermatology and subsequent services due to the implementation of TD, proportion of FTF appointments avoided, the reported duration of appointments and numbers of follow-up appointments.

4.7.1 Wait times

The impact of triaging patients using TD is highlighted by changes in the length of time that patients wait to receive definitive treatment and biopsies, and the time spent waiting between a GP referral and dermatologist contact, or to see a dermatologist in a conventional FTF. While there is heterogeneity in study characteristics and reporting, and the underlying services provided vary, the following graphs (Figure 4.14 to Figure 4.16) illustrate the overall trend in wait times across services comparing SAF TD to FTF dermatology consultation. Each graph presents the time in days (median or mean) to a particular event along the patient pathway for SAF on the y-axis and FTF on the x-axis. Each point on the graph represents a single comparator pair (SAF, FTF), with point size and colour related to total sample size and subgroups respectively. The dashed 45 degree line represents the line of equivalence. A point on this line demonstrates no difference in times experienced between interventions. Points above the line represent longer waiting times reported in the SAF intervention arm and points below the line represent longer waiting times in the FTF intervention arm. Comparisons involving live interactive TD, or comparisons between different forms of SAF TD are discussed narratively. Note in the following sections, the data are not disaggregated by type of SAF image. Table A 6, Table A 7 and Table A 8 in the Appendix provide further details of studies and results reported.

4.7.2 Time to definitive treatment

A total of 13 studies reported the time taken from GP referral to receipt of a definitive treatment (such as medication prescription, procedure completion). Of these, one study each involved a suspected melanoma[274] and a suspected NMSC population[310], nine studies involved suspected cancer populations,[285, 289, 291, 299, 305, 306, 309, 311, 341] and two were in mixed populations.[233, 319] There was variability in wait times across studies, with some reporting longer wait times for benign lesions compared with malignant lesions.[289] Further heterogeneity in study design and

context affected individual study wait times. Figure 4.14 illustrates reported time to definitive treatment in studies comparing SAF with FTF.

4.7.2.1 Suspected melanoma population

A single study[274] in patients with suspected melanoma was identified. It reported a shorter mean time from referral to diagnostic excision in the TD arm (SAF: 11.4 days vs FTF: 13.9 days.

4.7.2.2 Suspected NMSC population

The time from referral to definitive treatment in a suspected NMSC population was reported by one Spanish study.[310] The time to definite treatment (surgery) was significantly shorter in the TD arm (SAF: 26.1 days vs FTF: 60.6 days).

4.7.2.3 Suspected cancer (mixed) population

The time from referral to definitive treatment in a mixed suspected cancer population ranged from 35.5[311] to 112.7 days[291] in SAF patients compared with a range of 35 days[311] to 125 days[285] in FTF patients (Figure 4.14). Definitive treatment commenced between 0.3[291] and 36.2[341] days sooner for SAF patients compared with FTF patients.[291, 341]

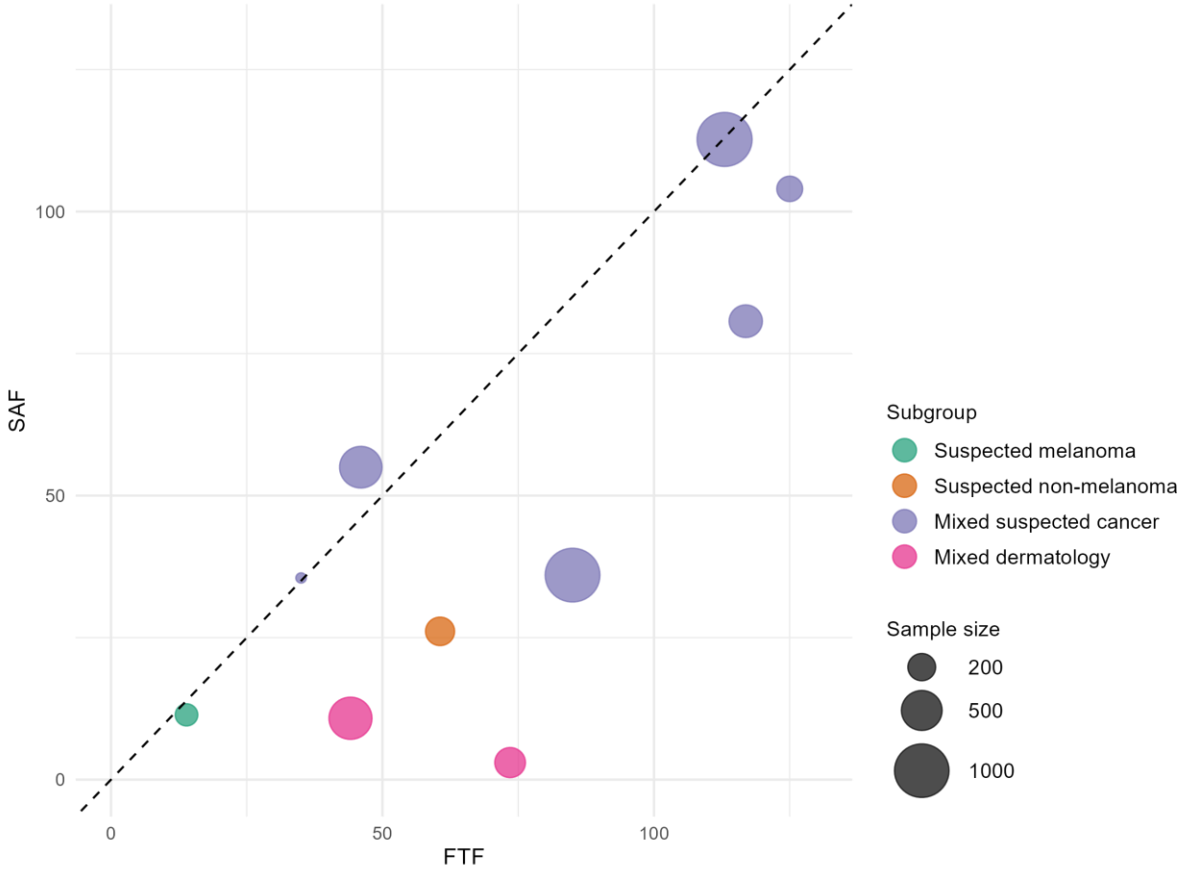
A service evaluation of a regional UK skin cancer service[306] reported that a higher proportion of histologically-confirmed melanomas initially prioritised as urgent were treated within the 62 day treatment target in the TD arm (SAF: 100% (median 21.5 days, range seven to 47 days) vs FTF: 77% (median 41 days, range 14 to 119 days)). They also reported that in histologically-confirmed squamous cell carcinoma, 60% of those prioritised as urgent by SAF were seen within 62 days (median 56 days) compared with 40% seen by FTF (median 73 days). One study compared the difference in time to definitive treatment in two SAF intervention arms, with one arm getting direct referral from GP to TD, and one getting referral to an imaging clinic prior to TD review. Direct referral took a median of 21.5 days compared with 94 days in those requiring a separate imaging appointment.[305] One study retrospectively compared time to surgical treatment in a biopsy-confirmed cancer population, reporting an 80.7 day wait in SAF patients compared with 116.9 days in FTF patients, including the time taken to biopsy after SAF or FTF consultation.[341] A study[299] in Sweden compared the mean time to definitive dermatology treatment in the year before and after implementation of SAF. It reported a reduction of seven days in the average wait time to treatment, although this was not statistically significant. In addition to the above studies, there was one study that reported time from SAF report to surgery rather than time from GP referral to surgery, where triage of SAF referrals occurred in a tertiary skin cancer centre. Compared with treatment times under the conventional FTF referral system, mean time to definitive

treatment was shorter for the subset of patients identified for high-priority management following SAF (mean time between SAF report and surgery: nine days vs 81 days for the conventional FTF referral system).[309] This study is not included in Figure 4.14.

4.7.2.4 Mixed dermatology population

In the two studies reporting in a mixed population, time to definitive treatment was shorter in the SAF arm compared with FTF (3.0 vs 73.5 days; 10.8 days vs 44.1 days (Figure 4.14)).[233, 319] However, the study reporting three days to definitive treatment in SAF included time to any treatment whereas other studies (including in the suspected cancer studies) tended to report time to surgical procedures only.[319]

Figure 4.14 Wait time to definitive treatment in days



Key: FTF – face-to-face, SAF – store and forward.
Footnote: *Time in days (median or mean) to event; points below the dotted line reflect longer waiting time in the FTF intervention arm. #Damsin 2023 not shown on graph.

4.7.3 Time to biopsy

4.7.3.1 Suspected cancer (mixed) population

Four studies[285, 286, 291, 341] reported time to biopsy in mixed suspected cancer populations, with this time noted to differ substantially between studies ranging from

9.7[286] to 47.3 days[291] in SAF patients compared with 13.8[286] to 65.4 days[341] in FTF patients. In three of the four studies, time to biopsy was shorter for SAF patients (4.1 to 38.7 days), while in one study it was 1.8 days slower compared with FTF patients. Figure A 6 in the Appendix illustrates the wait time to biopsy in days for suspected cancer patients. None of the studies reported explicitly if the biopsy occurred before, during or after the FTF appointment.

4.7.4 Time to initial dermatology contact

A total of 34 studies reported on time elapsed between GP referral and either teledermatologist contact/advice to GP or FTF appointment. This consists of one study[275] in a suspected melanoma population, 13 studies in mixed suspected cancer populations,[71, 112, 285, 288, 289, 299, 305-307, 311-314] 17 studies in mixed dermatology populations,[26, 27, 261, 264, 265, 290, 319, 323, 324, 329, 330, 336, 339, 341, 343, 352, 355], and three studies in non-cancer populations.[262, 266, 363] Figure 4.15 illustrates the overall wait times in studies comparing SAF and FTF patients.

4.7.4.1 Suspected melanoma population

A study[275] comparing wait time to initial dermatologist contact in a virtual SAF lesion service for suspected melanoma, using imaging clinics in New Zealand, reported a median wait of nine days in the SAF group compared to a median wait of 26.5 days for a FTF review. It may be possible that wait times to the SAF clinic were expedited as they only received referrals for suspected melanoma.

4.7.4.2 Suspected cancer (mixed) population

Ten studies compared SAF to FTF in suspected cancer populations (Figure 4.15).[71, 285, 288, 289, 306, 307, 311-314] Seven of these were direct referral to TD,[71, 285, 288, 289, 311, 313, 314] while three studies referred via imaging clinics.[306, 307, 312] Irrespective of where SAF imaging occurred, wait times were shorter in the SAF arm, with differences of between 4.8 and 119 days reported. The wait time to teledermatologist reply in direct referrals ranged from under one[289] to eight days[311] compared with between five[289] to 120 days[71] with conventional FTF consultation. The wait time to teledermatologist reply in studies with referral via imaging clinic was 28[307] and 39 days,[312] respectively, compared with 50[307] and 114 days[312] with FTF consultations in the same studies. One study compared the difference in wait times in two SAF intervention arms with one arm getting direct referral from GP to TD, and the second referred to an imaging clinic prior to TD review.[305] Direct referral took a median of five days compared with 42 days in those requiring a separate imaging appointment. Both arms had shorter wait times than the original imaging clinic pathway in the pre-intervention period.[305] A pilot study of SAF TD reported that wait times for FTF dermatology fell to a mean of 54 days in the intervention period,

compared with 139 days in areas that did not offer TD.[112] One study compared a wait time of 56.7 days for dermatology in the period before SAF was introduced with a wait time of 49.7 days (combined mean wait for initial FTF or SAF) after the introduction of a SAF imaging clinic.[299]

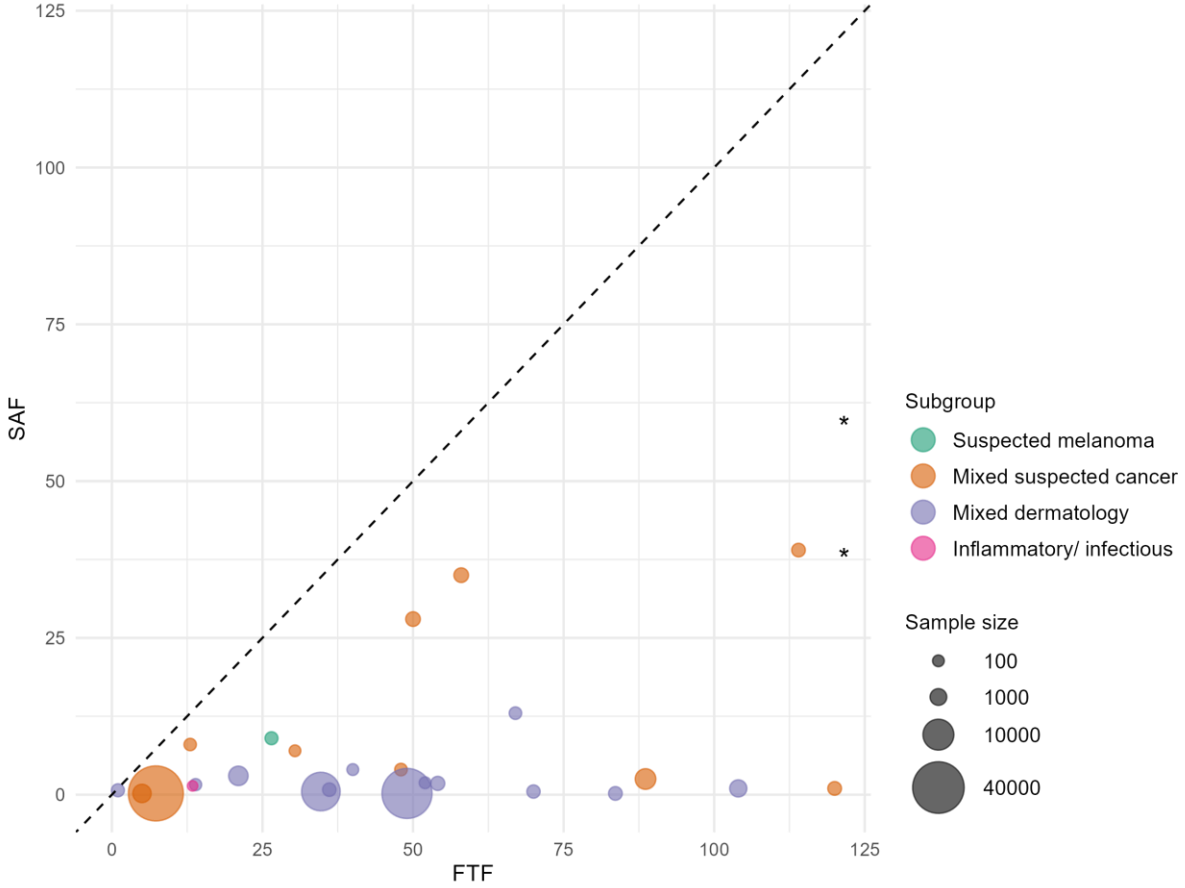
4.7.4.3 Mixed dermatology population

Of the 17 studies reporting in mixed populations, 14 compared SAF to FTF[26, 27, 264, 265, 290, 319, 323, 329, 330, 336, 339, 341, 343, 352] and one study compared SAF via an imaging clinic to FTF (Figure 4.15).[261] These studies are included in Figure 4.15. Wait times for SAF reply compared with FTF consultation were shorter irrespective of where imaging took place with differences ranging from 0.3 to 175 days. The 0.3 day difference occurred in a study with short wait times in SAF and FTF groups of 0.7 and one day, respectively,[264] while the longer wait time for FTF corresponds to a 30-week wait for routine FTF appointments.[261] The wait time to receive a teledermatologist reply after GP referral in SAF patients ranged from under one[329] to 13 days.[290] This compared with between one[264] and 104 days[343] in the FTF comparator population in these studies. The upper limit of FTF wait time of 104 days was in the intervention period of a study that reported a wait of 77 days for FTF during the pre-intervention period.[343] Time to SAF reply in the same study was only one day.[343] Where an imaging clinic was used in the SAF pathway, the wait time was 35 days compared with 210 days for FTF dermatology.[261] One study compared both SAF and LI to FTF, reporting waits of three, five and 21 days respectively.[352] Another study compared the median SAF wait time to the combined wait for SAF and FTF patients in the intervention period and to FTF wait in the pre-intervention period, with a wait of 0.5, one and 70 days in these periods respectively.[319] Two studies are not included in the graph. One study reported a mean wait for FTF consultation of approximately 91 days in the pre-intervention period compared with combined wait times for dermatology (SAF and FTF) of approximately 61 days in the intervention period.[324] A study comparing wait times for an initial LI appointment to FTF times found no significantly difference in a small sample.[355]

4.7.4.4 Inflammatory/infectious conditions population

Three studies compared wait times for SAF and FTF in non-cancer populations, with all three reporting shorter wait times with SAF (Figure 4.15).[262, 266, 363] In two studies the wait times for SAF were 1.4 and 56 days respectively, compared with 13.4 and 252 days wait for FTF, respectively.[262, 266] The third study reported that SAF resulted in waiting times of approximately 10 days (65 working hours) that were 50% shorter than those seen in FTF.[363]

Figure 4.15 Wait time to dermatologist contact after GP referral in days



Key: FTF – face-to-face, GP – general practitioner, SAF – store and forward.
* Outliers not show on graph (56, 252) and (35, 210).
Footnote: #Time in days (median or mean) to event; points below the dotted line reflect longer waiting time in the FTF intervention arm. †Two studies reported waiting times as working days.[352, 363] To facilitate comparisons, a conservative adjustment has been applied whereby two additional days have been added for every five days wait, in excess of five business days. ‡Six studies did not report sample sizes for the FTF comparator group, therefore overall sample size is likely to be larger than represented here.[261, 262, 264-266, 339]

4.7.5 Time to FTF appointment after initial TD

Where diagnosis or management is not possible with TD, a FTF referral may be warranted. Seven studies reported the length of time it took for a FTF appointment after SAF assessment.[26, 27, 289, 313, 314, 341, 343] Figure 4.16 illustrates the FTF appointment post-SAF wait times compared with wait times for those referred direct to FTF.

4.7.5.1 Suspected cancer (mixed) population

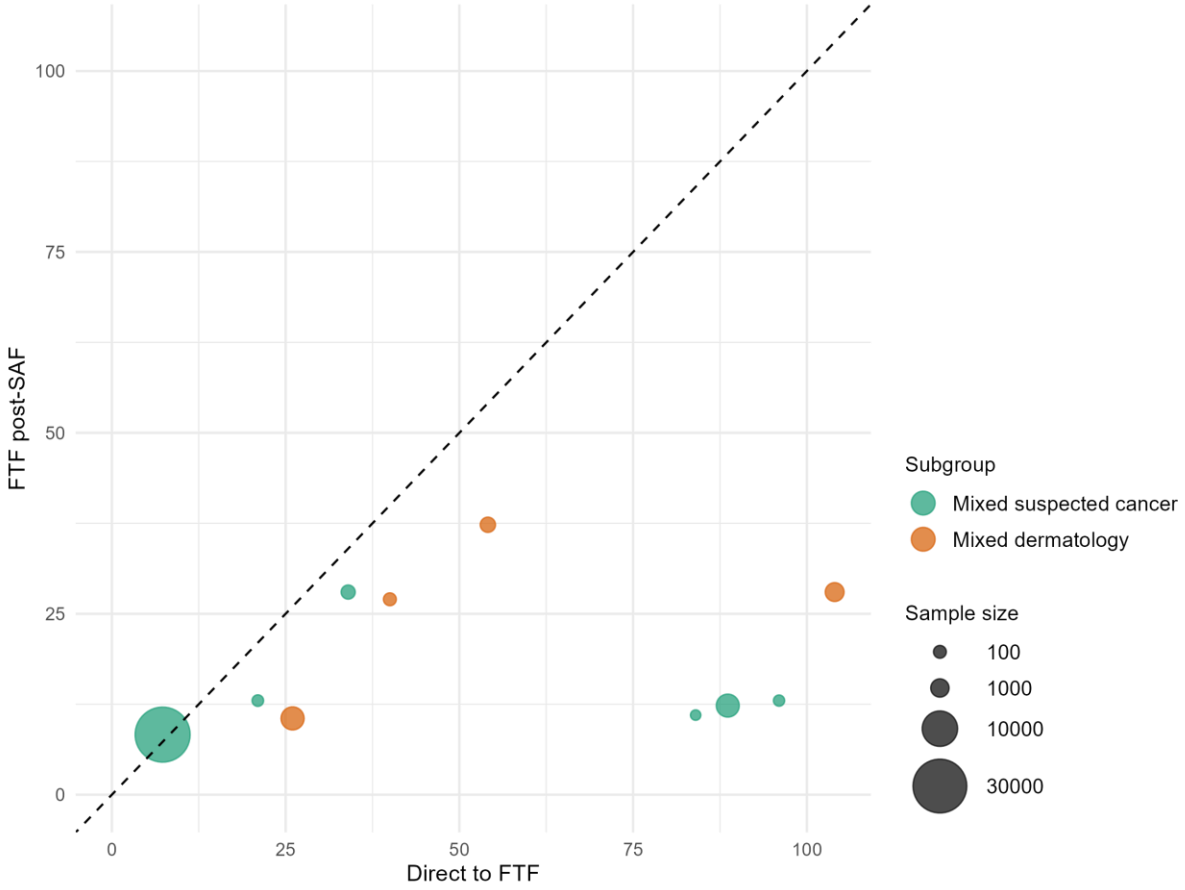
Four studies reported the wait time from referral for a FTF appointment post-SAF in suspected cancer patients, with three of the four studies reporting shorter wait times in the SAF arm (Figure 4.16).[51, 289, 313, 314] These ranged from 8 to 28 days

compared with from 7 to 96 days in patients referred directly to FTF.[51, 289, 314] This corresponds to wait times of 83 days less to one day more for FTF post-SAF consultation. The longer wait time was in a system where FTF consultations occurred in 7.3 days.[313] However, one study[51] reported only the wait time for lesions identified as high priority lesions following SAF compared to standard waits in FTF which could result in some bias.

4.7.5.2 Mixed dermatology population

Four studies reported the wait time from referral for a FTF appointment post-SAF in mixed populations (Figure 4.16), all of which reported shorter wait times in the SAF arm.[26, 27, 341, 343] Wait times ranged from 8.3 to 37.3 days compared with from 7.3 to 104 days in patients referred directly to FTF.[26, 27, 341, 343] This corresponds to a difference in wait times of between 13 and 76 days less for FTF post-SAF consultation.

Figure 4.16 Wait time to FTF appointment after initial TD appointment in days



Key: FTF – face-to-face, SAF – store and forward.
Footnote: Graph contains more points than studies as some studies reported multiple different groups; time in days (median or mean) to event; points below the dotted line reflect longer waiting

time in the FTF intervention arm. Note: Damsin 2020 (11, 84) compares high priority lesions to conventional referral population.

4.7.6 Face-to-face consultations prevented

A potential benefit of TD is the diversion of referrals away from the conventional hospital-based consultant clinic setting. A TD appointment does not equate to a complete resource saving in terms of FTF appointments and clinics, representing instead a shift in resource use. Each pathway comprises a number of interactions with healthcare professionals, some of which may be simplified or eliminated through the use of TD. However, it is also acknowledged that there is a risk that misclassification of conditions through TD could lead to increased healthcare utilisation. The following section details the impact of TD on FTF dermatology appointments. A total of 36 studies reported outcomes related to prevented FTF consultations.[26, 27, 29, 233, 261-265, 280, 285, 287, 290, 294, 304, 305, 307, 312, 314, 315, 318, 319, 321-324, 326, 330, 340-343, 349, 356, 370, 371] The definition of prevented appointments, the services provided, and the clinical context of the study setting differed greatly between studies thereby limiting comparison between different types of TD. Caution is advised in comparing results between different studies. However, to facilitate interpretation, results have been grouped into those that report the proportion of patients who could be managed between TD and the GP without requiring a FTF consultation to complete their diagnosis or treatment (appointments avoided), and appointments where a completed FTF consultation was defined as preventable or unnecessary (preventable appointments). Definitions of preventable FTF appointments varied across studies. Table 4.29 below provides details of preventable appointments and how individual studies define preventable. Figure 4.17 illustrates the percentage of avoided FTF appointments by population subgroups and Table A 9 in the Appendix provides further details of appointments avoided.

4.7.6.1 Suspected melanoma population

No studies reported appointments avoided, or preventable appointments in suspected melanoma populations.

4.7.6.2 Suspected cancer (mixed) population

4.7.6.2.1 Appointments avoided

Eleven studies reported on appointments avoided (Figure 4.17), with all studies reporting a reduction in the number of patients requiring initial FTF consultations.[285, 287, 290, 294, 298, 304, 305, 307, 312, 314, 370] The proportion of FTF dermatology consultations avoided with SAF TD consultation ranged from 13%[287] to 91.5%.[305] Of note, the low estimate of 13% related to a study that defined appointments avoided on the basis of patients requiring reassurance only and no follow-up. A further 9% of

patients in that study required review to re-photograph changing lesions after three to four months, although in reality this type of management could potentially be carried out through TD. One study using within-group comparison of SAF and FTF in the same patient group reported that a mean of 32.6% of SAF patients avoided a FTF appointment, while 38% of FTF appointments were deemed preventable.[304] One study[298] found that the addition of dermoscopy to SAF resulted in 60.7% of FTF appointments avoided compared with 52.5% with SAF alone, in a sample of 61 referrals. One study using SAF via an imaging clinic reported that 94% of patient referrals did not require a subsequent FTF appointment to establish a diagnosis.[312]

4.7.6.2.2 Preventable appointments

Preventable appointments were reported by three studies (Table 4.29).[29, 314] An RCT investigating SAF in individuals with subsequently diagnosed malignant, pre-malignant and benign skin tumours reported that 0%, 25% and 22% of appointments were preventable, respectively, as patients were either recovered or recovering, or manageable with GP treatment after SAF recommendation, compared with 0%, 25% and 11.8% in those seen FTF.[29] One study utilising SAF and dermatoscopy deemed 68% of referrals to a lesion diagnosis clinic as manageable by the GP with TD advice.[315] Another within-group comparison study reported that 29% of SAF referrals to FTF were considered unnecessary.[314]

4.7.6.3 Suspected NMSC population

4.7.6.3.1 Appointments avoided

One study[280] reported that 28% of SAF consultations for suspected NMSC required a FTF appointment, thereby avoiding the need for FTF follow-up in 72% of cases.

4.7.6.4 Mixed dermatology population

4.7.6.4.1 Appointments avoided

A total of 22 studies reported on appointments avoided in populations with mixed suspected cancer and non-cancer conditions (Figure 4.17), with all studies reporting that TD resulted in appointments avoided.[26, 27, 233, 261, 263-265, 290, 318, 319, 322-324, 326, 330, 340-343, 349, 356, 371] The proportion of appointments avoided ranged from 26%[318] to 84%.[343] Two studies using within-group comparisons reported the percentage of avoided or avoidable appointments as determined by SAF and FTF, respectively.[322, 342] In one study, teledermatologists advised 55.6% of participants that they did not require a FTF appointment, whereas a FTF consultation in the same group determined 42.6% of participant appointments were avoidable.[342] Another study reported that 65.6% of patients could continue to be managed through SAF or in primary care, while FTF consultation deemed 69.6% of patients suitable for follow-

up in primary care.[322] Three studies reported the proportion of patients with conditions manageable without FTF appointments, identifying them as patients that did not have a subsequent referral to FTF within a specified timeframe.[27, 319, 323] In these studies true avoidance, where FTF was not recommended by TD and patients were not referred to FTF subsequently, ranged between 53.7%[27] and 58.8%.[323]

4.7.6.4.2 Preventable appointments

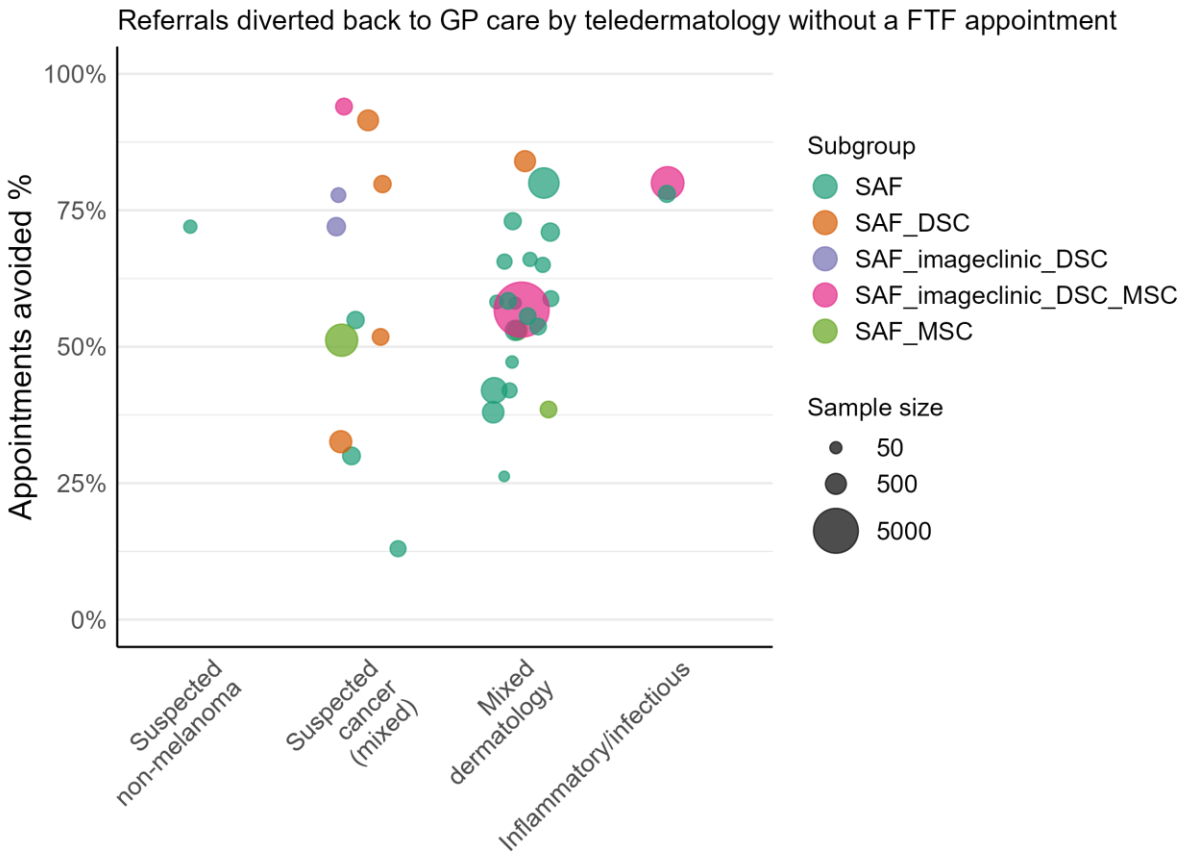
Preventable appointments were reported by three studies (Table 4.29).[29, 318, 321] An RCT reported 39.0% of FTF appointments after SAF were preventable (avoided) compared with 18.3% of FTF patients.[29] Another study reported 43% of FTF consultations after SAF were retrospectively deemed preventable if the TD and final diagnosis were the same, without suspicion of malignancy and with no specific management or biopsy required.[321] One study reported that 73.8% of SAF patients required a FTF opinion, however after that FTF appointment, approximately 30% of those had a diagnosis for which FTF care was not deemed necessary.[318]

4.7.6.5 Inflammatory/infectious conditions population

4.7.6.5.1 Appointments avoided

Two studies reported appointments avoided in non-cancer populations (Figure 4.17).[233, 262] One study reported that 80% of patients that had images (SAF, dermatoscopic, and macroscopic) taken at an imaging clinic for TD review were discharged back to the referring clinic. However, 13% were subsequently re-referred resulting in a true avoidance of 69.6%.[262]

Figure 4.17 FTF appointments avoided



Key: DSC – dermatoscopy, MSC – macroscopy, SAF – store and forward.
Footnote: Graphs contains more points than studies as some studies reported multiple different groups.

Table 4.29 Preventable appointments

Study ID	Study arm		Preventable appointments %	Study definition
Suspected cancer (mixed) population				
Eminovic 2009	Malignant skin tumour	SAF	0	• If the GP's treatment was successful and the patient recovered or was recovering, the dermatologic consultation in the office was considered preventable.
	Malignant skin tumour	FTF	0	
	Benign skin tumour	SAF	11.8	
	Benign skin tumour	FTF	22.2	
	Pre-malignant skin tumour	SAF	25	
	Pre-malignant skin tumour	FTF	25	
Moreno-Ramirez 2007	FTF		28.8	• Proportion of patients presenting with benign lesions after the live examination who were referred to the FTF clinic and who did not require any intervention and were discharged from the clinic.
Tan 2010	SAF_DSC_MSC		68	• Could potentially have been managed by the GP following advice from the teledermoscopist.
Mixed dermatology population				
Abdul-Gafoor 2024	SAF_MSC_DSC		31	• Defined as percentage of cases safely reassured, saving intended appointments.
Eminovic 2009	SAF		18.3	• If the GP's treatment was successful and the patient recovered or was recovering, the dermatologic consultation in the office was considered preventable.
	FTF		39	
Faucon 2022	SAF		43	• A FTF dermatological consultation was defined as preventable if all the following criteria were met: 1) the initial hypothesis in TD was the same as the final diagnosis; 2) no skin biopsy required; 3) no specific management required (including specific monitoring or treatment), and 4) no suspicion of malignancy.
Inflammatory/infectious conditions population				

Study ID	Study arm		Preventable appointments %	Study definition
Eminovic 2009	Psoriasis	SAF	0	• If the GP's treatment was successful and the patient recovered or was recovering, the dermatologic consultation in the office was considered preventable.
	Psoriasis	FTF	45.5	
	Acne	SAF	40.0	
	Acne	FTF	20.0	
	Infection	SAF	61.1	
	Infection	FTF	18.2	
	Eczema	SAF	51.7	
	Eczema	FTF	27.3	

Key: DSC – dermatoscopy, FTF– face-to-face, GP – general practitioner, MSC – macroscopy, SAF – store and forward, TD – teledermatology.

4.7.7 Change in rate of referrals

The following section describes the reported changes to referral rates to FTF dermatology and TD after the implementation of TD. Table 4.30 provides details of the outcomes reported in this section.

4.7.7.1 Suspected melanoma population

No studies were identified that reported on referral rates with TD. A single US study[279] compared appointments for new in-person referrals with telemedicine referrals during the COVID-19 pandemic. Details are provided in the Appendix B.

4.7.7.2 Suspected cancer (mixed) population

Three studies reported the impact on rates of referral for individuals with suspected cancer (Table 4.30).[261, 294, 299] An evaluation of a regional pilot in the UK compared referral rates from GP practices with access to a new SAF service with referral rates from GP services who did not have access to TD. This study was reported as a general dermatology pathway; however, for the purpose of this analysis it was considered to relate to a suspected cancer population given the characteristics of study population. Adjusted time series analysis showed a statistically significant increase in the number of FTF dermatology referrals after introduction of SAF which equated to one additional FTF for every 1,389 practice population in practices with access to SAF over the first year.[294] A separate regional study in the UK showed that, following the introduction of a TD service, referrals to Two Week Wait suspected cancer pathways continued to increase, with a 6% increase observed between April to September in 2018 and 2019.[261] A pre- and post- comparison[299] of the implementation of TD in a region of Sweden reported that in the year prior to implementation, 0% of referrals (n=321) were seen by TD, compared to 65.7% (n=211 of 321 total referrals) in the year after TD implementation.

4.7.7.3 Mixed dermatology population

Five studies reported on referral rates in mixed populations (Table 4.30).[261, 263, 336, 341, 343] A German RCT of regional implementation of SAF TD reported no significant difference in overall referral rates when comparing interventional practices where SAF was available to control practices where SAF was not available.[263] Following implementation of mandatory referral criteria to TD using SAF imaging clinics, and comparing six-month periods in the first three years (2017-2019), a regional UK study reported increasing referral rates to TD (19%, 33% and 46%) accompanied by decreases in the rate of referral to FTF appointments (37%, 34%, 29%); with results showing almost twice the number of TD consultations as FTF consultations for the same amount of consultant time. However, it should be noted that in this system, all lesions meeting specific criteria, excluding Two Week Wait referrals, were

required to be seen through TD.[261] A US study reported that the average rate of referrals to dermatology remained stable between pre- and post-implementation of TD consultations.[343] Data from a small Spanish pilot indicated a progressive decrease in SAF-based TD consultations which was attributed to a service design failure due to poor image quality.[336] One further study reported that over a 25-month study period, the volume of FTF referrals remained stable while SAF referrals increased from less than 1% to 10% of all referrals, indicating a potential increase in the overall rate of referrals during this time.[341]

Table 4.30 Changes in rate of referral to dermatology

Study ID	Study arm	Referrals	Context and key referral points
Suspected melanoma population			
Chang 2021	FTF_pre FTF_post	4.8 new weekly appointments 0.8 new weekly appointments	Pre and post COVID-19 pandemic closure comparison of new patient appointments seen in-person and by telemedicine. • Mean decrease of 4 in-person appointments (SD 3.1) p<0.001. • Mean increase of 0.67 telemedicine appointments (SD 1.3)p=0.04.
	LI_pre LI_post	0.0 new weekly appointments 0.67 new weekly appointments	
Suspected cancer (mixed) population			
Ford 2015	Combined_pre_DSC Combined_post_DSC	15.19 referrals / 1,000 practice population 17.30/1,000	Pre and post comparative evaluation of a pilot SAF_DSC service evaluating overall referral rates to dermatology in practices with access to TD compared with practices where TD is not available. • One additional referral per 1389 practice population.
	Combined_pre_noTD Combined_post_noTD	13.85/1,000 15.25/1,000	
Palamaras 2022	FTF	April-September 2017- 31% of all referrals 2018- 33% 2019- 35%	Evaluation of implementation of mandatory referral criteria to TD. Between 2018 and 2019: • 6% increase in Two Week Wait cancer referrals.
Sahin 2024	Combined_pre	0 TD referrals 321 total referrals	Pre and post implementation comparison. • 65.7% referrals diverted to TD in the year post-implementation.
	Combined_post	211 TD referrals 321 total referrals	
Mixed dermatology population			
Koch 2024 TELEDerm	Combined_pre_noTD Combined_post_noTD	66.29 referrals / 1,000 patients 68.40/1,000	Pre and post comparison of a SAF_DSC service implemented at a county level comparing overall referral rates to dermatology in counties with access to TD to counties where TD is not available. • No significant change in referrals over time.

Study ID	Study arm	Referrals	Context and key referral points
	Combined_pre Combined_post	48.81/1,000 53.04/1,000	
Naka 2018	Combined	10.77 referrals /1,000 visits	Pre and post comparison of implementation of a new SAF eConsult system comparing pre-and post implementation referral rates to SAF and FTF. • Average consult request volume remained stable throughout with no significant change at 10.77 referrals per 1000 patient visits.
	SAF_post	499 referrals /6 months	
	FTF_pre	1,258 referrals /6 months	
	FTF_post	628 referrals/ 6 months	
Palamaras 2022	SAF_imageclinic_DSC_MSC	April-September 2017- 19% of all referrals 2018- 33% 2019- 46%	Evaluation of implementation of mandatory referral criteria to TD utilising SAF imaging clinics with dermatoscopy and macroscopy over the first three years. Between 2018 and 2019: • 38% increase in TD referrals • 16% decrease in FTF referrals • TD consultants reviewed almost twice the number of patients than FTF consultants for the same amount of time.
	FTF	April-September 2017- 37% of all referrals 2018- 34% 2019- 29%	
Taberner-Ferrer 2009	SAF	128 consultations in 2006 21 consultations in 2007 9 consultations up to July 2008	Small pilot study involving two primary care centres and one secondary care dermatology service. • Progressive decrease in teleconsultations observed over time — possibly exacerbated by poor image quality.
Wang 2020	SAF_pre SAF_post	<1% of all referrals 10%	

Study ID	Study arm	Referrals	Context and key referral points
	FTF	1,000-1,400 referrals per month	Evaluation of implementation of a SAF TD programme over 25 months comparing SAF and FTF dermatology referral rates over time. • FTF referrals remained stable • Proportion of all referrals from TD increased from <1% to 10%.

Key: DSC – dermatoscopy, FTF– face-to-face, GP – general practitioner, MSC – macroscopy, SAF – store and forward, TD – teledermatology.

4.7.8 Missed appointment rates

Missed appointments, also known as 'did not attends' or 'no-show' appointments, have a profound impact on waiting times and lead to an inefficient use of healthcare resources.[377] By design, direct referral TD with imaging in a GP practice should not have missed appointments, as referral is contingent on attendance. However, TD via an imaging clinic or synchronous (live interactive) TD could be subject to a similar risk of missed appointments as conventional FTF appointments. Care must also be taken when comparing missed appointment rates in patients referred to FTF after a SAF TD appointment to patients referred directly to FTF. These populations may differ as it is possible more complex cases may be referred directly to FTF consultation, while patients with conditions that are healed or improving, or manageable with GP support, will have been managed within TD. While typically reported as missed appointments, one study reported these data as a referral capture rate;[233] this represents the proportion of TD or conventional FTF referrals that complete the pathway. Table 4.31 provides details of all the studies reporting on this outcome.

4.7.8.1 Suspected cancer (mixed) population

Within a suspected cancer population, two studies reported the rate of missed appointments comparing SAF TD to FTF dermatology appointments (Table 4.31).[233, 312] One study reported no difference in missed appointments (7%) between FTF consultation and those referred to TD via a SAF imaging clinic.[312] It also reported a low rate of missed appointments in those referred to FTF post TD of 0.5%.[312] One further study reported the referral capture rate in SAF consultations compared with FTF consultations in areas where TD was not available, with capture rates of 74.3% and 73% reported, respectively, in patients with neoplasms.[233] Although the authors do not offer reasons for the low referral capture rate in this study, it could be explained by a relatively large number of benign lesions or lesions of unknown significance in the FTF cohort without TD access that may have resolved by the time of the appointment. Conversely, practices with access to TD referred a greater proportion of neoplasms to FTF than SAF, without reporting the referral rate for this FTF group.

4.7.8.2 Suspected NMSC population

A Spanish pilot study investigating the use of TD with the ability to triage direct to surgery reported a 3.0% on-the-day cancellation rate for surgeries organised via SAF TD compared with an 8.9% cancellation rate for surgeries organised via conventional FTF dermatology.[310]

4.7.8.3 Mixed dermatology population

Four studies compared the percentage of missed appointments in SAF TD consultations to FTF dermatology consultations (Table 4.31).[233, 264, 319, 343] A pre- and post-intervention study reported that missed appointments fell in the FTF consultation cohort from 35.8% to 30.8% after SAF was introduced, while 12.1% of SAF patients referred to FTF registered a missed appointment.[319] Following implementation of TD, one study reported 24% missed appointments in those referred to FTF after SAF compared with 84% of those referred direct to FTF; however, it is noted that this study was undertaken in a setting with a poor rate of appointment completion (139 patients seen out of 1,258 referred pre-implementation of TD).[343] One study reported a referral capture rate of 88.4% for patients in the SAF cohort compared with 61% for the FTF cohort that did not have access to SAF. However, as GPs in the SAF arm had the option to refer directly to FTF this may have impacted upon the referral capture rate.[233] In one study, 22% of directly referred FTF appointments were missed compared with 11% of those referred to FTF from a SAF TD consultation.[264] One study reported 4.8% missed appointments in those referred to FTF after SAF TD compared with 9.7% in those referred directly.[341]

4.7.8.4 Inflammatory/infectious conditions population

There was one study reporting on missed appointments in a non-cancer population (Table 4.31).[233] A referral capture rate of 90.7% was reported for the SAF cohort compared with 61% for the FTF cohort in patients with inflammatory conditions.[233]

Table 4.31 Missed appointment rates

Study ID	Comparison	Missed appointments %	Referral capture rate^ %	Context
Suspected non-melanoma cancer population				
Ferrandiz 2007	SAF_MSC	3*	NR	• Comparing patients triaged directly to surgery from SAF without FTF consultation with conventional FTF route.
	FTF	8.9*		
Suspected cancer (mixed) population				
Lim 2012	SAF_imageclinic_DSC_MSC	7	NR	• No difference between missed appointments in SAF imaging clinic and FTF consultation.
	FTF	7		
	FTF_postSAF#	0.5		
Wu 2021	FTF_postSAF#	NR	74.3	• Comparing SAF with FTF (in an area without access to TD) in patients with neoplasms.
	FTF_noTD		73	
Mixed dermatology population				
Carter 2017	FTF_pre	36	NR	
	FTF_post	30.8		
	FTF_postSAF#	12.1		
Kim 2020	FTF	22	NR	
	FTF_postSAF#	11		
Naka 2018	FTF_postSAF_DSC#	24	NR	• Prior to implementation of SAF, poor rate of appointment completion compared with referral (139 of 1258).
	FTF	84		
Wu 2021	FTF_postSAF#	NR	88.4	• Comparing SAF with FTF (in an area without access to TD).
	FTF_noTD		61	
Wang 2020	FTF	9.7	NR	
	FTF_postSAF#	4.8		
Inflammatory/infectious conditions population				

Study ID	Comparison	Missed appointments %	Referral capture rate^ %	Context
Wu 2021	FTF_postSAF#	NR	90.7	• Comparing SAF with FTF (in an area without access to TD) in patients with inflammatory conditions.
	FTF_noTD		61	

Key: DSC – dermatoscopy, FTF – face-to-face, GP – general practitioner, MSC – macroscopy, SAF – store and forward, TD – teledermatology
^ Referral capture rate is the number of completed TD alone consultations plus the number of completed TD recommended FTF consultations divided by the total number of TD consultations.
* On the day cancellation rates for patients triaged directly to surgery from SAF compared with conventional referral.
# FTF_postSAF patients have been triaged to FTF by SAF as opposed to GP referral direct to FTF.

4.7.9 Number of appointments

There are five studies which compared the number of appointments between SAF and FTF.[285, 290, 323, 347, 371] Table 4.32 provides details of the context of reported results. Across studies there was heterogeneity in the manner of reporting including with respect to the types of appointments included and if initial diagnostic appointments were included. However, differences in mean numbers of appointments across all studies are of small magnitudes and differ depending on the appointment setting.

4.7.9.1 Suspected cancer (mixed) population

In a suspected cancer population, a study utilising retrospective analysis of patients who received dermatological surgery found a small but statistically significant difference in the number of follow-up FTF clinic visits, with fewer appointments required between initial SAF consultation and subsequent surgery compared with conventional FTF consultation.[285]

4.7.9.2 Mixed dermatology population

Four studies reported with respect to a mixed dermatology population. Two studies reported on the total number of dermatology visits over six months.[323, 347] There was no significant difference in the mean number of total dermatology visits in a propensity score matched sample of persons receiving SAF compared with those who were seen FTF in a system without TD access (0.58 visits vs 0.63).[323] Furthermore there was no significant difference in general outpatient, primary care or emergency department visits in the six months following SAF or FTF consultation.[323] Conversely, a RCT comparing SAF via an imaging clinic with conventional FTF referrals reported that SAF patients had significantly more primary care visits than FTF patients (2.24 vs 1.68) and significantly fewer FTF visits (0.01 vs 1.48).[347] When comparing follow-up appointments across the entire study sample, another RCT reported a small non-significant difference in the mean number of follow-up visits in those seen initially in SAF compared with FTF (0.48 vs 0.68).[290] However, when only those who required a FTF follow-up appointment were considered, SAF patients required a small but significant increase in the mean number of FTF follow-ups than conventional FTF patients, (1.42 vs 1.09).[290] The final RCT reported that SAF patients required a mean of 1.1 FTF follow-up appointments compared with 1.55 appointments in the conventional FTF group (however, it was not clear if this included the initial FTF diagnostic appointment).[371]

Table 4.32 Mean number of appointments

First Author, year	Intervention	Number of appointments	Comparator	Number of appointments	Context
Suspected cancer (mixed) population					
Hsiao 2008#	SAF	0.98 (SD 0.52)*	FTF	1.13 (SD 0.38)	• Follow-up FTF clinic visits between initial evaluation and surgery
Mixed dermatology population					
Bowns 2006	SAF	0.48 (SD 0.83)	FTF	0.66 (SD 0.59)	• Follow-up visits per patient referred within 3 months
		1.42 (SD 0.85)*		1.09 (SD 0.28)	• Follow-up visits per patient followed up within 3 months
Jariwala 2021	SAF	0.58	FTF_noTD	0.63	• Total dermatology visits over 6 months
		3.12		3.46	• Outpatient clinic visits over 6 months◇
		1.10		1.18	• PC visits over 6 months◇
		0.22		0.24	• ED visits over 6 months◇
Lopez-Liria 2022	SAF_imageclinic_DSC	2.24	FTF_DSC	3.16	• Total visits over 6 months
		2.24 (SD 0.65)*		1.68 (SD 0.76)	• PC visits over 6 months
		0.01 (SD 0.09)*		1.48 (SD 0.85)	• FTF clinic visits over 6 months
Whited 2013	SAF_MSC	1.1 (range 0 to 5)	FTF	1.55 (range 0 to 6)	• FTF clinic visits

Key: DSC – dermatoscopy, ED – emergency department; FTF – face-to-face, MSC – macroscopy, PC – primary care, SAF – store and forward, TD – teledermatology.

* Significantly different to comparator at $p<0.05$; # Hsiao 2008 study population of patients seen in dermatologic surgery clinics; ◇ Not restricted to dermatology related encounters.

4.7.10 Duration of appointments

The length of time that is required to provide a dermatology consultation will impact upon the efficiency of the service and subsequent waiting lists. 10 studies provided comparative evidence of the time spent managing and evaluating TD and dermatology consultations.[261, 264, 298, 304, 308, 329, 331, 340, 360, 370] There is substantial heterogeneity across studies in the durations that are reported and the components defined in managing and evaluating consultations. In some studies the time spent was broken down into component parts of managing consultations (such as gaining consent, taking photos, uploading to TD platforms or taking a medical history) and making a referral, or evaluating consultations (such as patient care and documentation). Table 4.33 provides the details of reported durations. It is important to consider that both TD and conventional FTF dermatology consults require GP time to create a referral and it is assumed that this written aspect should not differ much between pathways. However, if the SAF images are taken and uploaded at the GP surgery, this will have an additional time requirement for the referrer. SAF utilising an imaging centre will place this burden on a different healthcare service provider. A FTF dermatology consultation will usually entail further discussion of medical history compared with asynchronous TD which relies on information as provided with the primary care referral.

4.7.10.1 Suspected cancer (mixed) population

There were four studies[298, 304, 308, 370] reporting appointment times in suspected cancer (mixed) populations. A RCT comparing SAF to FTF reported a shorter mean total consultation time in SAF compared with FTF consultations (15 minutes vs 19 minutes).[304] Two studies compared SAF image only to SAF with dermatoscopy. One study found that the time spent managing and evaluating consultations were broadly similar,[281] while the other study[298] reported a greater, but not statistically significant, time investment was required by GPs with the addition of dermatoscopic images (11.6 minutes vs 17.4 minutes). A UK study[308] that compared FTF appointments after SAF imaging clinics with traditional FTF appointments reported that although FTF appointments after SAF were typically shorter than direct to FTF appointments (30 minutes vs 35 minutes), there was an additional time commitment of approximately 20 minutes for dermatoscopy imaging clinic appointments.

4.7.10.2 Mixed dermatology population

In studies comparing SAF to FTF, the time element for SAF referrals related to GP time ranged from one minute[264] to almost nine minutes,[331] while TD time spent evaluating the consult ranged from less than one minute[360] to 10 minutes.[261] Across studies, the overall time for FTF consultations ranged between four minutes[340] and 25 minutes.[264] The variation in duration of consultations may be

related to heterogeneity in reporting and in the services being provided. In a post-pilot survey after implementation of a regional SAF service in New Zealand,[329] 95.7% of GPs reported that additional time was required to upload photos and referrals. While 54.5% of GPs reported that composing a SAF referral was slower than a standard written referral, 22.7% reported it took the same time.

Table 4.33 Time spent managing and evaluating TD and FTF dermatology consultations

First Author, year	Intervention		Comparator	
	Study arm	Duration (minutes) ᵞ	Study arm	Duration (minutes)
Suspected cancer (mixed) population				
Vestergaard 2020	SAF_DSC	Total TD consultation 15m	FTF_DSC_histo	Total FTF consultation 19m (+/- 9m)
Ferrandiz 2017	SAF_DSC	Managing consultation* 8m53s (8m16s to 9m31s) Evaluating consultation^ 1m5s (1m2s to 1m8s)	SAF	Managing consultation* 7m10s (6m46s to 7m35s) Evaluating consultation^ 1m1s (1m0s to 1m2s)
Moreno-Ramirez 2006	SAF	Managing consultation (GP) 11.6m (95% CI 7.2 to 16.0m)	SAF_DSC	Managing consultation (GP) 17.4m (95% CI 12.3 to 22.5m)
Nizar 2024	SAF_imageclinic_DSC	Managing consultation 20m	FTF	Evaluating consultation 35m
	SAF_FTF	Evaluating consultation 30m		
Mixed dermatology population				
Kim 2020	SAF	Managing consultation* 1 to 5m Evaluating consultation^ 8m	FTF	Evaluating consultation^ 25m
Nami 2015	SAF	Managing consultation* 4m (SD 1m40s) Managing consultation including medical history 8m30s (SD 2m20s) Evaluating consultation 2m30s (SD 1m50s)	FTF	Managing consultation including medical history 4m30s (SD 3m30s) Prescription time 10m30s (SD 5m20s) Management and evaluating consultation 15m (SD 6m20s)
Vañó-Galván 2011	SAF	Evaluating consultation 2 to 3m*	FTF	Total FTF consultation 4 to 6m
Palamaras 2022	SAF_imageclinic_DSC_MSC	10m allocated	FTF	20m allocated for new FTF

First Author, year	Intervention		Comparator	
	Study arm	Duration (minutes) ʸ	Study arm	Duration (minutes)
Ilie 2022	SAFvideo	Diagnosis only 26s	FTF	Total FTF time# 9m48s

Key: DSC – dermatoscopy, FTF – face-to-face, histo – histology, m – minute, MSC – macroscopy, s – second, SAF – store and forward, SD – standard deviation, TD – teledermatology.

ʸDuration data were reported as either a median or mean; where not reported, duration was assumed to be a mean; *TD consent, photo and uploading time, ^Patient care and documentation, #Commencing from point of arrival at clinic.

4.8 Provider outcomes of teledermatology-supported referral management

4.8.1 Image quality

Studies assessing TD-supported referral management reported image quality using diverse methodologies. Ten studies[80, 255, 278, 283, 298, 304, 316, 318, 328, 378] rated images on a scale of poor to good or excellent, nine[71, 254, 315, 321, 331, 332, 348, 356, 370] only reported the proportion relating to a single metric, one[366] used a 5-point Likert scale, and one[332] used the photograph quality rating scale (PQRS). Data from these studies are summarised in Table 4.34. Overall, there was substantial variation across studies with the proportion reporting low/poor-quality images ranging from 0.26%[276] to 31%[278] in a suspected melanoma population, 2.1% to 5% in a NMSC population,[283] 0%[316] to 15.9%[80] in a suspected cancer (mixed) population, and 0.9%[328] to 18%[356] across studies with a mixed dermatology population. The range for the proportion of images assessed as low/poor-quality using standard SAF TD was 0.9%[328] to 31%[278] compared with 0%[316] to 36%[255] for SAF with dermatoscopy. In the study using a 5-point Likert scale, the quality of standard SAF images and SAF with a video attachment were compared. Both methods yielded an average score of three, classified as 'fair'. There was no statistically significant difference in quality between the two methods.

Additionally, thirteen studies explicitly reported the proportion of cases assessed by TD-supported referral management with insufficient image quality to make a diagnosis or referral decision.[26, 27, 51, 261, 263, 287, 289, 305, 309, 314, 326, 330, 340] Five studies included a suspected cancer (mixed) population; across these, the mean proportion of cases with insufficient image quality was 3% (range: 1% to 6%).[51, 117, 289, 305, 309, 314] Across the remaining eight studies which included a mixed dermatology population, on average 15% of cases had insufficient image quality (range: < 1% to 24%).[26, 27, 261, 263, 287, 326, 330, 340] The study reporting the lowest proportion of insufficient image quality had images acquired at an imaging clinic.[261] One study reported the proportion of total images obtained assessed as insufficient quality for diagnosis or referral; among 322 standard SAF images obtained, two were deemed inadequate for decision-making compared with 18 of 278 dermatoscopic images.[295]

Although not formally assessed, more recent studies appeared to report a lower proportion of low or poor quality images, suggesting a potential improvement in image quality over time. However, this observation should be interpreted with caution given variation in study design and reporting methods.

Table 4.34 Image quality

Study Author and Year	Study arm	N – images*	Image quality results	
Melanoma cancer population				
Massone 2007	SAF	36	**Excellent quality:** 4 images (11%) **Good quality:** 7 images (19%) **Fair quality:** 14 images (39%) **Poor quality:** 11 images (31%)	
	SAF_DSC	36	**Excellent quality:** 2 images (5%) **Good quality:** 15 images (42%) **Fair quality:** 15 images (42%) **Poor quality:** 4 images (11%)	
Arzberger 2016	SAF_MSC_DSC	1,922	**Excellent/Good quality:** The participating teledermatologists considered most images to be of excellent or good quality. **Poor quality:** 0.26% (5 lesions)	
Non-Melanoma Suspected Cancer				
Sola-Ortigosa 2020	SAF	1,000	**Actinic keratosis (n= 619):** Excellent quality – 93.9%; appropriate quality – 4.2%; poor quality – 1.9% **Other keratotic lesions (n=381):** Excellent quality – 82.9%; appropriate quality – 12%; poor quality – 5%	p<0.01 for SAF_DSC vs SAF
	SAF_DSC	1,000	**Actinic keratosis (n= 619):** Excellent quality – 96.8%; appropriate quality – 2.4%; poor quality – 18%. **Other keratotic lesions (n=381):** Excellent quality – 90.8%; appropriate quality – 7.1%; poor quality – 2.1%.	
Suspected cancer (mixed) population				
Ferrandiz 2017	SAF	125	**Low quality pictures:** 3.2%	p=0.41
	SAF_DSC	125	**Low quality pictures:** 1.6%	
Börve 2013	SAF_DSC	62	**Excellent quality:** FTF – 88.4%; TD2 – 21.7% **Sufficient quality:** FTF – 11.6%; TD1 – 94.2%; TD2 – 62.3% **Poor quality:** TD1 – 5.8%; TD2 – 15.9%	Poor agreement between dermatologists (K ~ 0)
Vestergaard 2020	SAF_DSC	519	**Good quality:** TD1 – 59%; TD – 56% **Fair quality:** TD1 – 32%; TD – 33%	

Study Author and Year	Study arm	N – images*	Image quality results
			Poor quality: TD1 – 9%; TD – 10%
Tan 2010	SAF_DSC_MSC	491	**Excellent quality:** 100%
Moreno-Ramirez 2006	SAF	61 patients	**Excellent quality:** 41.0% **Acceptable quality:** 55.7% **Poor quality:** 3.3%
	SAF_DSC	61 patients	**Excellent quality:** 63.9% of images **Acceptable quality:** 29.5% of images **Poor quality:** 6.6% of images
Warshaw 2009	SAF_MSC	7	**High quality:** 2 images (29%) **Moderate quality:** 4 images (57%) **Low quality:** 1 image (14%)
	SAF_MSC_DSC	3 6	**Images (polarised light dermatoscopy):** **High quality:** 0 images **Moderate quality:** 3 images (100%) **Low quality:** 0 images **Images (contact immersion dermatoscopy):** **High quality:** 2 images (33%) **Moderate quality:** 4 images (67%) **Low quality:** 0 images
Clarke 2021	SAF	308	**Blurred quality:** 4.2% (n=13)
Damsin 2020	SAF_MSC_DSC	105	**Low quality, out of focus images, missing macroscopic or dermatoscopic images: 2.9%** (n=3) **Impossible to assess:** n=3
Gao 2023	SAF_DSC	340 referrals	**Suboptimal quality:** 12.4% (n=42)
van der Heijden 2013	SAF_MSC_DSC	108 lesions	**Good quality:** 36% **Reasonable quality:** 28% **Bad quality:** 36%

Study Author and Year	Study arm	N – images*	Image quality results	
Mixed dermatology population				
O'Connor 2017	SAF	40	**Median PQRS:** 9/10 Image quality differed significantly based on whether or not a diagnosis could be provided (mean PQRS score with diagnosis rendered, 8.9; mean score with no diagnosis, 7.0; P=0.001).	
Nami 2015	SAF	391	Of 928 images sent to TD, 24 (6.1%) were out of focus or overexposed; patients still diagnosed through other photos	
Börve 2012	SAF	40	**Excellent quality:** 22.5% **Good quality:** 47.5% **Sufficient quality:** 22.5% **Poor quality:** 7.5%	
Faucon 2022	SAF	298	**Good quality:** 93%	
Romero 2010	SAF	328	**Poor quality:** 18%	
Massone 2021	SAF	254	**Optimal quality:** 96.6% (224/254) **Good quality:** 1.3% (3/254) **Sufficient quality:** 0.9% (2/254) **Insufficient quality:** 0.9% (2/254)	
AbdulGafoor 2024	SAF_MSC_DSC	78	**Insufficient quality:** 8% (n=6) of patient cohort	
Inflammatory/infectious conditions population				
Feigenbaum 2017#	SAF	21	**Average (SD) score from Likert scale (5=very good; 1= very poor):** 3.4 (0.7)	p=0.25
	SAFvideo	21	**Average (SD) score (5=very good; 1= very poor):** 3.7 (0.6)	

Key: FTF – face-to-face; K – kappa value; PQRS - photograph quality rating scale; SAF – store-and-forward; SAF_DSC – store-and-forward with dermatoscopy; SAF_MSC_DSC – store-and-forward with macroscopic and dermatoscopic images; SD – standard deviation; TD – teledermatologist.
Footnote: *Number of images unless stated otherwise. #Feigenbaum 2017 included SAF images and SAF video from 21 patients, assessed by 10 dermatologists.

4.8.2 Provider satisfaction with teledermatology-supported referral management

Only two studies (in a mixed population) provided comparative evidence for provider satisfaction with TD-supported referral management compared with traditional FTF referral and evaluation (Table 4.35).[26, 354]

In Piette 2017, 13 GPs responded to the two-option satisfaction questionnaire. Global satisfaction rates for both SAF and FTF methods were the same with 69.2% of GPs reporting being "very satisfied" or "satisfied" in both groups. Regarding time-to-treatment satisfaction, SAF achieved a higher satisfaction rate (76.9% considering "short" or "very short" time) compared with FTF at 53.9%, though the difference was not statistically significant (p=0.41).[26] Marchell 2017 evaluated satisfaction using a 5-point Likert scale, capturing dermatologist feedback on SAF, LI TD with low and high-quality video, and FTF evaluations. SAF had a mean satisfaction score of 4.48 (SD=0.78), LI with low-quality scored 4.53 (SD=0.47), and LI with high-quality scored 4.87 (SD=0.24). FTF evaluations received the highest satisfaction score at 5.00 (SD=0.03). While across all methods the ratings indicated very high levels of satisfaction, FTF evaluations were rated significantly higher than TD approaches (p<0.0001).[354]

Table 4.35 Provider satisfaction with teledermatology-supported referral management

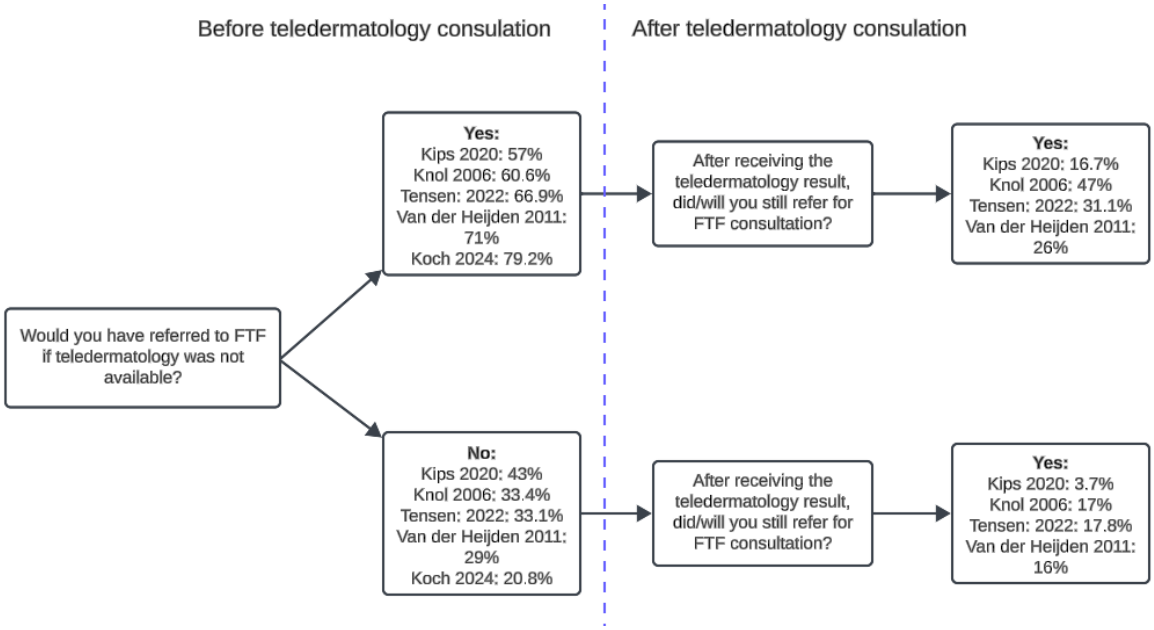
Study Author and Year	Study arm/ TD method	N - patients	Context and or satisfaction measurement	Results	
Mixed dermatology population					
Piette 2017	SAF	13	▪ Two-option questionnaire with GPs	Global satisfaction – % very satisfied or satisfied: 69.2% Time-to-treatment satisfaction – % short or very short: 76.9%.	p=1 p=0.41
	FTF	13		Global satisfaction – % very satisfied or satisfied: 69.2% Time-to-treatment satisfaction – % short or very short: 53.9%.	
Marchell 2017	SAF	212	▪ Mean (SD) satisfaction of dermatologist from 5-point Likert scale (1= strongly disagree; 5= strongly agree)	4.48 (0.78)	All remote methods were rated significantly lower than FTF (p<0.0001) LI_lowquality (p=0.000002) and SAF (p<0.000001) rated lower than LI_highquality No difference between LI_highquality and SAF.
	LI_lowquality	112		4.53 (0.47)	
	LI_highquality	98		4.87 (0.24)	
	FTF	211		5.00 (0.03)	

Key: FTF – face-to-face; LI_highquality – live interactive video on high quality; LI_lowquality – live interactive video on low quality; SAF – store-and-forward; SD – standard deviation.

4.8.3 GP referral perspectives using teledermatology-supported referral management

Five studies, one[301] in a suspected cancer population and four [52, 263, 325, 339] in a mixed population, assessed GP perspectives on patient referrals with or without access to a TD-supported referral management system. The GPs were first asked if they would have referred the patient for FTF consultation if TD was not available. Following TD feedback, GPs were asked if they did, or will still refer the patient for FTF consultation. The studies did not indicate what the TD feedback was in relation to the GP responses. Details are shown in Figure 4.18. The data show that TD may be used by GPs for a second opinion in some instances.

Figure 4.18 GP perspective on referrals using TD



Key: FTF – face-to-face; GP – general practitioner; TD – teledermatology.
Note: Koch 2024 did not indicate which group question 2 data referred to therefore data not shown on diagram. Study reported 53% of GPs answered yes to question two. One additional study[265], not shown in the figure, reported that in the absence of TD, 6.3% of patients would have been referred to the emergency department or urgent care (this study population had access to monthly FTF dermatology clinics).

4.9 Certainty of evidence and evidence gaps

To evaluate the certainty of the evidence across key clinical outcomes, the GRADE[379] (Grading of Recommendations Assessment, Development and Evaluation) framework was applied. GRADE was used to systematically assess the strength of evidence for a subset of outcomes considered relevant clinically and for decision-making across the included populations. The outcomes assessed included the percentage of avoided appointments, diagnostic concordance between TD and FTF evaluation, risk of incorrect diagnosis using TD compared with FTF evaluation, and safety.

A summary of the GRADE assessment is shown in Figure 4.19 with full summary of findings tables available in Appendix Table A 10 to Table A 14. Overall, the quality of evidence and certainty of effect varied across outcomes and populations:

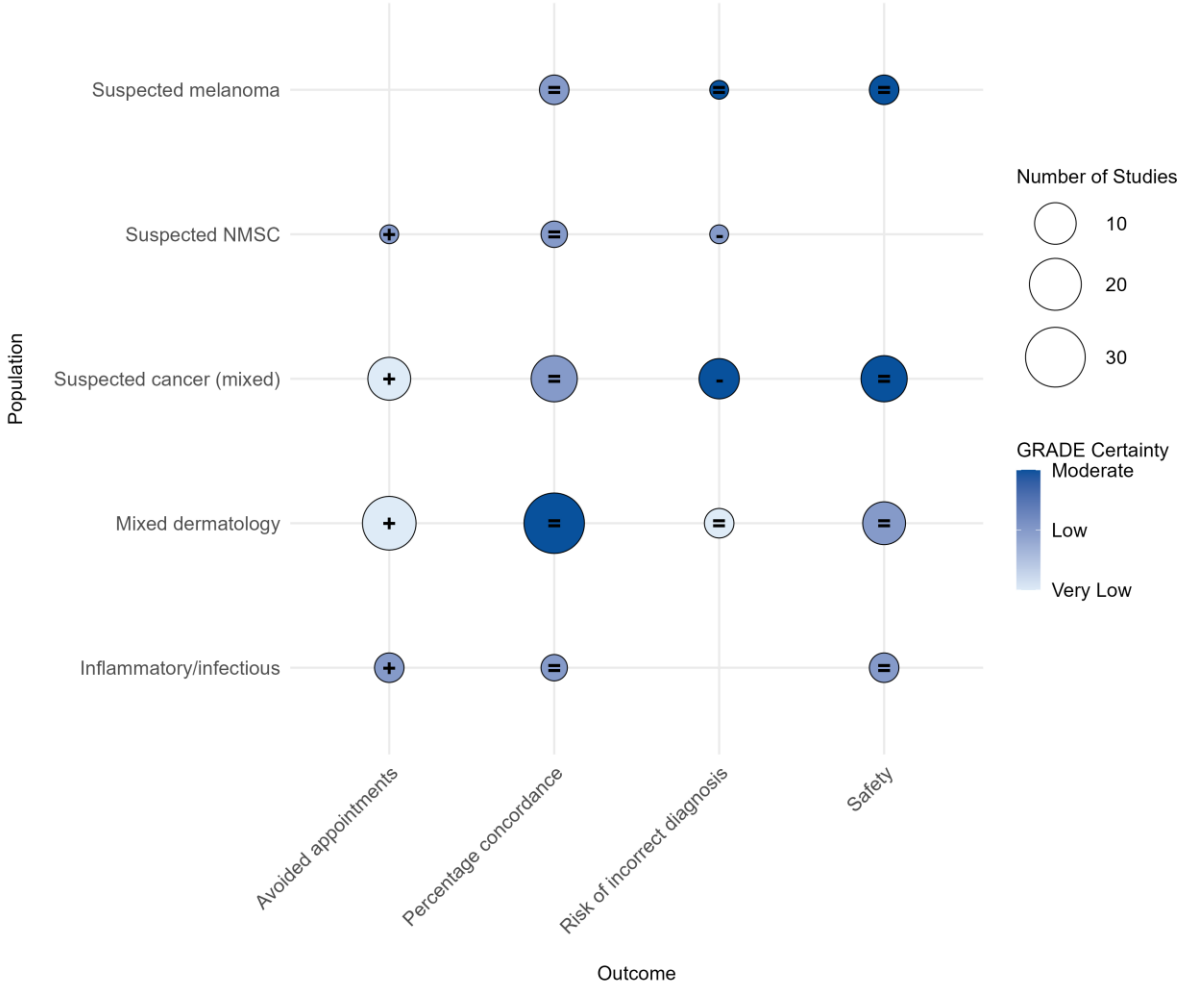
- The outcome of avoided appointments indicated that TD-supported referral management can reduce the need for in-person consultations. Despite the consistency in direction of effect, the certainty of evidence was rated 'very low' (suspected cancer (mixed), mixed dermatology) or 'low' due to high risk of bias, and large variation in the effect estimates. This may be explained by

methodological limitations and contextual differences in care pathways across studies.

- For percentage primary diagnostic concordance between TD and FTF evaluation, studies showed that there is concordance between TD and FTF diagnoses. The GRADE level of certainty for the suspected melanoma, suspected NMSC, suspected cancer (mixed), and inflammatory/infectious conditions groups was 'low', while for mixed dermatology, certainty was 'moderate'.
- The level of certainty for the risk of an incorrect diagnosis for the mixed dermatology and suspected NMSC groups were 'very low' and 'low', respectively, due to high risk of bias and imprecision. For the suspected cancer (mixed) and suspected melanoma populations, the level of certainty was assessed as 'moderate'.
- For safety, while studies varied in how safety was measured, the overall direction of effect remained consistent with no outliers indicating significant concern for safety issues. The certainty of evidence was rated as 'low' for the mixed dermatology and inflammatory/infectious conditions populations due to high risk of bias in the studies and 'moderate' for the suspected melanoma, suspected NMSC, and suspected cancer (mixed) populations.

The assessment of outcomes as low or very low certainty was largely attributable to issues of confounding or missing data which contributed to risk of bias and therefore lower GRADE certainty. It is important to note, however, that a low GRADE rating reflects uncertainty about the effect estimate, rather than evidence of no effect or harm. These ratings should therefore be interpreted as a reflection of methodological limitations in the evidence base, and not necessarily as an indication that TD is not clinically effective or that it is unsafe.

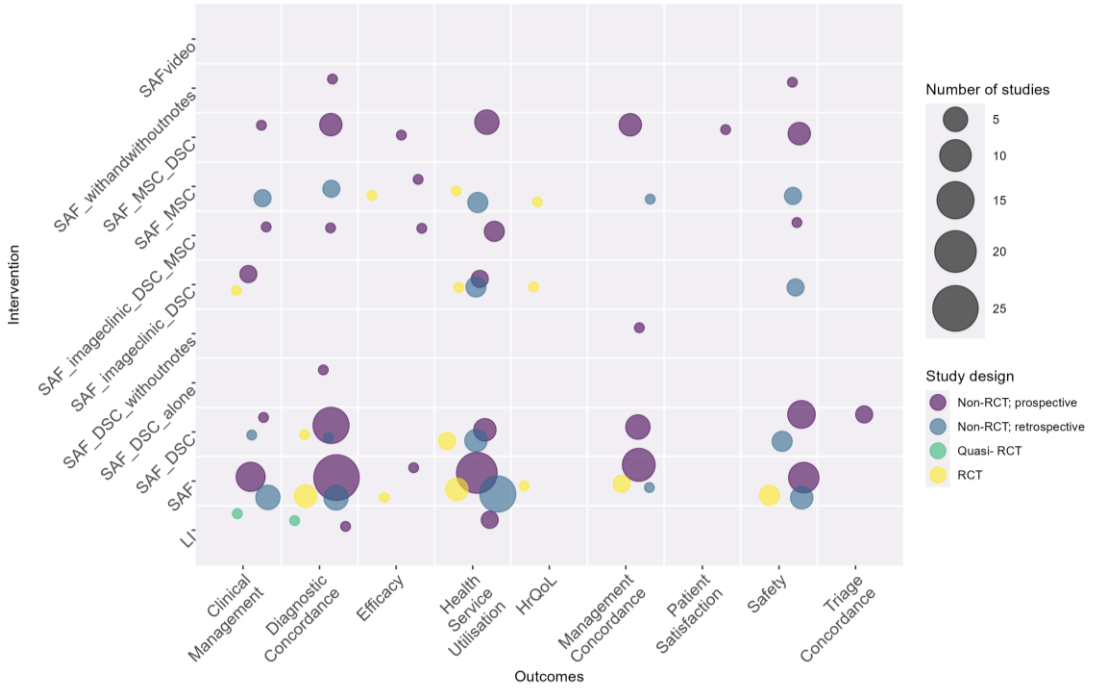
Figure 4.19 Summary of GRADE assessment



Key: GRADE – Grading of Recommendations, Assessment, Development and Evaluation; NMSC – non-melanoma skin cancer.
Note: "+" indicates beneficial effect with TD; "-" indicates no beneficial effect with TD; "=" indicates no difference in effect between TD and usual referral to FTF.

While the systematic review incorporates a large number of studies, there are gaps in the evidence base. Figure 4.20 presents an evidence and gap map, summarising the evidence and highlighting areas where data are sparse or absent.

Figure 4.20 Evidence and gap map for included studies involving TD



Key: HRQoL – health-related quality of life; LI – live interactive; RCT – randomised controlled trial; SAF – store-and-forward; SAF_DSC – store-and-forward with dermatoscopic (includes standard images); SAF_DSC_alone – store-and-forward with dermatoscopic images only; SAF_DSC_withoutnotes - store-and-forward with dermatoscopic images and no clinical notes; SAF_imageclinic_DSC – dermatoscopic images obtained at imaging clinic; SAF_imageclinic_DSC_MSC – dermatoscopic and macroscopic images obtained at imaging clinic; SAF_MSC – store-and-forward with macroscopic images; SAF_MSC_DSC – store-and-forward with macroscopic and dermatoscopic images; SAF_video – store-and-forwar of videos; SAF_withandwithoutnotes – store-and-forward with and without accompanying clinical notes; TD – teledermatology.

4.10 Ongoing trials

A search of clinical trial registries in June 2024 and again in February 2025 identified four trials which may be relevant to the research question posed by this systematic review. An overview of the trials is given in Table 4.36.

Table 4.36 Ongoing trials

Title	Status	Research group responsible	Clinical trial identifier
Development of Teledermatology System for the Globalization of NCGM - NCGM-Teledermatology[380]	Completed - not yet published	National Centre for Global Health and Medicine, Japan	JPRN-UMIN000020873
Tele-dermatology of Skin Cancer in a Cohort of Local Health Authority Employees in the Province of Bergamo[381]	Completed - not published	Centro Studi Gised	NCT02902822
Melanoma Surveillance Photography (MSP) to Improve Early Detection of Melanoma in Ultra-high and High Risk Patients (IMAGE)[382]	Completed - not yet published	Melanoma and Skin Cancer Trials Limited	NCT04385732
AI-Augmented Skin Cancer Diagnosis in Teledermatoscopy (AIDMel)[383]	Completed - not yet published	Karolinska University Hospital	NCT06080711

4.11 Discussion

A systematic review was undertaken to assess the clinical efficacy, effectiveness, impact on health service utilisation, and safety of TD-supported management of primary care referrals compared with traditional FTF dermatology consultations. Overall, 10 RCTs, two quasi-RCTs, 76 prospective non-RCTs, and 32 retrospective non-RCTs were included. The evidence presented in this chapter should be considered collectively rather than in isolation as each outcome captures a single aspect of a broader care pathway. It is important to consider the entirety of the body of evidence and how outcomes interact and contribute to the overall potential impact of TD-supported referral management.

4.11.1 Heterogeneity, confounding, and quality of evidence

The systematic review included a broad range of studies; however, it is important to acknowledge the clinical and methodological heterogeneity, potential for confounding, and quality of the evidence. The studies included a diverse patient pool with the majority conducted in mixed dermatology populations, followed by suspected cancer (mixed) populations, suspected melanoma populations, infectious and inflammatory condition populations, and the smallest number of studies assessing its use in suspected NMSC populations. Less than half of the studies included participants under 18 years of age, with five of the 120 studies focusing solely on a paediatric population. The type of TD varied; in suspected melanoma, NMSC, and suspected cancer (mixed) populations, most studies focused on the use of SAF with dermatoscopy, while studies in mixed dermatology and infectious/inflammatory conditions populations predominantly assessed standard SAF

methods. There was very limited evidence across all populations for LI TD. Differences between studies in how the interventions were applied meant that it was not possible to draw a conclusions as to which mode of TD provides the best outcome.

The quality of images is likely to have an impact on the ability of teledermatologists to accurately assess cases. Across the studies, image requirements, equipment used to obtain images, and the person responsible for obtaining the image varied (such as GP, nurse). Some studies relied on standalone cameras or smartphones with images taken at the primary care appointment while others involved specialised imaging clinics. The use of trained personnel at imaging clinics may ensure higher quality images are transmitted to the teledermatologist. In contrast, older studies using smartphones may lack the advanced resolution and capabilities of newer technology. Additionally, studies used different types of images such as standard photos, macroscopic images, or dermatoscopic images and also had varying requirements for how images should be taken and the number to be sent to the dermatologist. This variability in image acquisition is an important consideration, particularly in the context of diagnostic concordance between TD and FTF consultation where lower quality images could obscure diagnostic details.

High risk of bias was a concern in half of the included RCTs, primarily due to confounding and missing data. Twenty non-RCTs were assessed to have a critical risk of bias with respect to missing data. In some instances, missing data were not proportional across the cohorts, or there was confounding due to differences between study arms. Overall, the heterogeneity in study designs, population characteristics, diagnostic workflows, and follow-up methods may have introduced confounding and these differences in methodology limit the extent to which comparisons can be made across studies. The systematic review considered several outcomes; studies reported on one, or a combination of these outcomes with varying sample sizes. For a number of outcomes, individual studies had relatively small sample sizes which can reduce the ability to detect statistically significant difference between study cohorts, increase risk of bias and reduce generalisability.

To formally assess the certainty of evidence across key clinical outcomes, the GRADE framework was applied. This framework was used to systematically evaluate the strength of evidence for a subset of outcomes deemed most clinically relevant and decision-critical, including percentage of avoided appointments, diagnostic concordance between TD and FTF evaluation, risk of incorrect diagnosis with TD compared with FTF evaluation, and safety. Across the outcomes, the certainty of evidence ranged from very low to moderate. The GRADE assessment highlights that while TD appears to offer diagnostic performance that is comparable to direct referral to FTF consultation, and results in fewer FTF appointments needed, the

underlying certainty of evidence is limited. It is important to consider that low certainty does not imply a lack of effect, but rather reflects limitations such as study design, bias, missing data and in some instances imprecision. However, the evidence assessed in this chapter consistently indicate that TD can perform at least as well as direct referral to FTF consultation, although the precise magnitude of effect is uncertain.

Despite these limitations, all studies were considered appropriate to include in the systematic review as it is unlikely that large, higher-quality RCTs will be conducted in the future given that the technology is already widely incorporated into various health systems. In the context of decision-making, it is important to consider the best available evidence, which for TD-supported referral management includes RCT and non-RCT evidence.

4.11.2 Teledermatology-supported referral management effectiveness compared with usual care

The effectiveness of TD-supported referral management compared with traditional referral pathways was assessed by examining triage concordance, diagnostic concordance, diagnostic reliability, and management concordance.

In the context of triage concordance, a small body of evidence examining concordance between TD and traditional referral routes was available with three studies in a suspected cancer (mixed) population and two in a mixed dermatology population. In studies assessing the prioritisation of cases, TD-supported referral management generally performed at least as well as triage conducted through usual referral routes or FTF assessment. However, small sample sizes and potential confounding due to imbalances in patient characteristics between study arms limit the robustness of the data. In a mixed dermatology population, one study demonstrated concordance of between 85% and 100% for benign and malignant tumours across two teledermatologists, but only 50% and 67% concordance for dermatitis. Interpreting these results in the context of the study definition is important – the authors assumed that results were concordant if the priority level assigned following TD was at least as high as that assigned following FTF consultation. This approach may overestimate the true effect, particularly in contexts where many cases are triaged as high priority, as it does not fully capture whether the priority aligns with actual clinical urgency. In the context of TD-supported referral management, this means that some patients who do not require FTF consultation may still be referred for an appointment, thereby limiting the potential beneficial impact TD may have on wait times. Despite limitations in the evidence, the findings generally showed a consistent direction of effect which suggests a potential for TD to accurately support the triage of patients.

The ability to accurately clinically evaluate patients is an important aspect of a TD-supported referral management system. Risk ratios provide insight into the risk of incorrect diagnosis, while percentage concordance and kappa coefficients offer complementary perspectives on agreement and reliability between TD and FTF evaluation. In this meta-analysis, RRs suggested that FTF consultation tended to have a lower risk of incorrect diagnosis compared with TD. However, pooled primary diagnosis percentage concordance was relatively high at 76% for suspected cancer (mixed) populations and 77% in a mixed population.

While the evidence base was limited and meta-analysis was not possible for the suspected melanoma, NMSC, and inflammatory and infectious conditions populations, the studies reviewed suggested that diagnostic concordance between TD and FTF assessment was generally high, although findings varied across conditions and methodologies.

Diagnostic reliability, as measured by kappa coefficients, demonstrated moderate to strong agreement between TD and FTF consultation. However, there are statistical challenges associated with pooling kappa coefficients, especially when studies are very heterogeneous and therefore a pooled estimate may not be an accurate reflection of what would be observed in practice. While it was not possible to test for differences between subgroups, the evidence suggested that enhanced SAF methods such as those which included dermatoscopic images, a video, clinical notes, or LI TD tended to yield better results. Notably, however, there were far fewer studies using these methods compared with standard SAF approaches and so the extent to which definitive conclusions can be drawn is limited.

Interpretation of these data should consider several factors. First, diagnostic concordance appears lower when considering only the teledermatologist's primary diagnosis. Additional analyses, when data were available, indicated that percentage concordance between TD and FTF evaluation is higher when differential diagnoses are taken into account. This suggests that when a range of diagnostic possibilities is considered, as is likely to occur in clinical reasoning, TD aligns more closely with FTF assessment. This is an important consideration in the context of a referral management system, where TD is often used not to provide a definitive diagnosis but to determine whether referral to a FTF consultation is necessary, prioritise urgency, or safely return the patient to primary care. Additionally, by study design, primary diagnostic concordance analyses often required teledermatologists to assign a diagnosis in all cases, even when diagnostic confidence was low. In studies that explored the relationship between diagnostic confidence and concordance, higher concordance rates were observed when teledermatologists reported high confidence in their diagnostic conclusions. As noted previously, different methods of image acquisition may result in varying image quality and influence the ability of the

teledermatologists to assess the patient. Studies assessing diagnostic concordance tended to handle low-quality images differently. In suspected cancer (mixed) population studies, four out of 13 studies excluded these images from analysis while three of 32 adopted this approach in mixed population studies. Where studies explored the impact of image quality on percentage concordance, a pattern of higher concordance with higher image-rated quality was observed. In a real-world context, when image quality is insufficient for assessment, or if a primary diagnosis is uncertain, it is expected that teledermatologists may either request additional images, or refer the patient to FTF consultation. These options minimise the risk of incorrect patient management, but may mean that some patients require an additional primary care appointment for the images to be retaken and or do not experience the benefits of shortened waiting times.

Management concordance reflects the ability of a TD-supported referral management system to replicate FTF consultation decision-making regarding patient care pathways, including referrals, the need for biopsies, and treatment initiation. High management concordance may reflect clinical reliability, but also has implications for healthcare resource utilisation and patient safety. Data on management concordance were available for suspected melanoma, suspected NMSC, suspected cancer (mixed) and mixed dermatology populations. Despite methodological and study design differences, management concordance between TD and FTF consultation was predominantly high, particularly when dermatoscopy was used. It should be noted, however, that studies were designed so that teledermatologists chose from pre-defined management categories which may not be reflective of real-world clinical practice, limiting the generalisability of the data. Overall, concordance between TD and FTF evaluation regarding clinical management such as biopsy or surgical excision was higher than diagnostic percentage concordance. This suggests that in some cases, even when precise diagnoses differ, TD can still reliably guide appropriate management.

4.11.3 Clinical efficacy and safety of teledermatology-supported referral management

Evidence of the clinical efficacy of TD-supported referral management and impact on HRQoL is scarce. There are challenges in designing a study to adequately capture long-term outcomes of TD compared with FTF consultation including the difficulty in isolating the impact of an initial consultation method from subsequent management and care, and controlling for external factors which may influence outcomes over time. In the limited clinical evidence identified for this review, there were no data to suggest a statistically significant difference in patient outcomes when assessed through TD versus FTF consultation. Both cohorts demonstrated improvements in HRQoL over time with no evidence showing a difference between the groups.

The safety of TD was assessed using several outcomes across studies. While there is evidence to show that misdiagnoses can occur during TD evaluation, the results should be considered in relation to a study setting where teledermatologists were required to provide primary and or differential diagnoses for each assessment. In contrast, in the context of a health system, it is expected that uncertainty will prompt referral for FTF consultation. Similarly, the review highlighted the potential for missed diagnosis. However, considering the entirety of the clinical pathway and a TD-supported referral management system, in cases where the patient does not proceed to a FTF, they are discharged back to primary care with management advice. This workflow ensures that the patient remains in the clinical pathway and offers the opportunity for re-referral if deemed necessary by primary care. While this system may reduce the risk of serious clinical implications from diagnostic errors, it requires the GP to re-refer the patient, necessitating the patient to re-enter the waiting list.

4.11.4 Impact of teledermatology-supported referral management on health service utilisation

Health service utilisation is an important consideration when evaluating a TD-supported referral management system. While multiple studies assessed various aspects of health service utilisation, interpretation of the results should consider the differences in healthcare systems across the study settings. Overall, TD was associated with shorter time to definitive treatment from initial GP contact compared with FTF consultation with the biggest difference seen in mixed populations. Time to definitive treatment was longer when images were acquired at specialised imaging clinics compared with when they were taken in primary care. Similarly, time to initial dermatology contact was shorter for patients evaluated with TD, even when TD recommended FTF evaluation rather than discharging back to primary care.

A critical aspect of health resource utilisation is ensuring that limited resources are directed toward patients who require them most. In the context of long dermatology waiting lists, the prevention of unnecessary appointments provides an opportunity for increased efficiency. This systematic review found that TD did avoid unnecessary consultations although the extent of this varied considerably across studies. This variability is likely due to the unique context of each study and therefore definitive conclusions regarding the impact it may have on Irish waiting lists is difficult to quantify. Nevertheless, the evidence does support the utility of a TD-supported referral management system to divert patients away from a hospital setting who do not need or for whom timely delivery of appropriate care may be facilitated through dermatologist-recommended management plans. Studies further demonstrated that no show rates and missed appointments appeared lower among patients evaluated through TD compared with FTF consultation in mixed and non-cancer populations,

however only a small number of studies assessed this outcome. In general, there was no evidence to suggest that TD-supported referral management negatively impacts on health service utilisation and while it may prevent a proportion of FTF consultations, the potential for shifting the resource burden to other parts of the health system should also be considered.

4.11.5 Patient and provider satisfaction with teledermatology-supported referral management

Comparative data on patient and provider satisfaction with TD compared with FTF consultation was limited. Most studies assessed satisfaction using non-validated Likert scales. Just one study assessing patient satisfaction used a validated tool. Overall, patient satisfaction scores indicated high levels of satisfaction in both cohorts. Considering specifically patient satisfaction with wait times, across studies patients indicated higher levels of satisfaction with TD; however, these differences were not necessarily statistically significant. While these studies provide some insight into patient attitudes regarding wait time for care, it is unclear if they form part of a care pathway with relatively short or long waiting lists. Only two studies assessed provider satisfaction with TD compared with FTF consultation; one study found no statistically significant difference between the modes of care while one reported that SAF and LI both had statistically significant lower mean satisfaction scores compared with FTF consultation. The contrasting results highlight the difficulty in drawing conclusions based on a small body of evidence.

4.11.6 Applicability to Ireland

In the context of decision-making, it is important to consider the applicability of the evidence base to Ireland. There are challenges with generalising the results from this systematic review to an Irish setting as no Irish studies were identified in the search. The evidence base encompassed a wide range of countries and patient populations, but this diversity may not fully reflect Ireland's unique health system needs or patient demographics. For example, the incidence and prevalence of dermatological conditions or skin cancers may differ from those in the included study settings. This has implications for the relevance of the findings in Ireland.

The health system in Ireland currently faces long waiting lists for dermatological care which, especially in the context of health service utilisation outcomes, may not be comparable to those in the setting of the included studies. For example, when assessing the time to initial dermatology contact, the longest duration in the FTF arm was on average four months. In contrast, as outlined in Chapter 3, data as of January 2025 indicate that 48% of patients in Ireland are waiting over six months for an outpatient dermatology appointment and 22% are waiting over 12 months. Although the body of evidence suggests that TD-supported referral management has

the potential to negate some of the challenges currently experienced in Ireland, the magnitude of this effect will depend on how it is integrated into the current system. The potential impact on waiting lists by introducing a TD-supported referral system in Ireland is estimated in Chapter 7.

4.11.7 Strengths and limitations of the systematic review

There are strengths and limitations to this systematic review. A comprehensive search strategy was employed which identified 20 years of evidence. A broad range of study designs were included, ensuring a comprehensive overview of efficacy, effectiveness, safety, and health resource utilisation data for TD-supported referral management.

The inclusion of a large number of studies allowed for broad coverage of the available evidence, with meta-analyses performed where appropriate. The use of multiple methods of evidence synthesis (including pooling, tabulating, and graphing) provided a detailed exploration of the available evidence. Presentation of an evidence and gap map highlights areas where data are sparse or absent.

However, limitations were present. Small sample sizes within subgroups, particularly in the concordance analyses, reduce the robustness and generalisability of some results. Furthermore, while the inclusion criteria focused on studies published from 2004 onward, 43% of included studies were published prior to 2015. Data from these earlier studies should be considered with caution, as the TD technologies used may differ from those in more recent research, particularly in the context of image quality obtained by smartphones. Such discrepancies could introduce bias, particularly in evaluating the performance and capabilities of different TD modalities.

4.11.8 Conclusion

There is a large body of evidence exploring the use of a TD-supported referral management system. While the evidence base has limitations and uncertainties arising from heterogeneity and risk of bias, the direction of effect supporting the utility of TD across outcomes is generally consistent. In the context of a triaging system, evidence suggests that it should achieve a reduction in waiting times for those who need to be seen in the hospital system, while enabling timely delivery of appropriate care for those referred back to primary care with a management plan. While the impact on wait times was positive, the extent to which waiting lists are reduced is highly context-specific and influenced by local healthcare systems and individual workflows. Patient safety is an important consideration for a TD-supported referral management system, and while some studies report instances of missed and misdiagnoses, the overall risks appear to be low in the context of implementation into a complete clinical pathway.

5 Systematic review of economic evaluations

Key points

- A systematic review was undertaken to identify, synthesise, and critically appraise the international evidence on the cost effectiveness of teledermatology (TD) for the management of patient referrals from primary care to consultant-led dermatology services in secondary care versus conventional referral pathways.
- Of the 20 included studies:
  - Three were full economic evaluations (cost-effectiveness analysis, cost-utility analysis) while the remaining studies only considered cost outcomes (cost-consequence analysis, cost-minimisation analyses, costing analyses).
  - Five were from the US, five were from Spain, three were from the UK, two were from the Netherlands, two were from New Zealand, and one each from Scotland, Australia, Denmark, and Canada. With one exception, studies were limited to adult populations.
- Eighteen economic studies compared store-and-forward (SAF) TD with conventional referral pathways:
  - Fifteen studies only considered cost outcomes, of which 12 reported reduced costs associated with SAF TD.
  - Three studies considered cost-effectiveness or cost-utility, two of which reported reduced costs associated with SAF TD. One reported TD to be cost-effective. Two reported cost per day saved (waiting for resolution), which cannot directly interpreted due to a lack of willingness-to-pay threshold.
- Two studies compared live-interactive (LI) TD with usual care for triage of referrals. One study reporting reduced costs with the use of TD, while the second study reported additional costs with its use.
- The included studies were considered to be of low to moderate quality largely due to concerns regarding the adequacy of cost considerations, sensitivity analysis, and potential conflicts of interest.
- The available evidence suggests that TD for managing primary care referrals is likely to reduce costs relative to usual care. Although there was variability in the degree of effect, almost all studies on SAF TD reported cost reductions mainly due to the reduction in FTF appointments.

5.1 Introduction

The chapter reviews the existing international evidence on the economic evaluations of teledermatology (TD) to support the management of patient referrals from primary care to consultant-led dermatology services in secondary care versus conventional face-to-face (FTF) consultation pathways. The review specifically focused on the included costs (for example, general practitioner (GP) visits, dermatology consultations, resource use, the technology used), outcomes (such as the impact on waiting times, impact on waiting lists, incremental cost-effectiveness ratios (ICERs) and incremental costs), and perspectives considered (either payer or societal perspectives).

5.2 Review methodology

A systematic review was undertaken to identify the available cost-effectiveness evidence for TD used to support referral management and to assess its applicability to the Irish setting. The purpose of the systematic review is to inform decision-making regarding the potential introduction of TD in Ireland.

The reporting of this systematic review adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) criteria and national guidelines.[248, 249]

5.2.1 Review question

What is the cost effectiveness, impact on costs and service utilisation of TD for the management of primary care referrals compared with direct referral to traditional FTF consultations?

The following Population, Interest, Context (PICOS) framework (Table 5.1) was developed to address the above research question:

Table 5.1 Population, Intervention, Comparator, Outcomes and Study Design (PICOS) eligibility criteria

Population	Adults and children with skin conditions being referred to a consultant dermatologist.
Intervention	TD for referrals from primary care (synchronous and asynchronous) with or without dermatoscopy.
Comparator	Usual care with FTF interaction or another form of teledermatology.
Outcomes	▪ ICER (for example, per life-year gained or quality-adjusted life year) or net monetary benefit (NMB). ▪ Costs. ▪ Impact on: – resource use – service utilisation – waiting times – waiting list.
Study design	Economic evaluations: ▪ Cost-effectiveness analysis ▪ Cost-utility analysis ▪ Cost-benefit analysis ▪ Cost-minimisation analysis ▪ Cost-consequence analysis.

Key: FTF – face-to-face; ICER – incremental cost-effectiveness ratio; NMB – net monetary benefit; TD – teledermatology.

5.2.2 Study type

The review aimed to identify both empirical and model-based economic evaluations, including cost-effectiveness analysis, cost-utility analysis, cost-benefit analysis, cost-minimisation analysis, and cost-consequence analysis.

5.2.3 Types of participants

Adults and children with skin conditions being referred by a GP or primary care provider to a consultant dermatologist.

5.2.4 Intervention and comparator

The intervention of interest was TD for referrals from primary care (synchronous and asynchronous) with or without dermatoscopy, with the comparator of interest being usual care. For this review, usual care was defined as an initial consultation with a GP or primary care provider, followed by a referral and FTF consultation with a dermatologist.

5.2.5 Outcomes of interest

The outcomes of interest were the impact of the TD versus usual care on the following outcomes: ICER or NMB and impact on costs, service utilisation, waiting times and waiting list.

5.2.6 Exclusion criteria

Studies that limited the use of TD to the ongoing treatment or management of skin conditions were excluded. Studies conducted in non-Organisation for Economic Co-operation and Development (OECD) countries were also excluded. This criterion was applied to ensure that included studies have similarly developed healthcare systems to Ireland.

5.2.7 Search strategy

A comprehensive search was carried out in the following databases: Embase (Elsevier), Medline Complete (Ebscohost), CINAHL Complete (EBSCOhost), PsycInfo (EBSCOhost), INAHTA database, and the Cochrane Library. The search strategy was developed by a librarian and peer-reviewed by a second librarian. Searches were limited to the period from January 2004 to November 2024. Studies pre-2004 were not considered applicable due to advances in the technologies used in the intervention.

Following completion of the search, the scope of the review was expanded to include melanoma. Consequently, new searches were conducted in February 2025. The search strategies were amended to identify literature focusing on the use of TD for both melanoma and non-melanoma skin conditions.

Forward and backwards citation chasing was conducted to ensure comprehensive capture of relevant studies. This process involved reviewing the reference lists of initially-included studies, and citations of these studies to identify any additional publications that might meet the inclusion criteria but which were not retrieved in the initial search. The reference lists of related systematic reviews were also screened.

5.2.8 Study selection

Titles and abstracts were reviewed independently by two reviewers using Covidence® to sort the records by likely relevance. The full text of potentially eligible articles was retrieved and independently assessed for eligibility by two reviewers according to the specified criteria (outlined in Table 5.1). A PRISMA flow diagram, outlining the study selection process, was completed. Disagreements were resolved through discussion, or if necessary, through the involvement of a third reviewer. Where needed, studies not originally in English were translated using DeepL Translate.

5.2.9 Data extraction

Data extraction was conducted independently by two reviewers using a standardised, pre-piloted electronic data extraction form. Disagreements in data extraction were resolved through discussion, or if necessary, by a third reviewer. The primary outcomes of interest were summary measures capturing both costs and consequences, such as the incremental cost associated with TD in comparison to usual care, or costs per quality-adjusted life year (QALY) gained.

5.2.10 Data synthesis and analysis

Study characteristics, costs, and consequences from the considered studies are presented in table format. Due to the heterogeneity across studies in terms of resource costing, population, and healthcare system, a narrative synthesis was conducted.

To facilitate comparison of results across countries and years, costs were converted to Irish Euro in accordance with national health technology assessment guidelines. Costs were transformed to a common year and currency (2024 Irish Euro) using consumer price indices for health and purchasing power parities. If the cost year was not reported, it was assumed to be year of study publication.[384]

When studies presented ICERs in terms of either incremental cost per QALY gained or incremental costs per day early resolution or waiting time avoided, preference was given to the incremental cost per QALY due to the availability of accepted willingness to pay (WTP) thresholds to facilitate interpretation. WTP thresholds of €20,000 and €45,000 per QALY gained have been used previously as reference values in Ireland to guide interpretation of cost-effectiveness estimates.[384, 385]

5.2.11 Quality appraisal and transferability assessment

The Consensus on Health Economics Criteria (CHEC) framework was used to appraise the methodological quality of all included studies.[386] The transferability of individual study findings to the Irish context was evaluated using the International

Society for Pharmacoeconomics and Outcomes Research (ISPOR) questionnaire.[387] Both the quality appraisal and transferability assessment were conducted by two reviewers independently. Disagreements were resolved through discussion or, if necessary, involvement of a third reviewer.

5.2.12 Presentation of results

Studies were grouped into 'suspected melanoma', 'suspected non-melanoma skin cancer (NMSC)', 'suspected cancer (mixed)', 'mixed dermatology', and 'inflammatory/infectious conditions' based on the referred patient population included in the studies. All studies were categorised as 'mixed dermatology' unless they explicitly reported the included population. Where relevant to the outcome being discussed, results were also grouped by TD intervention type (store and forward (SAF) or live interactive (LI)), and by economic evaluation type.

5.3 Results

5.3.1 Search results

During the initial search, 1,368 records were identified from database searches. No additional records were identified through other sources. A total of eight duplicate records were removed. A further 1,302 records were excluded following title and abstract screening with 58 being included in full text review. Following full-text review, 19 studies that met the systematic review's eligibility criteria were identified for inclusion in the synthesis.[261, 312, 339, 388-403] An overview of the study selection process is presented in the PRISMA flow diagram in Figure 5.1. When the scope was expanded to include participants with suspected melanoma, an additional 1,068 records were identified from database searches, of which two were considered for full text review and one study met the eligibility criteria.[275] An overview of the melanoma-specific study selection process is presented in the PRISMA flow diagram in Figure 5.2. From the two searches, a total of 20 studies were included in the review.

Figure 5.1 PRISMA flow diagram of study selection process

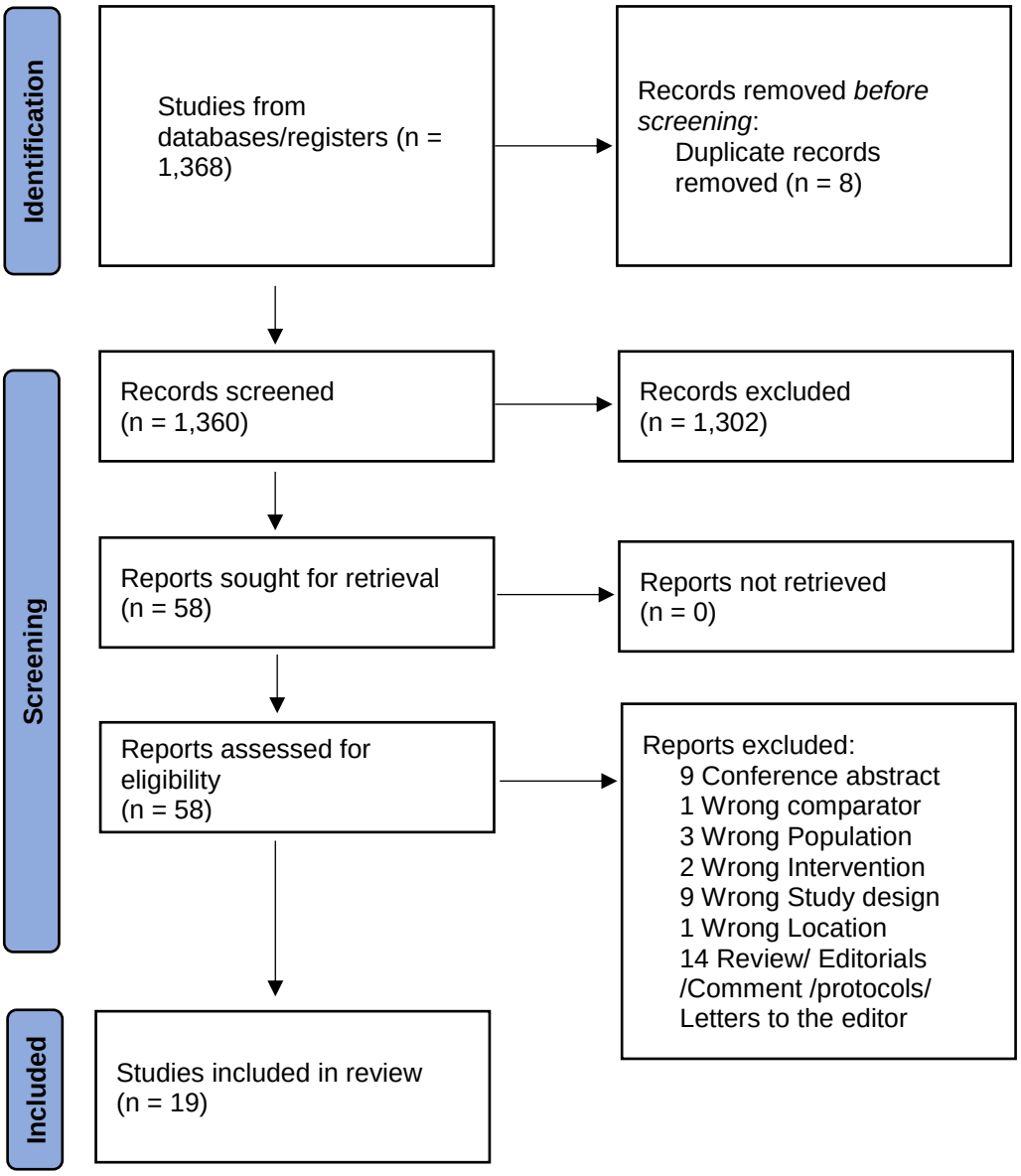
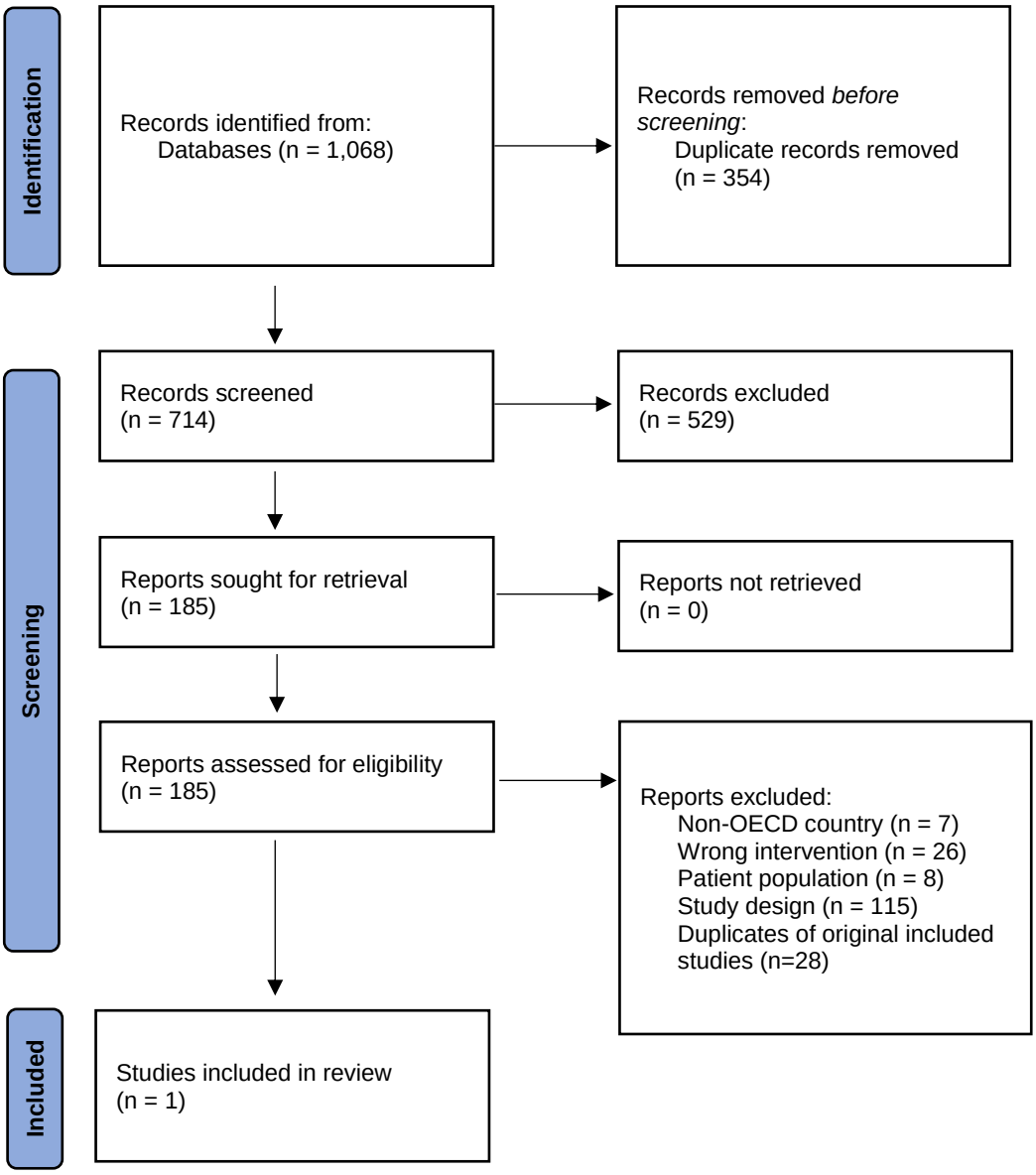


Figure 5.2 PRISMA flow diagram of study selection for inclusion of studies with populations with suspected melanoma



5.3.2 Characteristics of the included studies

An overview of the key characteristics of the included studies is presented in Table 5.2. Of the 20 included studies, five were from the US, five were from Spain, three were from the UK, two were from the Netherlands, two were from New Zealand, and one each from Australia, Denmark, and Canada.

There was one cost-utility analysis which presented results in terms of incremental cost per QALY gained. A second study measured both costs and utilities, but did not express results in terms of cost per QALY as utilities were not statistically significant

during the period of study. There were two cost-effectiveness analyses: one expressed results as incremental cost saved per waiting day avoided, and the other presented results in terms of incremental cost per day saved to clinical resolution. The remaining studies were either cost-minimisation analyses, costing analyses or cost-consequence analyses. Two of the costing analyses also estimated the environmental impact associated with different strategies in terms of carbon emissions.

5.3.2.1 Patient population

Population characteristics for the included studies are presented in Table 5.3. Overall, 13 studies included 'mixed dermatology' populations, five included suspected cancer (mixed) populations, and one each of suspected NMSC, and suspected melanoma populations. Of the included studies, only one specified that paediatric patients were included in their overall population.[403] It is assumed that the remainder pertained to adult populations only, although this was not explicitly reported in all studies.

Table 5.2 Characteristics of included studies

Study, Country	Type of economic evaluation	Perspective	Teledermatology model used	Currency
Armstrong 2007, USA [401]	CMA	Healthcare system	LI	2007 USD
Congalton 2015, New Zealand[275]	Costing analysis	Healthcare system	SAF	2014 NZD
Datta 2015, USA [400]	CMA	Healthcare system and societal	SAF	2015 USD
Eminovic 2010, Netherlands [399]	CMA	Societal	SAF	2004 EUR
Lim 2012, New Zealand [312]	Costing analysis	Healthcare system	SAF	2011 NZD
Livingstone 2015, UK [398]	Costing analysis	Healthcare system	SAF	2012 GBP
Lopez-Villegas 2020, Spain [397]	Costing analysis	Healthcare system and societal	SAF	2020 EUR
Lopez-Villegas 2024, Spain [396]	CUA	Healthcare system and societal	SAF	2024 EUR
Moreno-Ramirez 2009, Spain [395]	CEA	Societal	SAF	2005 EUR
Orruno 2010, Spain [403]	Costing analysis	Healthcare system	SAF	2008 EUR
Pak 2009, USA [394]	CMA	Healthcare system and societal	SAF	2006 USD
Palamaras 2022, UK [261]	Costing analysis	Healthcare system and societal	SAF	2019 GBP
Persaud 2005, Canada [393]	CMA	Societal	LI	2004 CAD
Scottish Health Technologies Group 2023, Scotland [402]	Cost-consequence analysis	Healthcare system and societal	SAF	2021 GBP
Snoswell 2018, Australia [392]	CEA	Healthcare system	SAF	2016 AUD

Study, Country	Type of economic evaluation	Perspective	Teledermatology model used	Currency
van der Heijden 2011, Netherlands (339)	Costing analysis	Healthcare system	SAF	2011 EUR
Vestergaard 2024, Denmark (391)	CMA	Societal	SAF	2017 EUR
Vidal-Alaball 2018, Spain (390)	Costing analysis	Healthcare system and societal	SAF	2015 EUR
Yang 2019, USA (389)	Costing analysis	Healthcare system	SAF	2018 USD
Zakaria 2021, USA (388)	CMA	Healthcare system	SAF	2020 USD

Key: CEA: cost-effectiveness analysis; CMA: cost-minimisation analysis; CUA: cost-utility analysis; LI – live-interactive; SAF: Store and forward; US: United States; UK: United Kingdom.

Table 5.3 Patient population characteristics

Study, Country	Patient population group	Primary diagnoses
Armstrong 2007, USA	Mixed dermatology	TD clinic • Five most frequent diagnoses: actinic keratosis (13.4%), eczema (12.2%), acne (11.9%), benign neoplasm (9.1%) and viral infections (5.2%). General dermatology clinic • Five most frequent diagnoses: actinic keratosis (13.0%), benign neoplasm (11.6%), acne (8.8%), eczema (7.5%) and viral infections (7.4%).
Congalton 2015, New Zealand	Suspected melanoma	Referrals to TD clinic (patients, n=345) • Most frequent diagnoses for excised lesions (n=99 [129 lesions]) were melanoma (n=45 [48 lesions]) and NMSC (n=43 [49 lesions]).
Datta 2015, USA	Mixed dermatology	Not reported.
Eminovic 2010, Netherlands	Mixed dermatology	Not reported.
Lim 2012, New Zealand	Suspected cancer (mixed)	TD clinic (n=383 lesions) • Benign (79%), malignant (13%) and borderline (8%). FTF clinic (n=210 lesions) • Benign (60%), malignant (32%) and borderline (8%).
Livingstone 2015, UK	Suspected cancer (mixed) (adult 18+ aged)	Not reported in full. • 3 lesions reviewed by TD suspected to be malignant. Following investigation, none were malignant. Overall, no patients who used TD pathway were diagnosed with a malignancy.
Lopez-Villegas 2020, Spain	Mixed dermatology	Diagnostic suspicion on TD referral (n=7,030 referrals) • Malignant disease (10.7%), benign disease (84.1%) and diagnostic suspicion not included in referral (5.2%).
Lopez-Villegas 2024, Spain	Mixed dermatology (older than 18 years)	Reasons for initial GP consultation: • Injury (51.6%)

Study, Country	Patient population group	Primary diagnoses
		• Rash (11.6%) • Injury and rash (3.1%) • Other (33.8%)
Moreno-Ramirez 2009, Spain	Suspected cancer (mixed)	Not reported.
Orruno 2010, Spain	Mixed dermatology Included paediatric population	Not reported.
Pak 2009, USA	Mixed dermatology	Not reported.
Palamaras 2022, UK	Suspected non-melanoma cancer	Five most frequent diagnoses among cases discharged to GPs (namely excluding those referred for a surgical biopsy or FTF review): • Seborrheic keratosis (49.8%), benign melanocytic nevus (15.0%), actinic keratosis (10.2%), dermatofibroma (5.2%) and vascular lesion (3.6%).
Persaud 2005, Canada	Mixed dermatology	Not reported.
Scottish Health Technologies Group 2023, Scotland	Mixed dermatology	Not reported.
Snoswell 2018, Australia	Suspected cancer (mixed)	Not reported (relying on the literature).
van der Heijden 2011, Netherlands	Mixed dermatology excluding pigmented skin lesions	Most frequent diagnoses included: • Eczema (29%), infectious diseases (13%), benign tumours (12%), erythematosquamous diseases (11%), pre-/malignant tumours (7%), acneiform conditions (4%) and vascular disorders (4%).
Vestergaard 2024, Denmark	Suspected cancer (mixed)	Not reported.
Vidal-Alaball 2018, Spain	Mixed dermatology	Not reported.

Study, Country	Patient population group	Primary diagnoses
Yang 2019, USA	Mixed dermatology	Not reported.
Zakaria 2021, USA	Mixed dermatology	Most frequent diagnoses in study population included: • Benign growth (32.0%), infection (14.5%), eczematous dermatitis (12.4%), neoplasm of uncertain significance (6.5%), psoriasis (5.6%) and acne or rosacea (5.2%).

Key: FTF: face-to-face; GP: general practitioner; NMSC: non-melanoma skin cancer; TD: teledermatology; USA: United States of America; UK: United Kingdom.

5.3.2.2 Type of teledermatology service

The type of intervention and image acquisition details are provided in Table 5.4. Eighteen of the studies included in the review used SAF TD models, while the remaining two used a LI model.

In studies using SAF TD models, the pathway involved an initial assessment with a primary care clinician or GP followed by completion of a TD referral form including patient details, relevant clinical information, and digital images.

In 13 studies, either the GP or a member of the GP practice staff took the images needed for the referral. Two studies (same research group/institution) used a pathway where a nurse-led TD clinic appointment was arranged after an initial GP review.[396, 397] Here, TD nurses obtained the patient history and took images, and uploaded them to the referral platform. In one study, the GP obtained patient details and clinical information for the referral, and images were subsequently obtained at a later time by a medical photographer based within a primary care setting.[261] In two studies based on the same service, patients were referred to a community-based clinic run by a private provider where a trained nurse obtained the patient's history and took digital images.[275, 312]

For all studies that involved a SAF teledermatology model, the referrals were subsequently reviewed remotely by a dermatologist. Based on this review, the dermatologist provided a diagnosis and or made recommendations on further management (such as advice to GP for community-based care, referral for face-to-face assessment with a dermatologist, or referral for assessment with surgical team).

For the two studies that used a LI teledermatology model, patients attended a clinic at the originating site with the assistance of a nurse practitioner, while the dermatologist evaluated patients remotely using interactive videoconferencing technology.

5.3.2.3 Approaches to costing

In the included studies, TD costs could be fee-per-service based, or derived from estimation of the complete set-up plus ongoing delivery costs at a provider level. The cost per patient could include costs associated with obtaining images and generating a referral, and TD review costs. TD-related costs could be broadly categorised into:

- TD equipment costs could include: photography equipment (smartphone, camera or tablet), with or without dermatoscope, computer; videoconferencing equipment (LI services)
- Software costs could include: TD software for image upload, sending referral, and review by dermatologist
- Staff costs:
  - Primary care: initial consultation with GP; staff resources required to obtain images and generate referrals (included GP, nursing staff or medical photographer); GP follow-up (communication of the outcome of TD assessment to patient, undertaking management recommendations).
  - Hospital: staff resources required to review TD referrals, provide diagnostic advice and or advice and guidance on management to GP; administrative input required to arrange additional follow-up, where required; secondary care follow-up (FTF dermatology clinic, nurse-led treatment clinic).
- Training costs: could include training of staff involved with obtaining images and or generating referral, training of dermatologists providing TD service
- Telecommunication and infrastructure costs: internet, building, electricity, heating and so on.

Studies considering a societal perspective incorporated a range of costs, including lost productivity, travel, and companion costs.

There was considerable heterogeneity in the approaches used to cost TD services among the included studies. Eight studies applied a unit cost per TD service used, based on private provider or healthcare payer (national or private insurance) reimbursement prices. Four[275, 312, 339, 398] of these studies used costs that were specific to TD services, three[261, 392, 394] used costs that were not specific to TD services, and one[389] applied a cost which was the mean of a cost specific to a TD service and a general consultation fee. Of the studies that used costs specific to TD services, two[339, 398] specified that the cost included use of the TD system and the dermatologist's review, one[312] specified that the cost included costs associated with set-up and running of the TD clinic and one[275] did not outline the components included in the TD clinic costs. The remaining 12 studies calculated costs by identifying and valuing each of the resources used in delivering a TD consultation; while all considered staff resources required to review the referrals, there was inconsistency regarding the inclusion of additional resources (such as software, training, equipment and infrastructure).

All studies considered the costs associated with attending a FTF dermatology clinic, both for patients who received usual care and for those who received TD and were

deemed to require in-person clinical dermatology review. Costs associated with subsequent GP follow-up were included in seven studies.[275, 388, 390, 392, 397, 399, 402] In all of these seven studies, primary care follow-up costs were only applied to the TD arm as it was assumed that those who underwent routine FTF dermatology review would have all clinical care delivered in that setting. The costs associated with diagnostic and therapeutic interventions required post-TD were included in seven studies.[275, 312, 392, 394, 399, 400, 402] These included costs associated with biopsies, excisions and other surgical interventions, photodynamic therapy and medications. A number of studies assumed that treatment options would differ for those who received TD versus usual care. For example, Lim et al.[312] considered that patients who underwent TD but did not require consultant-level follow-up could be directly referred for a nurse-led treatment clinic; this was not considered an option in the pathway for patients who received usual care. Similarly, the Scottish Health Technologies Group (SHTG)[402] assumed patients in the TD arm but who did not require a FTF clinical dermatology review could be referred directly to other services (such as nurse-led clinic, direct to surgical list, direct to photodynamic therapy) while those who underwent usual care would not be referred to until after a FTF appointment, and therefore these were not costed in the usual care arm.

Eleven studies considered societal costs, primarily those associated with travel and productivity loss.[261, 390, 391, 393-397, 399, 400, 402] The majority of these studies considered societal costs associated with the patient only; however, three included societal costs incurred by persons accompanying the patients (such as transport costs and or productivity loss for family member or carer travelling with patient to their appointment).[391, 393, 399] Of all studies that included societal costs, four presented results from a societal perspective only while the remainder presented results from both societal and healthcare payer perspectives separately.[391, 395, 399]

Table 5.4 Teledermatology intervention details, costs and outcomes

Study, Country	Type of TD intervention used	Image acquisition	Costs included	TD cost per patient (incremental costs)*	Key outcomes considered
Armstrong 2007, USA	LI	Videoconferencing technology operated with the assistance of a nurse practitioner.	TD technology costs (including hardware, maintenance, staff training and network connection charges), facility and personnel overheads, physician compensation.	Healthcare: €324.73 (€85.33 less than FTF) per hour	None
Congalton 2015, New Zealand	SAF_imageclinic_DSC	Images were taken by a specially-trained nurse at a community-based clinic, run by a private provider.	▪ Private TD clinic fees ▪ FTF assessment ▪ Excisions ▪ Biopsies ▪ GP follow-up	Healthcare: €452.90 (€754.43 less than FTF)	▪ Teledermatoscopic diagnosis ▪ Histological diagnosis (if excised) ▪ Wait time between referral and first TD appointment, and between TD outcome report and excision.
Datta 2015, USA	SAF	Referring clinician took the images used.	Healthcare system perspective: ▪ TD intervention or referral (no equipment related costs). ▪ Referral and follow-up visits at the dermatology clinic.	Healthcare: €286.83 (€27.94 less than FTF) Societal: €428.38 (€76.36 less than FTF)	Utilities (elicited from study participants, valued using TTO method).

Study, Country	Type of TD intervention used	Image acquisition	Costs included	TD cost per patient (incremental costs)*	Key outcomes considered
			▪ Dermatology medications. ▪ Travel cost reimbursement ▪ Dermatology-related hospitalisation. Societal perspective: ▪ Dermatologic care sought outside the provider network ▪ Associated travel costs. ▪ Productivity loss.		
Eminovic 2010, Netherlands	SAF	Referring GPs took the images used.	Five major costs considered: ▪ Investment in TD ▪ GP care ▪ Dermatology care ▪ OOP expenses to patients ▪ Employer costs.	Societal: €496.75 (€42.36 more than FTF)	None.
Lim 2012, New Zealand	SAF_imageclinic_DSC	Images were taken by a specially-trained nurse at a community-based clinic, run by a private provider.	▪ Private TD clinic fees. ▪ Nurse treatment clinic costs. ▪ Biopsies ▪ FTF assessments. Costs of surgery and initial GP referral were excluded	Healthcare: €183.51 (€29.14 less than FTF)	▪ Waiting time from date of referral until first appointment. ▪ Management pathways following initial clinic visit

Study, Country	Type of TD intervention used	Image acquisition	Costs included	TD cost per patient (incremental costs)*	Key outcomes considered
			as these were not expected to differ between TD and conventional dermatology reviews. Patient travel-related costs were excluded.		▪ Patient satisfaction survey.
Livingstone 2015, UK	SAF_DSC	Images were taken by a trained member of the GP practice staff.	▪ TD set-up costs (staff training and imaging kit) ▪ FTF dermatology referral cost ▪ TD referral cost.	Healthcare: €195.09 (€81.84 less than FTF)	▪ Diagnostic outcomes for any possibly malignant lesions referred for TD. ▪ Patient satisfaction survey.
Lopez-Villegas 2020 Spain	SAF_imageclinic_DSC	GP referred patients for a TD consultation with a TD nurse, where images were acquired.	Healthcare system perspective: ▪ Staff costs ▪ TD-related materials and equipment. Societal perspective: ▪ Transport costs ▪ Productivity loss	Healthcare: €25.07 (€11.61 less than FTF) Patient: €7.45 (€20.41 less costly than FTF)	▪ Number of FTF dermatology visits required following TD consultation.
Lopez-Villegas 2024, Spain	SAF_imageclinic_DSC	GP referred patients for a TD consultation with a TD nurse, where images were acquired.	Healthcare system perspective: ▪ Staff costs (follow-up costs) ▪ Facilities (consultation room)	Healthcare: €110.04 (€124.28 less than FTF) Societal: €118.21 (€152.57 less than FTF)	▪ Health-related quality of life (Euro-Qol-5D 5L) ▪ Number of primary care visits

Study, Country	Type of TD intervention used	Image acquisition	Costs included	TD cost per patient (incremental costs)*	Key outcomes considered
			▪ Ambulance-related costs. Societal perspective: ▪ Transport costs ▪ Productivity loss ▪ Companion costs		▪ Number of FTF dermatology visits.
Moreno-Ramirez 2009, Spain	SAF	Images were taken by GP practice.	▪ TD-related costs including equipment, GP costs, dermatology teleconsultation review costs. ▪ FTF dermatology clinic costs ▪ Skin cancer clinic costs. ▪ Transport costs ▪ Productivity loss.	Healthcare: €118.18 (€73.46 less than FTF)	▪ Waiting interval from first GP visit to final intervention.
Orruno 2010, Spain	SAF	Images were taken by the referring primary care physician.	▪ Primary care costs including review, image acquisition, and referral ▪ TD equipment, photography training and software costs ▪ Dermatologist evaluation and report-related costs.	Healthcare: €163.27 (€88.15 less than FTF)	None.
Pak 2009, USA	SAF	Not reported.	Direct costs ▪ Clinic visits ▪ Follow-up costs ▪ TD appointments	Healthcare: €363.84 (€13.61 more than FTF) Societal: €420.77 (€39.60 less than FTF)	None.

Study, Country	Type of TD intervention used	Image acquisition	Costs included	TD cost per patient (incremental costs)*	Key outcomes considered
			▪ Radiology procedures ▪ Laboratory costs, including preparations ▪ Procedures (such as biopsies) ▪ Medications. Indirect costs ▪ Productivity loss		
Palamaras 2022, UK	SAF_imageclinic	Medical photographers in a TD service in a primary care setting.	▪ TD appointment costs ▪ Trust overhead costs with TD service (such as medical photographers) ▪ FTF dermatology appointment costs ▪ Productivity loss.	Healthcare: Average cost saving with TD €110.81	▪ Waiting times for appointments ▪ Management pathways following initial clinic visit ▪ Patient satisfaction survey ▪ Carbon footprint.
Persaud 2005, Canada	LI	Not reported.	Fixed costs ▪ Equipment-related costs ▪ Maintenance costs ▪ Administrative costs. Variable costs ▪ Patient costs ▪ Attending family's costs ▪ Specialist physician time ▪ Telecommunication costs.	Healthcare: €97.96 (€18.07 more than FTF) Accounting for specialist physician cost and telecommunication.	None.

Study, Country	Type of TD intervention used	Image acquisition	Costs included	TD cost per patient (incremental costs)*	Key outcomes considered
Scottish Health Technologies Group 2023, Scotland	SAF	Not explicitly reported; assumed GP/practice staff.	Healthcare system perspective: ▪ GP visit and image upload ▪ Photo-triage and appointment allocation ▪ Dermatology consultant diagnostic clinic ▪ Dermatology nurse clinic ▪ Community GP special interest clinic. Societal perspective: ▪ Travel-related costs.	Healthcare: Average savings of €5.98 with TD Societal: Average savings of €6.43 with TD	▪ Carbon footprint.
Snoswell 2018, Australia	SAF	Referring GPs took the images used.	▪ GP costs ▪ Dermatologist FTF costs ▪ Dermatology TD costs ▪ Laboratory costs ▪ Excision costs.	Healthcare: €228.37 (€39.19 more than FTF)	▪ Days to clinical resolution (diagnosis by dermatologist or excision of lesion by a GP) ▪ Diagnostic outcomes.
van der Heijden 2011, Netherlands	SAF	Referring GPs took the images used (following training for which they received formal accreditation).	▪ TD costs (based on health insurance prices). ▪ FTF dermatology costs (based on Dutch healthcare system prices).	Healthcare: €194.37 (€43.24 less than FTF)	▪ Management pathways following initial clinic visit ▪ Diagnostic outcomes.

Study, Country	Type of TD intervention used	Image acquisition	Costs included	TD cost per patient (incremental costs)*	Key outcomes considered
Vestergaard 2024, Denmark	SAF_DSC	Referring GPs took the images used (with a smartphone and dermatoscope).	Healthcare system perspective: ▪ TD-related costs ▪ GP costs ▪ Dermatologist costs ▪ Follow-up consultations. Societal perspective: ▪ Productivity loss ▪ Transport costs	Societal: TDS1-€650.01 and TDS2 – €644.05 (€23.32 and €17.37 more than FTF, respectively)	None.
Vidal-Alaball 2018, Spain	SAF	Referring GPs took the images used.	Direct costs ▪ Equipment costs ▪ Staff costs Excluded costs ▪ Telecommunication ▪ Facilities ▪ Training Societal costs ▪ Productivity loss, travel costs.	Healthcare: Average saving of €4.70 Societal: Average savings of €15.68	None.
Yang 2019, USA	SAF	Referring primary care physicians took the images used (using a platform that could be used on mobile devices).	Direct medical costs ▪ PCP visit ▪ TD cost ▪ Dermatology visit ▪ Emergency room.	Healthcare: Average savings of €8.59 to €45.19	▪ Number of TD referrals recommended for FTF visits.

Study, Country	Type of TD intervention used	Image acquisition	Costs included	TD cost per patient (incremental costs)*	Key outcomes considered
Zakaria 2021, USA	SAF	Referring clinicians took the images used.	▪ Primary care provider costs (personnel). ▪ FTF dermatology visit costs (personnel). ▪ TD consultation costs (personnel - training and technology – licensing, installation and maintenance).	Healthcare: €448.89 (€112.35 less than FTF)	None.

Key: FTF: face-to-face; GP: general practitioner; LI – live-interactive; OOP: out-of-pocket; PCP: primary care provider; SAF: store-and-forward; SAF_imageclinic_DSC – store-and-forward conducted at image clinic with dermatoscopy; SAF_DSC – store-and-forward with dermatoscopy (including clinical images); SAF_imageclinic - store-and-forward conducted at image clinic; TD: teledermatology; TTO: time trade-off.
* Costs converted to 2024 Irish Euro.

5.3.3 Summary of findings

Of the 20 studies identified, two studies used cost-effectiveness analysis, one used cost-utility analysis, and the remaining studies were cost-minimisation and cost-consequence analyses, which assumed no difference in health benefits between the care models.

5.3.3.1 Cost-utility analysis

A randomised, controlled, non-blinded, and multicentre study from Spain presented outcomes in terms of incremental costs per QALY gained in an adult, mixed dermatology population from a societal perspective. The study reported cost reductions of €153 and a QALY gain of 0.05 resulting in an ICER of -€3,051 per QALY, favouring TD.[396]

Another randomised clinical study compared TD with usual care in terms of costs and utilities from both US Department of Veterans Affairs (healthcare payer) and societal perspectives. Utilities were measured in the study population at baseline and nine-month follow-up using the time trade-off method. Both TD and usual care groups experienced a gain in utility over the study period (0.03 and 0.02, respectively); however, the difference between the groups was not statistically significant. The authors therefore presented the results of an incremental costing analysis only.[400]

5.3.3.2 Cost-effectiveness analysis

Cost-effectiveness analysis was undertaken in two studies. An Australian study[392] reported the incremental cost per day of earlier clinical resolution was €2 (95% Credible Interval: €0.62 to €3.79; healthcare payer perspective). Due to the unclear clinical significance of earlier resolution, the authors could not determine if TD represented a cost-effective intervention relative to usual care. A study from Spain[395] reported that, from a societal perspective, TD was associated with a mean reduction in cost of €73 per patient episode and 76.3 fewer days waiting time (to either first visit at a skin cancer clinic or time to final intervention). Both studies focused on suspected cancer (mixed) populations.

5.3.3.3 Cost-minimisation/cost-consequence analysis/costing analysis

Seventeen studies pertained to cost-minimisation, cost-consequence or costing analyses. Of these, 15 evaluated SAF teledermatology models and two LI teledermatology models.

5.3.3.3.1 SAF models

Among the 15 studies that examined SAF TD models, three studies reported that TD was associated with higher costs than usual care. Vestergaard et al. 2024 (Denmark) reported incremental additional costs of €17 to €23 (depending on teledermatologist used) per patient episode in an adult, suspected cancer (mixed) population (societal perspective).[391] Eminović et al. 2010 (Netherlands) reported an additional cost of €42 (95% CI: -€37 to +€96) per TD episode in an adult, mixed dermatology population (societal perspective).[399] When adopting a healthcare payer perspective, Pak et al. 2009 (US) reported an additional cost of €14 per TD patient episode in a mixed dermatology population; however, when a societal perspective was adopted, TD was associated with a cost reduction of €40 per patient episode due to greater productivity and travel-related savings.[394]

The remaining 12 SAF TD studies[261, 275, 312, 339, 388-390, 397, 398, 400, 402, 403] reported that TD was associated with cost reductions relative to usual care, ranging from €5 to €754 per patient episode, when adopting a healthcare perspective. Of these studies, four[261, 397, 400, 402] (two in Spain, one in the US, and one in the UK) also considered societal perspectives, reporting cost reductions of €6 to €76 (95% CI: €11 to €142) per patient episode. These reductions were attributed to avoided FTF consultations when a healthcare perspective was adopted, and to additional reductions due to productivity gains and reduced travel costs when a societal perspective was adopted.

5.3.3.3.2 LI models

Two studies compared LI TD models with usual care using cost minimisation analyses. Armstrong et al. 2007 (US) reported cost reductions of €85 per hour of clinic delivery (interactive TD practice versus conventional clinic), primarily due to lower facility and personnel costs (healthcare perspective).[401] Persaud et al. 2005 (Canada) reported additional costs of €18 per LI consultation, as compared to conventional consultation (societal perspective).[393]

5.3.3.4 Sensitivity analysis

Of the 20 studies considered, 10 included some form of sensitivity analysis, such as one-way sensitivity analysis (OWSA), scenario analysis, or probabilistic sensitivity analysis (PSA).

5.3.3.4.1 One-way sensitivity analysis and scenario analysis

Two model-based evaluations (one cost-utility analysis and one cost-effectiveness analysis) used OWSA to investigate the impact of parametric uncertainty on the model results; however, Lopez-Villegas et al. (2024; cost-utility analysis) only applied the analysis to the costing model meaning the impact of uncertainty was

only investigated in terms of the incremental cost (not the ICER). Snoswell et al. (2018; cost-effectiveness analysis) presented the results of OWSA using five variables. The model results remained 'cost saving' for each day saved to clinical resolution under all permutations evaluated in the OWSA.[396]

Four studies used scenario analyses to investigate the conditions necessary for the strategies examined to become equal in terms of cost. Three of these studies had reported TD to be the less costly alternative in the base case analysis. In scenario analyses, Eminovic et al. (2010)[399] reported that the strategy costs would be comparable if 37% of referrals by GPs to conventional dermatology were avoided due to TD; this compared to the base case analysis where TD was (more costly than usual care (TD €42 [95% CI: -€37 to +€96]). However, it was considered unlikely that this proportion of referrals could be avoided (achieved in 5.5% of model Monte Carlo simulations). Zakaria et al. estimated that for TD and usual care costs to be equivalent, TD costs would need to increase by 316% (or usual care costs decrease by 56%) from the value applied in their base case. A costing analysis from Spain found that even with a 40% increase in the costs of performing and assessing TD, it remained less costly, with total per-patient costs of €138.28 compared to €170.86 for conventional FTF consultations.[403] The US study using a LI TD model estimated that the threshold value for the hourly TD clinic costs could increase 9.3-fold over the base case value before it would have the equivalent cost to a FTF clinic.[401]

Three studies reported the most influential variables affecting the incremental cost of TD. TD consultation costs, staff compensation, and the proportion of patients referred back to their GP after a TD consultation were found to significantly contribute to the overall cost of TD. All three studies had reported TD to be less costly than usual care. They noted that when these variables were adjusted within plausible ranges, TD remained less costly than FTF consultations.[388, 392, 399]

Two studies examined referral efficiency and consultation durations in OWSA. One study found that if at least 37% of FTF consultations are avoided, TD costs would remain lower than those of conventional FTF consultations. In an analysis undertaken from a societal perspective, distance to healthcare facilities was another determining factor contributing to cost reductions through reduced travel costs for patients.[395, 399]

Scenario analyses were used in studies from Denmark and the US to assess cost variations under different conditions. A cost minimisation study from Denmark examined scenarios like TD investments, equipment utilisation, and consultation efficiency, finding that reducing investments and running costs had a minor effect on overall TD costs. However, increasing the frequency of TD equipment use significantly improved cost reductions, making TD more economical than FTF

consultations.[391] A US study demonstrated that TD remained less costly under various scenarios, except when the cost of a TD visit was at its highest and the cost of emergency room or in-person dermatology visits was at its lowest.[389]

Probabilistic sensitivity analysis

PSA was used to assess the robustness of TD cost-effectiveness under varying conditions in three studies. The Australian cost effectiveness study demonstrated that when costs were varied between A$22.69 to A$97.35 per person (compared with the base case estimate of A$54.64) and time to clinical resolution varied from 13 to 38 days, the ICER ranged from A$0.87 to A$5.29 per day saved in clinical resolution.[392] A cost minimisation study from the Netherlands used Monte Carlo simulation to show that the conventional model was less expensive than the TD model in 89% of all simulations.[399] A cost-utility study from Spain performed a bootstrap simulation, showing that treatment in the FTF group was more expensive and did not reflect better effectiveness results than the TD group, with effectiveness in the TD group being slightly higher.[396]

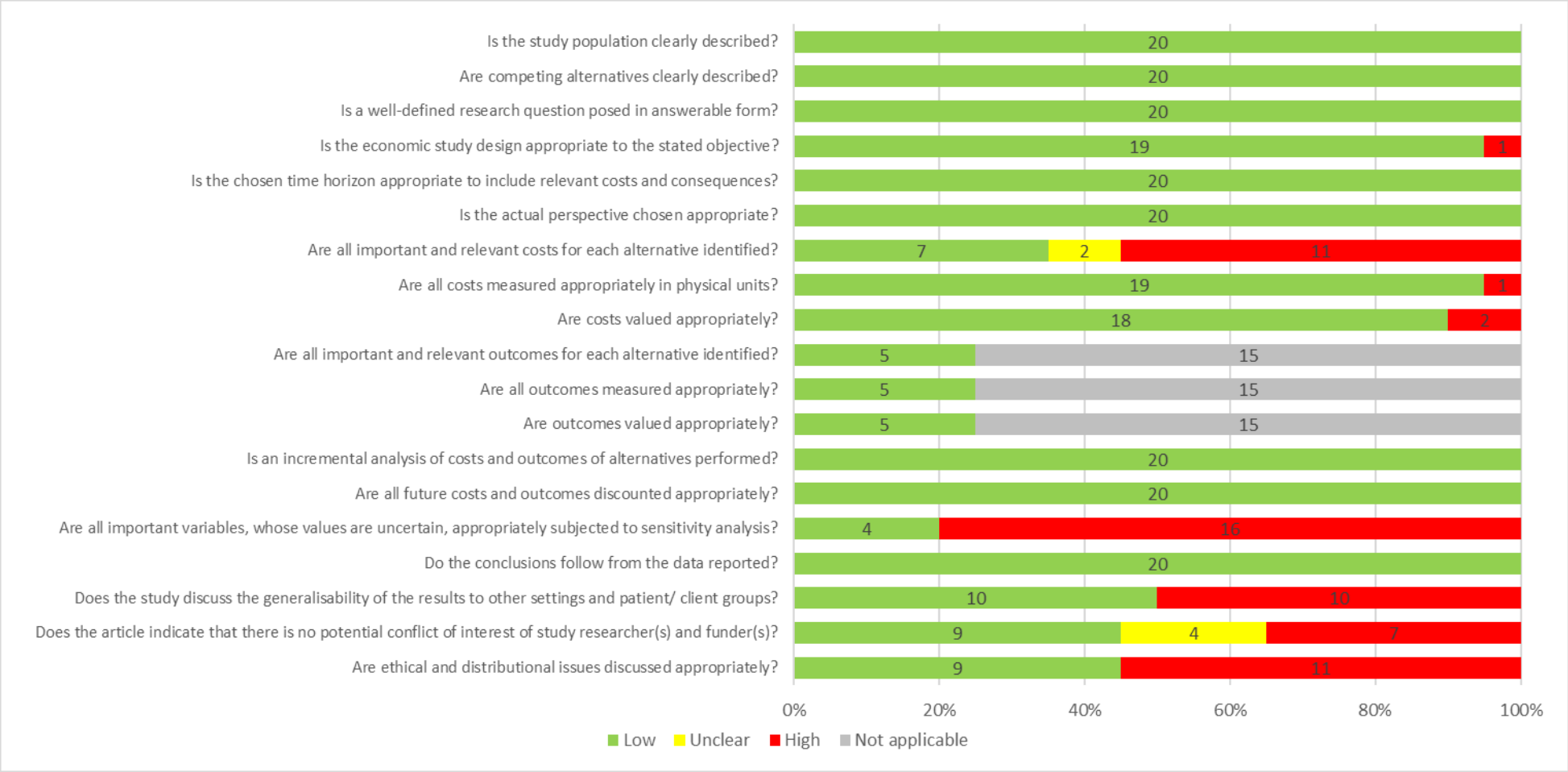
5.3.4 Quality appraisal

The quality of studies, assessed using the CHEC-list questionnaire, was variable (see Figure 5.3). Overall, studies provided clear descriptions of objectives, study populations, and results. However, several quality concerns were raised, particularly regarding the adequacy of cost considerations, sensitivity analysis, and conflicts of interest.

Only four studies conducted comprehensive sensitivity analysis,[392, 396, 399, 401] not all reported estimates of parameter uncertainty or distributional assumptions for every input. While it is acknowledged that obtaining uncertainty estimates for all parameters can be challenging, it is important that the choice of parameters for sensitivity analysis be clearly outlined.

Six studies identified potential conflicts of interest, as the authors were promoters of TD or reported receipt of a fee-for-service payment for its use.[312, 339, 388, 392, 394, 400]

Figure 5.3 Quality assessment of economic evaluations using CHEC-list: risk of bias



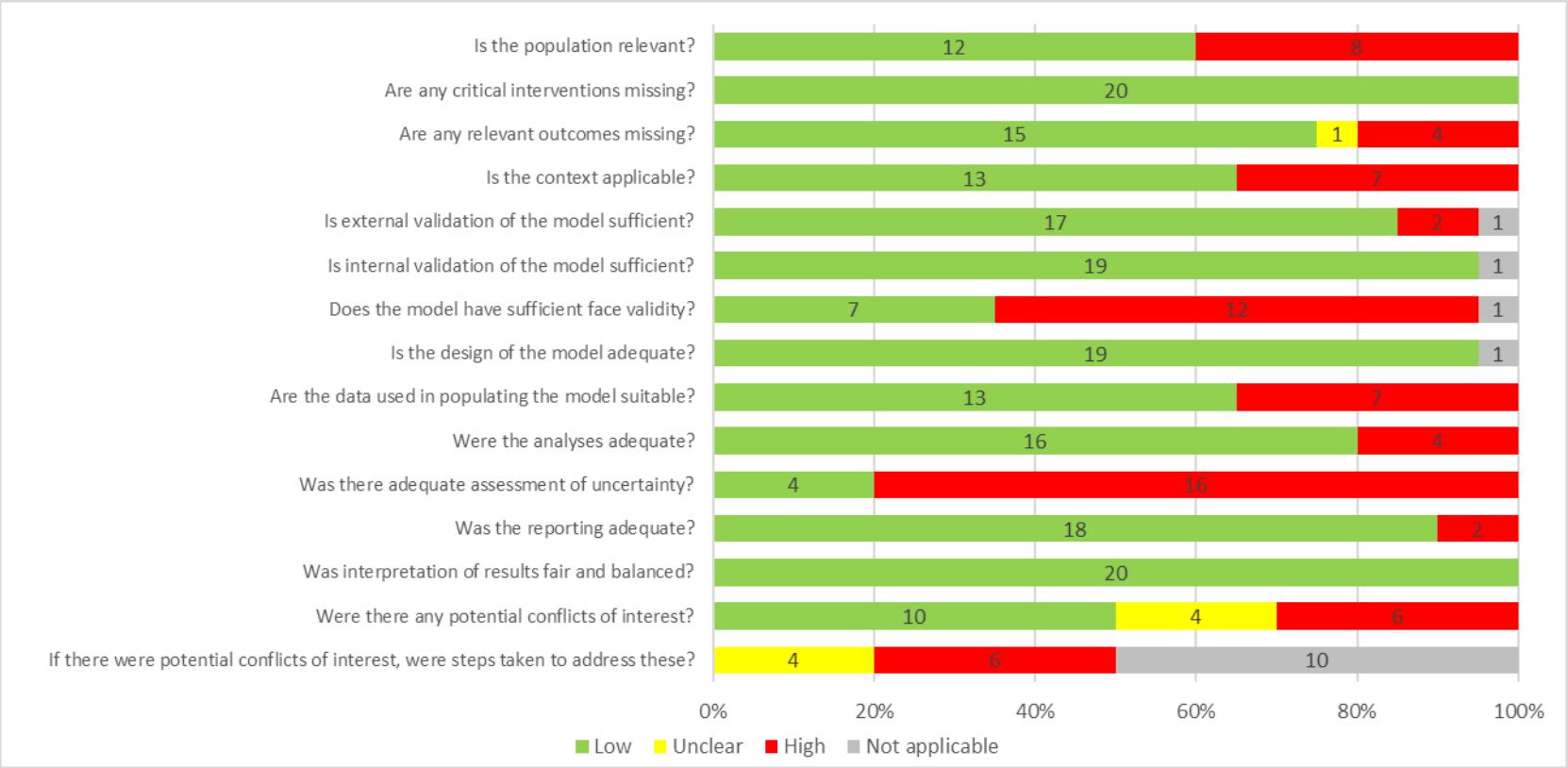
5.3.5 Transferability assessment

The transferability and applicability of the included studies to the Irish context were assessed using the ISPOR questionnaire. This assessment aimed to determine the extent to which the findings of published economic evaluations could be relevant to decision-makers in Ireland. The results of the applicability assessment are presented in Figure 5.4. Studies conducted in the US, Canada, New Zealand, and Australia were not considered applicable due to differences in healthcare system structure and financing.[312, 388, 389, 392-394, 400, 401] There were also three studies that adopted a societal perspective only.[391, 395, 399] While a societal perspective can be adopted in cost analyses for Ireland, it is typically secondary to the perspective of the publicly-funded healthcare system. It should be noted that values attached to travel cost and lost productivity can vary substantially from country to country, and, in the context of TD, can be heavily influenced by geography.

Several common issues with applicability were identified, as illustrated in Figure 5.4. Seven studies lacked appropriate cost data for populating models according to established standards. Seven studies provided insufficient information on model validation, including both external validation and internal verification. In terms of sensitivity analysis, 16 studies were found to have inadequate approaches for assessing parameter uncertainty, with many failing to conduct univariate or probabilistic sensitivity analyses. In many cases, the trial-based design of studies limited the scope for extensive sensitivity analyses.

Reporting quality was also a significant concern in two studies.[390, 393] Potential conflicts of interest were identified in six studies. These potential conflicts were typically related to fee-for-service arrangements for the use or promotion of the technology being evaluated, or where the authors did not disclose potential conflicts of interest in their studies.[312, 339, 388, 392, 394, 400]

Figure 5.4 Transferability assessment of economic evaluations to the Irish context using the ISPOR questionnaire: risk of bias



5.4 Discussion

This systematic review aimed to evaluate the evidence of cost effectiveness and costs of TD compared to traditional FTF dermatology consultation, and to assess the applicability of that evidence to the Irish context. A total of 20 studies were included in the analysis, of which three were full economic evaluations (two cost-effectiveness analyses and one cost-utility analysis), and the remaining studies only considered cost outcomes (cost-minimisation analysis/costing analysis and cost-consequence analysis). Out of the 20 studies for review, 18 assessed SAF TD, while two employed LI care models.

Overall, the majority of studies reported TD to be less costly per patient than conventional FTF consultations. The difference in per patient cost ranged from TD being €42 more expensive to being €754 less expensive. There was substantial variation in the per-patient baseline cost of FTF care, ranging from €25 to €647, highlighting differences in the included components of care and the values attached to them. Studies differed in whether they included primary care costs, follow-up care, and the types of equipment that were considered as part of the provision of TD.

Two studies were model-based [392, 402] while the remaining studies used a combination of empirical data from pilot studies for clinical outcomes and costs from secondary sources. Four studies[394, 396, 399, 400] used data from an RCT where patients were randomised to TD or FTF, while a fifth study evaluated both FTF and TD in the same population.[304] As such, other studies may be considered at risk of bias as TD and FTF were provided to different populations. The included studies were of varying levels of quality and applicability. The main identified issues with studies related to the included costs and the extent of sensitivity analyses.

A number of studies presented analyses that adopted a societal perspective. In these analyses, substantial costs could be averted by reduced travel and lost workforce participation through fewer patients requiring FTF appointments at a hospital. Some of those studies looked specifically at remote or rural populations, which may overstate the benefits that could accrue at a national level.

For the studies that used SAF TD models, the pathway involved an initial assessment with a primary care clinician or GP followed by completion of a TD referral including taking patient details, relevant clinical information and digital images. In the majority of the SAF TD referrals, images were taken in the GP office. However, four studies involved images captured outside the GP setting: two by TD nurses, one by a medical photographer, and one by a melanographer. None of the studies reported on the image quality or the impact of image quality on TD evaluations and economic

outcomes, so it is unclear to what extent image quality impacts costs and or cost effectiveness outcomes.

LI TD was used in two studies. In these studies, TD consultations via LI were of similar duration or longer than usual FTF appointments. In both studies there was a videoconferencing facility at the primary care site and a coordinator to support the session, and so they are of limited applicability to the Irish context. Cost reductions presented in a US-based study were due to lower facility and consultant costs, which was in contrast to the Canadian study finding which reported considerable investments for the set-up. There was no evidence regarding the use of LI TD in a home setting or using a mobile phone.

In studies that included TD equipment costs such as high-resolution cameras and digital platforms, some incorporated depreciation over a fixed period, usually three to five years. Studies noted that the cost of TD technology could decrease with increased adoption through economies of scale. Additionally, some studies reported TD equipment provided by third-party vendors, with a bundled cost integrating software, hardware, and maintenance expenses into a single fee, simplifying TD implementation for healthcare providers.

While all studies considered the costs associated with hospital-based dermatologists, the incorporation of primary care costs was less consistent. Specifically, three studies from the UK and the Netherlands did not consider any primary care costs. Although most studies included TD-related costs, only a few considered expenses related to training, telecommunication, and infrastructure. Two cost analyses from Spain assessed the proportion of patients who avoided FTF consultations following TD evaluations. From the perspective of assessing costs in an Irish setting, primary care costs may be important depending on how TD is implemented.

Follow-up costs were addressed in four studies. Two studies from the United States included costs for referral and follow-up visits at dermatology clinics, investigations, and medications over four to nine months.[394, 400] Two studies from New Zealand included follow-up assessments such as FTF evaluations, biopsies, nurse assessments and GP follow-up.[275, 312] Additionally, two randomised clinical trial-based economic evaluations included extra costs for follow-up visits to dermatologists and GPs during care episodes.[396, 399] Another study from the US considered pathology testing costs during follow-up.[392] In the context of this HTA, the focus is on referral management rather than ongoing care, so follow-up care should be a less significant consideration.

Overall, cost reductions were reported across different perspectives, including healthcare system and societal perspectives. Multiple studies indicated that TD referral reduced the need for FTF consultations, with avoidance rates ranging from

50% to 90% depending on the setting and patient population. The lower bound of this range corresponds to the average effect observed in Chapter 4, suggesting that the studies included here may overstate the impact of TD and, as a consequence, overstate the potential cost reductions. Reductions in waiting times for specialist consultations were also observed, ranging from a few weeks to several months, in line with findings from Chapter 4.

Most economic evaluations were cost minimisation, cost-consequence analysis, or costing analysis, assuming equivalent effects across treatment strategies. Two studies attempted to capture utility within six to nine months; however, one study failed to show statistically significant differences, while the other showed only a marginal gain. Study designs varied, with challenges in randomisation and the inability to accurately replicate real-world patient waiting lists for dermatologist FTF consultations.

5.5 Conclusion

The international evidence reviewed suggests that TD for managing primary care referrals may reduce costs compared with usual care. Although there was variability in the degree of effect, almost all studies on SAF TD reported cost reductions mainly due to the reduction in FTF appointments.

6 Budget impact analysis and resource implications

Key Points

- Demand for outpatient dermatology services is increasing, with 43,500 more referrals in 2024 than there was capacity to see face-to-face. Assuming that referral rates for new patient dermatology appointments rise in line with population growth and demographic changes, referrals will grow by a predicted 1.7% each year, reaching over 120,000 new referrals each year by 2035.
- The ability of the current dermatology pathway to deal with new outpatient referrals is related to consultant capacity. It is estimated that, on average, a consultant dermatologist within the HSE has capacity for approximately 900 new patient appointments each year.
- Budget impact and resource implication analyses were undertaken of teledermatology (TD) to support the management of primary care referrals.
  - The main analysis was undertaken assuming that dermatology capacity is expanded by an additional five whole-time equivalent (WTE) consultant posts each year. Secondary analyses assumed maintaining current dermatology capacity, and immediately increasing capacity to meet new referral demand. Capacity increases were assumed to occur for both the current care and the TD pathways.
- If consultant capacity were to increase by an additional five WTE consultant posts each year, the estimated 10-year incremental budget impact of a TD pathway would be almost €2.7 million. This would comprise €9.8 million primary care costs, approximately €0.25 million in secondary care equipment costs, and a reduced consultant workforce requirement to meet demand, reducing the overall spend by over €7 million relative to the current pathway workforce spend. As a result of uncertainty around workforce requirements, the overall budget impact could vary substantially (95%CI: -€36.8 million to €11.7 million). In this scenario, a TD pathway would enable an additional 270,000 patients to be managed over 10 years, compared with the current pathway. TD would begin reducing the waiting list backlog from year nine, while it would still be increasing with the current pathway.
- The budget impact of delivering TD within the capacity currently available for dermatology, 63.6 WTE consultants, would have a similar incremental

budget impact of €9.9 million over 10 years. Capacity constraints in this scenario would mean that waiting lists would continue to grow rapidly. Despite this, TD would have a positive impact on removing people off the waiting list and the cumulative waiting list by year 10.

- If consultant capacity were to increase to meet new referral demand, most of the recruitment would be required in year one: 45 consultant posts in the current pathway and 37 with TD, representing the current demand-capacity gap. Reduced consultant requirements would mean that the cost of implementing TD would be completely offset by reduced salary costs. Both pathways would see positive impacts on waiting list numbers and numbers of patients removed from the waiting list. However, a TD pathway would reduce the number of patients needing to be seen face-to-face and DNAs compared to the current pathway, potentially freeing up capacity in outpatient department clinic spaces.
- Results of the analyses were sensitive to changes in the proportion of patients returned to their GP without a FTF appointment. Setting key TD-specific parameters at their lowest efficiency simultaneously would eliminate the positive impact on waiting lists. If a TD pathway were to be introduced, consideration should be given to what contingencies could be put in place to ensure the service could maintain efficiencies as modelled. The main analysis assumed adding five dermatologists per annum, which could prove challenging to achieve in practice.
- It was assumed that demand will increase in line with an ageing and increasing population. There may also be currently unmet demand that may only come to light as capacity expands. Increases in demand above what has been estimated here would place an additional burden on the service.

6.1 Introduction

This chapter describes the budget impact analysis (BIA) and analysis of resource implications undertaken to estimate the cost and impact on waiting lists of implementing a teledermatology (TD) pathway to support the management of primary care referrals to dermatology services in Ireland.

6.2 Methods

For the purpose of the BIA, it was assumed that the TD pathway would involve a store and forward (SAF) system, with imaging occurring at the point of referral in

the general practice clinic. As discussed in earlier chapters, there are other models of TD, such as SAF TD via an imaging clinic or live-interactive TD. However, there are less data to support these interventions and, as such, the evidence base was considered insufficient to inform a BIA. The rationale underpinning this decision in the context of the Health Service Executive (HSE) is explored in detail in Chapter 7. The inputs and data sources used in the analyses are described further in the following sections. The analyses described in this chapter were conducted in line with national HTA guidelines,[385, 404] and were undertaken in Excel 2016.

6.2.1 Target population

The target population for the TD pathway includes individuals, adults and children, for whom expert dermatological advice is sought by their GP from publicly-funded dermatology services in Ireland. The demand for dermatology services in secondary and tertiary care has been set out in Chapter 3.

In 2024, the HSE delivered 49,334 dermatology outpatient department (OPD) appointments for new patients. This figure had risen by 21% between 2019 and 2024.[225] The overall capacity of the system to see new patients is related to the number of whole-time equivalent (WTE) dermatology consultants in post in the HSE (63.6 WTE), with annual new patient attendances per consultant remaining at approximately 805 patients. In 2024, the HSE received 99,994 new patient dermatology referrals. This figure had risen by 55% since 2019, although annual referral rates were noted to vary over this period.[225] A growing population and changes to demographics may explain part of this increase. Census data indicates that between April 2019 and April 2024, the population of Ireland increased by 8.5%. Moreover, the proportion of the total population aged over 65 years increased from 13.8% in 2018 to 15.5% in 2024.[405] As discussed in Chapter 3, an ageing population will likely contribute to increasing referral rates for dermatology conditions such as skin cancers. Referral numbers also appear to have been impacted by COVID-19, with some of the large increase in referrals in recent years may reflect unmet needs for outpatient dermatology in 2020 and 2021.

6.2.2 Intervention

The intervention under consideration was the use of TD to support the management of primary care referrals. The modelled TD pathway assumes that images of the dermatological condition of concern would be taken in the GP practice as part of the referral process to secondary and tertiary care. The referral would be sent via Healthlink to a consultant dermatologist, who would then triage the referral using the clinical information plus the images. This would involve the addition of up to three images of the dermatology condition to the Healthlink referral. Some referrals are currently received via other means, such as email or post. In order to facilitate

efficient triaging and maintain image integrity, it was proposed that triaging of referrals within a TD-supported referral system would be completed electronically. That is, it was assumed that the proposed pathway would not be based on receiving referrals with printed images in an envelope. A consultant would review referrals (written information and images) in Healthlink on a computer screen or tablet, with this information used to support triage decisions. For patients whom the dermatologist deemed it necessary to see in a face-to-face (FTF) capacity, it is assumed that the patient would be assigned to an appropriate clinical prioritisation category (urgent, semi-urgent, or non-urgent) and managed as per the current system after this point. For other patients, the images may support a decision by the dermatologist to manage the patient remotely, returning the patient to their GP with correspondence and or advice, without the need for a FTF appointment.

6.2.3 Comparator

Currently, most GPs send an electronic referral through Healthlink when referring a patient to dermatology in secondary and tertiary care. Some GPs still rely on other referral methods. Information relating to the current referral system is discussed in detail in Chapter 7. The Healthlink referral system uses a standardised form containing details including referral information, patient demographics and history, history of the complaint and any clinical findings. Once received by the hospital, referrals are typically printed by administrative staff for review by a dermatology consultant who assigns a clinical prioritisation category. Administrative staff notify the referring GP via Healthlink and typically a letter is issued advising the patient of the waiting list they have been placed on, with a follow-up letter sent six weeks prior to the scheduled appointment date.

6.2.4 Model design

The BIA was designed as an open-cohort model and estimated the incremental cost to the HSE of implementing TD to support the management of primary care referrals to dermatology services in Ireland. The model included costs relating to staff, training and equipment. The BIA model also considered potential cost offsets that may be realised with TD. The incremental budget impact per annum, and total budget impact over 10 years were estimated, defined as the difference in average costs between TD-supported referral management and the current standard care.

A resource implication model was designed to investigate the impact that TD may have on waiting lists and efficiencies within the dermatology referral system over a 10-year horizon. This took into account current and predicted referrals, current attendances, and dermatology consultant workforce, to ascertain the implications of adopting TD over three capacity scenarios. Consultant dermatologist numbers have increased by 15 WTE since 2022 with ongoing recruitment for an additional five

consultants.[406, 407] Therefore the base-case analysis considered if consultant capacity were to increase by five WTE dermatology consultants annually. This analysis investigated the feasibility of delivering a TD-supported management pathway for referrals while increasing capacity at a pragmatic rate.

Secondary analyses considered the impact of delivering the TD service within current staffing levels for consultant dermatologists, and considered if consultant capacity were to increase immediately to meet predicted referral demands. These secondary analyses were included to show the impact of the extremes of no further recruitment of consultant dermatologists, and of the recruitment required to address demand and prevent further increases in the waiting list.

The resource implications were considered in terms of the impact on the waiting list, number of patients removed from the waiting list, number of FTF appointments completed, number of did-not-attends (DNAs), and the dermatology consultant workforce required to meet demand.

6.2.5 Perspective and time horizon

The analysis adopted the perspective of the publicly-funded health and social care system in Ireland (the HSE). Only direct costs to the HSE were considered (such as staff, training or equipment). Indirect costs (such as patient travel) were not considered, in accordance with national BIA guidelines.[404]

The BIA and resource implication analysis are reported for 5 and 10-year horizons to represent the short- and medium-term impacts.

6.2.6 Model input parameters

Costs and resource use were estimated from a variety of published and unpublished sources including salary scales, quotes for equipment, supplemented by input from experts. Value added tax (VAT) was included, where appropriate, in the BIA model. Discounting and or depreciation were not applied, as the included costs reflect the actual expenditure by the HSE in each year reported. However, capital investments that are expected to depreciate will incur a cost for replacement goods in the appropriate year, for example ICT equipment after three years.[385, 404] Where relevant, estimates were informed by the systematic review of clinical, safety and service utilisation (Chapter 4) and targeted reviews (Appendix Table A 18). Parameter inputs and the underpinning model assumptions were confirmed by expert opinion and international data from existing teledermatology pathways and guidelines. See Table A 16 for key model assumptions. Model inputs were considered in terms of their generalisability to the context of the publicly-funded health and social care system in Ireland.

Clinical parameters were selected with consideration to the hierarchy of evidence. Supplementary information relating to their selection is provided in Appendix C. Much of the clinical data informing the BIA was obtained from Chapter 3 (Epidemiology and burden of disease) and Chapter 4 (Clinical efficacy, effectiveness, healthcare service utilisation and safety). Data informing parameters on staffing, capacity and demand for dermatology were taken from Chapter 3. Of the 69 studies reporting on healthcare service utilisation in Chapter 4, 61 reported on outcomes relevant to the BIA. Of these, 39 studies were ultimately deemed suitable for inclusion.[26, 27, 51, 71, 80, 233, 254, 255, 261, 264, 276, 278, 281, 283, 290, 298, 304, 314, 315, 317-319, 321-326, 328-331, 340-342, 348, 356, 360, 371] The most common reasons for exclusion were: study outcomes not in a mixed dermatology population (n= 5), outcomes not reported in sufficient detail for the purpose of the BIA (n= 4), studies involved imaging clinics (n= 3), and studies that did not provide comparative evidence for specific parameters (n= 3). Further details on reasons for exclusion are provided in the Appendix C. Additional information was sought for four key parameters included in the model: avoided FTF appointments; re-referral rates; DNA rates for FTF appointments and for FTF appointments after store and forward (SAF) teledermatology consultations; and time spent managing and evaluating teledermatology consultations. A targeted country guideline review and a targeted parameter review were conducted to further inform these four parameters, in June 2025. Three studies identified through the guideline review,[307, 308, 408] and six studies identified through the targeted parameter review were ultimately used in the BIA parameter analysis.[409-414] Detailed information regarding the targeted guideline review and targeted parameter review conducted is provided in the Appendix C.

Individual parameter details are discussed in the following sections.

6.2.7 Cost inputs

Costs are presented in 2025 Euro (€). Costs were derived from sources within Ireland and where necessary were adjusted to 2025 prices using the Central Statistics Office's (CSO) Consumer Price Index.[415] Costs considered in the BIA model include the additional costs that would be required to provide equipment for teledermatology to primary and secondary and or tertiary care, and to develop training.

6.2.7.1 Staff training

GPs would require training on TD, to include taking images and including them in the referral. It was assumed that the cost of developing an e-module for delivering this training would be borne by the HSE. An additional cost was included in years four, seven and 10 for updating training material and to include any costs incurred for administration or hosting of training material between those years.

6.2.7.2 Equipment costs

In primary care, GPs would require access to a camera to take images. Cameras could be provided on a per practice or per GP basis. If cameras are provided to GPs on a per practice basis, issues of timely access to the equipment may arise in larger practices. A conservative approach was taken, costing on a per GP basis to minimise disruption to consultations.

Standards proposed by the British Association of Dermatologists for equipment specification relating to SAF teledermatology have been leveraged in the absence of Irish standards.(416) These propose that any camera used for taking images should have the ability to combine a flash and macro setting, have a short telephoto setting, white balance and autofocus, with the ability to control shutter speed/aperture to 400 ISO, 1/50th sec shutter speed and F5.6 aperture ideally. Any monitor used for viewing images should also have a minimum resolution of 2000 x 1500 pixels and a sRGB colour specification.(416) There could potentially be a wide range of possible products that meet these specifications. Choices on the equipment provided would be influenced by procurement processes within the HSE. The model uses prices that are indicative of the typical costs associated with products meeting these specifications (Table 6.1).

In secondary and tertiary care, in order to facilitate efficient triaging of referrals using the Healthlink platform, the cost of a laptop for each HSE dermatology consultant was included. In line with expected depreciation of ICT equipment, the cost of replacing cameras and laptops every three years was also included. No additional software costs over what may be supplied with the specified laptops and cameras were anticipated or included.

The model does not include a cost for the secure storage of digital images. The extent to which referral images will need to be stored is reliant on HSE data retention policies.(417) The HSE currently provides storage for patient referrals, and images are considered an extension of this requirement.

Table 6.1 Cost inputs

Parameter	Cost €	Specification	Source
Primary care costs			
Camera	€684.00	Digital camera with appropriate lens	Online retailer
Training	€43,059	Cost of developing an e-module	Previous BIA to support National Clinical Guideline No.29[418]
Secondary and tertiary care costs			
Laptop	€650.00	Windows laptop	Email correspondence with ICT procurement in a public body.

Key: BIA – budget impact analysis; ICT – information and communications technology.

6.2.8 Staff costs

6.2.8.1 Primary care

For the purpose of the BIA, a static GP workforce count was modelled. It was assumed that the additional time required to capture images is not reimbursed, as this would become part of creating a referral. However, the impact on GPs as an opportunity cost was considered and reported as the impact per GP.

6.2.8.2Secondary and tertiary care

Staffing was only costed for scenarios where requirements were different to current capacity, and was limited to consultant dermatologist posts. The base case analysis assumed that the capacity to provide dermatology appointments increases incrementally by five WTE dermatology consultants annually. The increase in staff was modelled as five individuals going into five full-time posts each year.

Scenario analyses considered the impact of delivering the service within current capacity, and the impact of expanding consultant dermatologist capacity to meet immediate demand. If the consultant capacity required to meet immediate demand was lower with TD than in the current pathway, the incremental difference in total pay costs to the HSE for additional consultants was estimated to offset against incremental costs of teledermatology. Consultant salary costs (€470,291 per annum, including employer PRSI, overheads and imputed pension costs) were calculated in line with national guidelines using the Consultant Contract 2023 base salary for a clinician consultant.[404, 419] This was a conservative approach as, in reality, reductions in consultant workforce requirements would likely be accompanied by reductions in OPD staff requirements and further savings.

6.2.9 Resource inputs

6.2.9.1 Staffing

6.2.9.1.1 Primary care

As discussed in Chapter 3, quantifying the number of GPs with public contract working in Ireland is complex. A recent report estimated that there were 3,626 GPs currently working in Ireland in a capacity that "provide general practice services that are broadly available – that is, clinically active, qualified, Ireland-based GPs who are not constrained to out-of-hours or specialist services and are likely available during some to most standard working hours (with morning and afternoon sessions between Monday and Friday) to provide standard general practice services to the general public".[210] While a small percentage of these GPs may not be using Healthlink, this figure provides a reasonable estimate for the number of cameras required by GPs to take images for referrals and recognises that eventually all or almost all GPs will refer via Healthlink. A proportion of new GPs will also join each year to replace GPs leave the profession or retiring, and require a camera for imaging. Assuming that the average age of retirement for a GP is 68 years,[420] and that between 7% and 9% of the workforce are 65 years of age and older,[210], up to 98 GPs could retire each year. It is estimated that an additional 49 GPs will leave the workforce for other reasons.[420] Assuming that all those leaving the workforce (retiring and other) are replaced, this would correspond to 147 new GPs entering the system each year who will require a camera to enable TD referrals.

6.2.9.1.2 Secondary and tertiary care

Data provided by the HSE indicates there are currently 63.6 whole-time equivalent dermatology consultants, employed by the HSE across 68 posts.[224] Although a further five posts were in recruitment at the time of this analysis, current consultant capacity only considered consultants in post. The impact of additional recruitment was considered in the analyses which looked at both the impact of increasing the consultant workforce incrementally by five WTE annually and the required workforce to meet the immediate and predicted demand. The model assumes that consultant dermatologists that retire or otherwise leave the service are replaced, and any increase to the consultant dermatology workforce is in addition to this. Support staff were not included in costings. The extent to which additional staff will be needed may vary by department, and they may not be dedicated to the delivery of OPD activity.

6.2.9.2 Capital assets

As expenditure is directly proportional to the GP and dermatologist workforce numbers, there was no anticipated requirement for building to create capacity in

primary or secondary and tertiary care spaces. Analyses that estimate the additional consultant capacity required to meet current and predicted demand may require additional resources such as clinic space and the costs that are associated with their use, for example, overheads. For the purpose of this HTA, it was assumed that increases in dermatologist capacity in the two pathways would attract commensurate and equivalent associated resources.

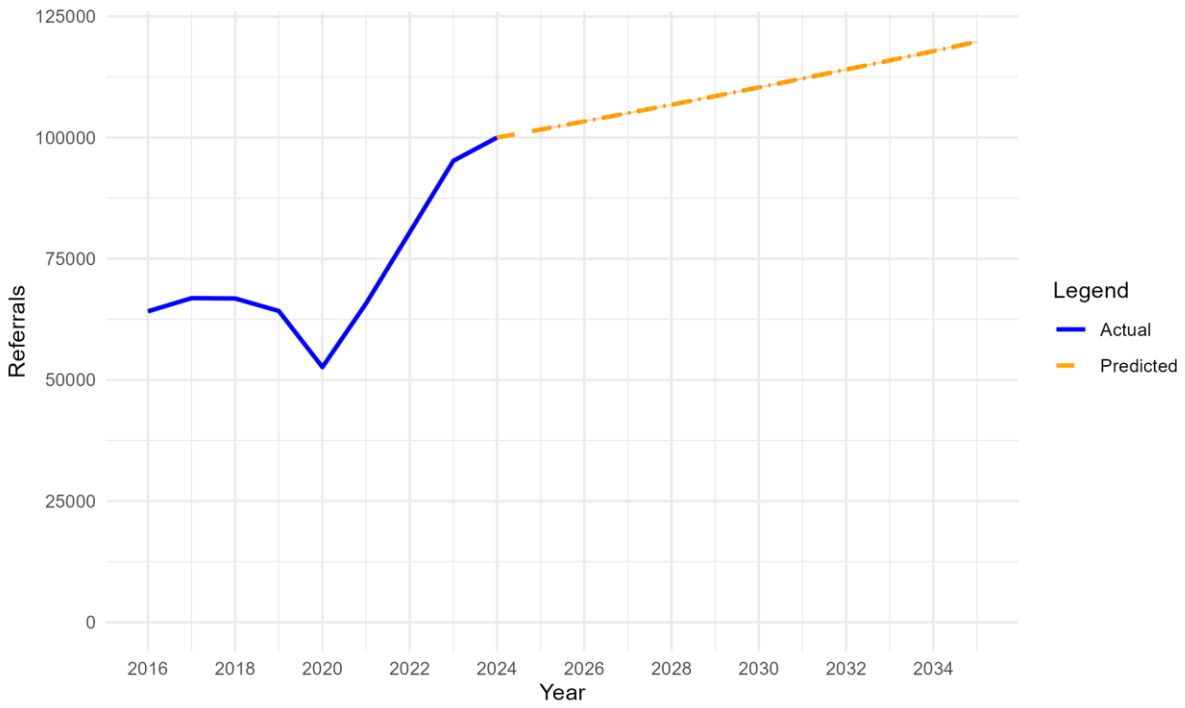
6.2.10 Referrals and attendances inputs

Data on the total number of new patient dermatology OPD attendances, total number of return patient attendances and the total number of new referrals to dermatology were obtained from the HSE Business Intelligence Unit for individual hospitals by month from 2019 to 2024.[225] These data were supplemented with annual figures in published HSE reports for the years 2015 to 2019.[1]

6.2.10.1 New patient dermatology referrals

Analysis of HSE Acute hospitals referral data highlighted that, whilst showing an overall increasing trend, this was not consistent, see Figure 6.1, and may have been impacted upon by external events (as discussed in section 6.2.1). New patient referral rates for outpatient dermatology were 18.6 referrals per 1,000 population in 2024. This was up from 13.0 referrals per 1,000 in 2019. Given the lack of consistent trend in the increase in referral rates, the expected annual increase in referrals for the next 5 to 10 years was estimated to take into account the predicted population growth, changes in the age profile of the population, and age-related resource utilisation in dermatology. No national data pertaining to outpatient dermatology usage by age-group were available. In the absence of national data, data published by NHS England were used, which report new attendances at NHS dermatology OPD services in England by age group; it is noted that these NHS data are in the context of an established TD service.[421] The rate of dermatology OPD utilisation for new attendances per 1,000 population was calculated for the age groups 0-17 years, 18-44 years, 45-64 years, 65-84 years and 85 years and older.[422] This rate was then applied to population predictions for Ireland for the 10-year period 2025–2035 by age group to estimate the predicted mean increase in referrals for the model.[423] A mean age-standardised increase of 1.7% was then applied annually in the model from the base of 99,994 referrals in 2024.[225] This predicted that the annual number of referrals would reach 120,163 by year 10 of the model. The actual and predicted trend in referrals is shown in Figure 6.1.

Figure 6.1 Actual and predicted trend in referrals



6.2.10.2 New patient attendances and consultant capacity

In 2024, there were 49,334 new patient dermatology OPD attendances across HSE hospitals.[225] As previously noted, attendances appear constrained by consultant capacity. In 2019, 2022 and 2023, the average number of new patient OPD attendances per consultant was approximately 815. This figure dropped in 2020 and 2021 due to COVID-19 pandemic-related closures. Between 2023 and 2024, the number of consultants increased by approximately eight WTE, resulting in an estimated mean of 770 new patient OPD attendances per consultant per annum in 2024. It is possible that this recruitment occurred over the course of the year and consultants did not deliver a full year of appointments. Excluding data from 2020 and 2021, where new OPD attendances were impacted by the COVID-19 pandemic, there was a mean of 805 new patient OPD attendances per consultant per annum between 2019 and 2024. This figure only considers the number of patients who attended their appointments. Therefore the capacity within the system for new patient OPD attendances is greater. Given a DNA rate of approximately 12.4%,[424, 425] discussed in the next section, the mean number of appointments that each consultant has available for new patients was calculated at approximately 919 appointments per annum.

In the current pathway, the ratio of new to return attendances seen by a consultant dermatologist is approximately 1:2. This will vary, some OPD clinics may provide 'see and treat' services that return a high proportion of patients to primary care after the

first appointment. On the other hand, clinics specialising in complex chronic cases may have a ratio closer to 1:3. It is predicted that TD will change the patient case mix seen at FTF appointments given the assumption that 50% of referrals will be diverted back to GP care, resulting in a shift to a potentially more chronic condition case mix in the OPD clinics. Data from the NHS in England reported that for every new dermatology patient that attended (FTF and TD) in 2023/2024, there were on average 1.6 return appointments in that year.[426] The overall ratio of new to return attendances, 1:2.6, also takes into account return patients who first attended in previous years and for each new patient seen in 2023/2024, there were as many return attendances for patients first seen in previous years.[426] Therefore a conservative assumption was made that, given a current new to return ratio for dermatology in Ireland of 1:2, this would increase to 1:3 following introduction of TD; that is, on average for every new patient seen FTF at an OPD clinic, there would be three return patient attendances.

6.2.10.3 Did-not-attends (DNAs)

DNA rates are likely to vary between hospitals as a result of a complex mix of factors including population case mix, waiting times, and initiatives employed to minimise DNAs. In the absence of a national rate of DNA for new patient dermatology attendances, the rate of DNA for all outpatient attendances in Ireland was used in proxy. In 2022, there were 3.4 million attendances at HSE OPD clinics while there were 481,432 recorded DNAs.[424, 425] This equated to a national DNA rate for OPD attendance (new and return) of approximately 12.4%. This figure was used as a proxy for current OPD appointment DNAs.

Evidence from four international studies was used to estimate the impact that TD has on DNA rates. These studies compared DNA rates in a mixed dermatology population referred directly for a FTF dermatology appointment with DNA rates for a population receiving a FTF appointment after TD in the same setting.[233, 264, 341, 411] Within these studies, the proportion of DNAs at conventional FTF appointments ranged from 9.7% to 35%, and at FTF appointments after TD from 4.8% to 11.8%. This would suggest that DNAs may be higher in people with potentially less urgent conditions that are dealt with via TD alone. This may be influenced by waiting times and the issue having resolved by the time the appointment comes around. For each study, the risk ratio (RR) of DNA was calculated when comparing FTF after TD with DNA following direct referral to FTF. The RRs ranged between 0.23 and 0.63, with an average RR of 0.46. This suggests that DNAs after TD may be approximately half of the current level. This RR was applied to the Irish national DNA figure above to provide an estimate of 5.7% DNAs for FTF appointments after TD in the BIA model. It was assumed that follow-up appointments would attract the same DNA rate in both pathways.

The National Outpatient Waiting List Management Protocol 2022 dictates that where a patient does not attend and has not been identified as urgent and or high clinical and or social needs, the patient's record should be brought to the attention of the clinician to see if the patient should be removed from the waiting list.[6] In practice, clinicians use their discretion in considering the suitability of a patient's condition and their specific circumstances in relation to keeping them on the waiting list. The National Clinical Programme for Dermatology Model of Care reports that approximately 50% of referrals to dermatology are for skin cancer.[1] In the absence of accurate data relating to the number of individuals removed from waiting lists due to DNAs over a year, it was assumed that in the current system 50% of DNAs would return to the waiting list. In a TD pathway, a conservative assumption was made that 100% of these DNAs would return to the waiting list.

6.2.10.4 Re-referral rates

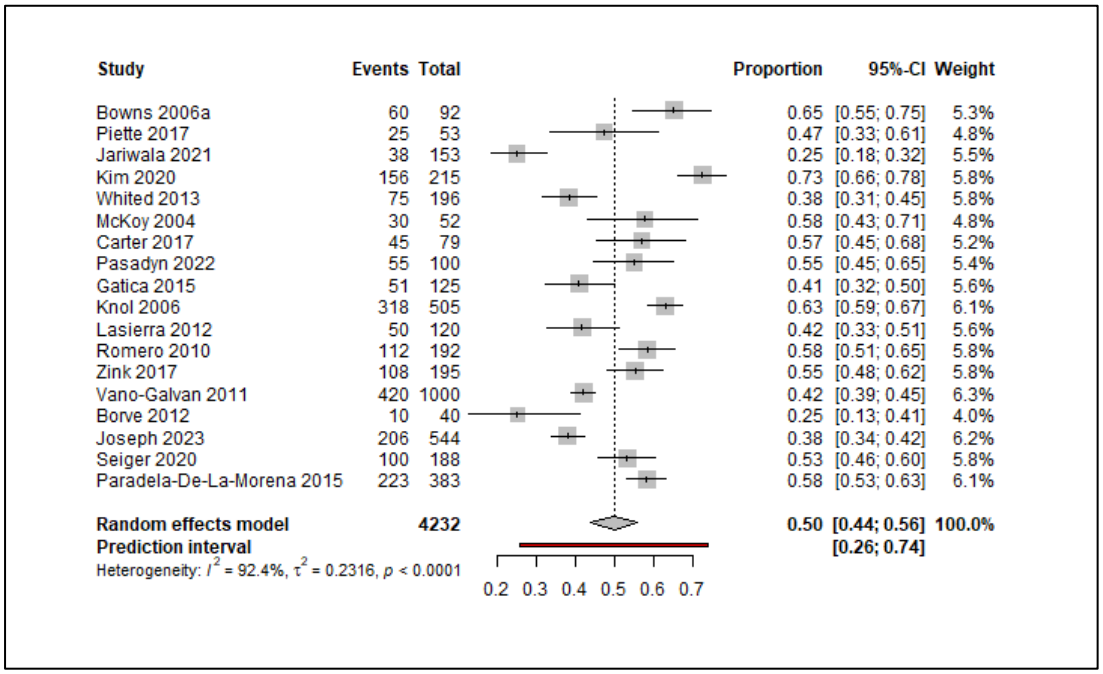
Re-referrals occur where a patient has been discharged from secondary or tertiary care and a subsequent referral is submitted for the same concern, for example, if a condition has not resolved or has progressed. Information regarding re-referral rates in TD was sparse, with only one study using SAF teledermatology in a mixed dermatology population (Chapter 4) reporting a re-referral rate of 4.6%.[339] Two studies in SAF imaging clinics in the UK reported rates of re-referral after discharge. One study retrospectively reviewed all patients in a mixed dermatology TD population (n=3,050) who were discharged and re-referred within a 12-month period. There were 32 re-referrals, although only two (0.06%) were for the same lesion.[261] A second study in a population with inflammatory conditions reported a 13% re-referral rate after discharge to the referring GP with advice and guidance, and this was in the context of 80% of referrals initially discharged without a FTF.[262] Targeted searches did not identify any further studies in TD and no studies were identified reporting on re-referral rates in the current system. Furthermore, cases re-referred after discharge from dermatology in the current system are included in the current referral data but cannot be distinguished from new referrals. No evidence was found to suggest that re-referral rates after TD and current care are different, and therefore the decision was made to exclude the impact of re-referral rates from the model.

6.2.11 Referrals diverted back to GP without a FTF appointment

Eighteen studies in mixed dermatology populations provided data regarding referrals that could be diverted back to GP care without the need for a FTF appointment after TD triage.[26, 27, 264, 290, 318, 319, 322-326, 330, 340, 342, 356, 371, 413, 414] These studies met the criteria for inclusion of having a mixed dermatology population including suspected cancers and inflammatory and or infectious conditions, and having a study design that either randomised to intervention groups or did not allow choice in referring via

TD or conventional pathways. A meta-analysis with random effects was performed to obtain a pooled estimate of effect, Figure 6.2. The meta-analysis was performed in RStudio version 4.4.1,[258] using the *metaprop* function,[257] and was conducted in accordance with Cochrane guidelines.[256] The estimated mean proportion of referrals that could be diverted back to the GP without a FTF appointment was 0.50 (95% CI: 0.44-0.56). There is substantial heterogeneity across the studies (I^2=92.4%), with prediction interval ranging from 0.26 to 0.74. Reasons for this could include differences in the relative proportions of included indications, the quality of images received and individual service thresholds for referring for FTF care.

Figure 6.2 Meta-analysis of appointments diverted back to GP care without the need for FTF appointment



6.2.12 Durations

The durations spent managing and evaluating new patients were broken down into a number of stages to facilitate comparison. These included:

- time spent triaging a dermatology referral letter
- additional time spent triaging referral images with TD
- additional time spent in TD corresponding with a GP for patients not requiring a FTF appointment
- time spent on a new patient FTF dermatology appointment.

Duration figures used in the model were informed by a variety of sources. Analysis of data from Chapter 4 and from the targeted searches did not provide sufficient detail on the individual stages as reported above. However, the overall figures

reported (see Appendix Table A 18) aligned with the total durations used in the model. The British Association of Dermatologists "A Guide to Job Planning for Dermatologists" provides indicative durations for TD and outpatient general dermatology clinics.[427] This recommends 5 to 10 minutes for a TD appointment. This allows for a mixture of lesions and rashes, but advises that complex cases requiring more than 10 minutes may benefit from a virtual or FTF appointment. In the absence of national standards for durations, advice was also taken from the expert advisory group on the duration parameters incorporated into the model with these adjusted accordingly to reflect the context in Ireland. The figures incorporated into the model are reported in Table 6.2.

6.2.13 Re-imaging rates

It was assumed that a proportion of referrals in the first and second year of a TD pathway would need to be returned to the GP for re-imaging due to insufficient image quality. However, it was assumed that the proportion of referrals returned for re-imaging would decrease over time due to a training effect and would be negligible by year three. Data from studies included in Chapter 4 across all study populations, where image quality was reported were considered. The proportion of images rated as poor, insufficient, low or bad quality was used as a proxy for the proportion of referrals that would require re-imaging. Nineteen studies provided data; it was calculated that a mean of 8.8% of images would need to be re-taken in year one.[51, 71, 80, 254, 255, 276, 278, 283, 298, 304, 315, 317, 318, 321, 328, 331, 348, 356, 370] On the basis of an assumption that the burden in year two would be half of the burden in year one, accordingly it was estimated that 4.4% of referrals would require re-imaging in year two. These figures were a conservative estimate for the number of referrals requiring re-imaging, as in reality a referral may contain multiple images and while one image may be considered unusable, a triage or management decision may be possible from the remaining images. It is also possible that in cases where poor image quality was an issue, the dermatologist could apply caution and triage the patient for a FTF appointment. Referrals to the HSE for people with medical or GP cards are paid by capitation and therefore would not receive an additional fee for an appointment to re-take images. While a private patient appointment for re-imaging would not generate a cost for the HSE, it could create an additional cost for private patients. This would be outside the control of the HSE, unless an agreement to reimburse this cost was in place.

Table 6.2 Parameter values for the base case analysis

Parameter	Mean (95% CI)	Information	Source
Staffing			
Number of GPs	3,262	Based on GPs providing standard services to the public	IGEES report[210]
Annual GP turnover	147	Based on estimation of GPs retiring and those leaving workforce for other reasons	IGEES report,[210] Medical Workforce Planning Report[420]
Number of WTE dermatology consultants	63.6	Email correspondence with the National Clinical Programme for Dermatology	HSE email
Absolute number of dermatology consultants	68	Email correspondence with the National Clinical Programme for Dermatology	HSE email
Demand			
Number of new patient referrals in 2024	99,994		HSE Business Intelligence Unit[225]
Expected annual increase in referrals	1.7% (1.3 to 2.0)	Age-standardised increase based on predicted population growth and demographic changes	NHS England[421, 422] Central Statistics Office[423]
Number of new patient attendances in 2024	49,334		HSE Business Intelligence Unit[225]
Number of return patient attendances in 2024	99,381		HSE Business Intelligence Unit[225]
Consultant capacity for new appointments each year	918.8 (896.4 to 941.1)		HSE Business Intelligence Unit,[225] Workforce Intelligence Reports[406, 407]
Current new:return appointment ratio	1:2.0 (follow-up 1.6 to 2.4)	For every new patient seen face-to-face, there will be an average of two return appointments	HSE Business Intelligence Unit[225]

Parameter	Mean (95% CI)	Information	Source
Assumed new:return ratio with TD pathway	1:3.0 (follow-up 2.6 to 3.4)	For every new patient seen face-to-face, there will be an average of three return appointments	Assumption NHS England[421, 422]
Capacity			
Proportion of FTF outpatient appointments that are missed/did-not-attend.	12.4% (9.9 to 14.7)	2022 HSE data on DNAs and total outpatient attendances used as a proxy for national dermatology new patient attendance DNA	Department of Health.[425] HSE.[424]
Risk ratio of DNAs at FTF appointment after SAF TD triage.	RR 0.46 (0.3 to 0.6)	Risk ratio applied to national outpatient DNA	Chapter 4 and targeted review[233, 264, 341, 411]
Proportion of all DNAs returned to the waiting list currently	50.0% (fixed)	Assumed based on model of care figure for proportion of all lesions that are referred as suspected cancer.	HSE[1, 6]
Proportion of all DNAs returned to the waiting list in TD	100.0% (fixed)	Assumed as 100% as patients have already been triaged using images as needing FTF appointment.	Assumption
Proportion of TD referrals that require re-imaging to enable triage in year 1	8.8% (4.5 to 13.1)	Images rated as poor/insufficient/ low/ bad	Chapter 4 (n=19 studies)[51, 71, 80, 254, 255, 276, 278, 283, 298, 304, 315, 317, 318, 321, 328, 331, 348, 356, 370]
Proportion of TD referrals that require re-imaging to enable triage in year 2	4.4% (0.1 to 8.7)	Half of year 1 rate	Chapter 4 (n=19 studies)[51, 71, 80, 254, 255, 276, 278, 283, 298, 304, 315, 317, 318, 321, 328, 331, 348, 356, 370]
Proportion of all referrals triaged and returned to GP care from TD without a need for a FTF appointment.	50.0% (26.0 to 74.0)	Based on meta-analysis of studies involving SAF TD in mixed dermatology populations	Chapter 4 (n=16 studies).[26, 27, 264, 290, 318, 319, 322-326, 330, 340, 342, 356, 371] Targeted searches for BIA (n=2 studies).[413, 414]
Durations			

Parameter	Mean (95% CI)	Information	Source
Time spent triaging a dermatology referral letter.	1.5 minutes (fixed)	The length of time it takes a consultant dermatologist to read the details of a Healthlink or written referral and triage it to an appropriate appointment timescale.	Expert opinion
Additional time spent triaging referral images with TD.	3.5 minutes (2.8 to 4.2)	British Association of Dermatologists Job Planning for Dermatologists (5-10 minutes per TD referral including triage, evaluation and management) *Interpretation: The extra time it will take to triage referrals based on viewing images of a skin complaint alongside written referral details in the TD system	British Association of Dermatologists guidelines[427]
Additional time spent in TD corresponding with GP for patients not requiring FTF appointment.	5.0 minutes (4.0 to 6.0)	British Association of Dermatologists Job Planning for Dermatologists (5-10 minutes per TD referral including triage, evaluation and management) *Interpretation: The extra time that a teledermatologist may spend corresponding with a GP when a patient does not need to be seen FTF by a dermatologist.	British Association of Dermatologists guidelines[427]
Time spent on new patient FTF appointment.	10.0 minutes (8.0 to 12.0)	*Interpretation: The length of time spent seeing a newly referred patient in a FTF appointment plus additional time for clinic correspondence.	Expert opinion

Parameter	Mean (95% CI)	Information	Source
Total time spent evaluating a return appointment.	10.0 minutes (8.0 to 12.0)		Expert opinion*

Key: DNA – did-not-attend; FTF – face-to-face; RR– risk ratio; SAF – store and forward; TD – teledermatology; WTE – whole time equivalent.

* This figure is consistent with approximately 150,000 attendances being managed by 63.6 consultants typically providing three clinics a week of three hours duration.

6.2.14 Model outputs

For the BIA, estimated incremental costs associated with, and cost offsets as a result of implementing TD to support the management of primary care referrals were reported. For the resource implications analysis, estimated incremental differences in the number of patients dealt with and removed from the waiting list, number of FTF appointments delivered, annual and cumulative impact on waiting list numbers and impact on DNAs for FTF appointments were reported.

6.2.15 Assessment and quantification of uncertainty

Probabilistic and deterministic sensitivity analyses were conducted to test the robustness of the BIA and resource implications outputs.

6.2.16 Sensitivity analyses

6.2.16.1 One-way sensitivity analysis

One-way sensitivity analysis (OWSA) was conducted by fixing key parameters in turn at upper and lower bounds, while all other parameters were held at the mean. The results are presented on a tornado plot to provide visual representation of the sensitivity of the model output, cumulative waiting list effects, to the uncertainty associated with individual parameters. Details of parameter variations used in both one-way and worst-case sensitivity analyses are provided in Table 6.3.

Table 6.3 Parameter values for sensitivity analyses

Parameter	Mean	OWSA		Worst-case	Information/ Source
		Lower bound	Upper bound		
Cost of a laptop	€650.00	€585.00	€715.00	-	+/- 10%
Cost of a camera	€684.00	€547.20	€820.80	-	+/- 20%
Cost of training e-module	€43,059.29	€34,447	€51,671.15	-	+/- 20%
Number of GPs	3,262	3,187	4,456	-	Upper and lower limits – self reported as GPs in Medical workforce Intelligence Report and GPs with PCRS agreements.
Absolute number of consultant dermatologists	68	63	73	-	+/- five WTE
Expected annual increase in referrals	1.7%	1.5%	1.9%	-	Upper and lower limits as per CSO scenarios for

Parameter	Mean	OWSA		Worst-case	Information/ Source
		Lower bound	Upper bound		
					predicted population change[423]
Risk ratio of DNAs at FTF appointment after SAF TD triage.	RR 0.46	RR 0.23	RR 0.63	RR 1	Chapter 4 and targeted review[233, 264, 341, 411]
Proportion of TD referrals that require re-imaging to enable triage in year 1	8.8%	0.0%	36%	-	Chapter 4 (n=19 studies)[51, 71, 80, 254, 255, 276, 278, 283, 298, 304, 315, 317, 318, 321, 328, 331, 348, 356, 370]
Proportion of all referrals triaged and returned to GP care from TD without a need for a FTF appointment.	50%	26%	74%	26%	Chapter 4 (n=16 studies).[26, 27, 264, 290, 318, 319, 322-326, 330, 340, 342, 356, 371] Targeted searches for BIA (n=2 studies).[413, 414]
Additional time spent triaging a referral images with TD.	3.5 minutes	2.8 minutes	4.2 minutes	4.2 minutes	OWSA +/- 20%
Additional time spent in TD corresponding with GP for patients not requiring FTF appointment.	5 minutes	4 minutes	6 minutes	6 minutes	OWSA +/- 20%
Time spent on new patient FTF appointment.	10 minutes	8 minutes	12 minutes	12 minutes	British Association of Dermatologists guidelines.[427] Expert opinion.

Key: CSA – Central Statistics Office; DNA – did not attends; FTF – face-to-face; GP – general practitioner; OWSA – one-way sensitivity analysis; PCRS – primary care reimbursement service; RR – risk ratio; SAF – store and forward; WTE – whole-time equivalent; TD - teledermatology.

6.2.16.2 Worst-case sensitivity analysis

A number of key parameters were simultaneously varied to simulate a worst-case situation. Specified parameters were fixed at the worst-case figure to test the impact of unrealised efficiencies within the TD pathway (Table 6.3).

6.2.16.3 Probabilistic sensitivity analysis

The results of the analyses are subject to parameter uncertainty. A probabilistic sensitivity analysis (PSA) was conducted to take into account the concurrent uncertainty in multiple parameters. Key model parameters were defined by a

statistical distribution to represent uncertainty in the mean parameter value. For each parameter, an appropriate statistical distribution was selected (for example, a beta distribution for a probability). Using a Monte Carlo simulation with 10,000 iterations, parameter values were drawn at random from their specified distributions and budget impact and resource implications were recalculated. These are presented in the results sections below. Depending on the combination of parameter values used in a simulation, it is possible that supply exceeds demand; that is, the available dermatology workforce is able to see all new referrals and clear the waiting list. In those simulations, requirements for additional dermatologists were adjusted to prevent capacity from exceeding cumulative new referrals and waiting list demand.

6.1.1 Scenario analyses

In developing the BIA and resource implications model, a number of important assumptions were made regarding parameter uncertainty. Scenario analyses were conducted to assess these uncertainties, whereby model assumptions and base case parameter values were systematically varied. The following scenarios were modelled:

- *Scenario 1:* this scenario considered the impact of the proportion of patients returned to their GP without a FTF appointment on resource implications. The base case mean value of 50% was varied to its lower bound, and a threshold analysis was conducted to ascertain the proportion below which there is no benefit relative to the current care pathway.
- *Scenario 2:* in the base case analyses, it was assumed that the rate of DNAs at FTF appointments after TD was less than half the current DNA rate. A scenario analyses where no efficiencies were realised in DNAs was conducted where both pathways utilised the estimated national DNA rate of 12.4%.
- *Scenario 3*: the base case analysis assumed that images from a digital camera were sufficient for referral triage purposes. A dermatoscope may provide additional diagnostic value which may facilitate the ability to direct patients back to their GP without a FTF appointment. The cost of a dermatoscopic lens attachment suitable for a digital camera (€1,759) was added for each GP practice (n=1,451). The cost of replacing lenses for staff turnover was included, but estimated on a per practice basis. The cost of an additional e-module for dermoscopy training was also included.
- *Scenario 4:* in all base case analyses, the cost of equipment to take images is based on an assumption that each GP contracted to the HSE would require a camera. It is possible that savings could be made by the sharing of equipment in practices with more than one GP. A scenario analysis was

conducted where the cost of cameras was based on one camera for a practice with two or fewer GPs (n=1,002 practices), and two cameras per practice with more than two GPs (n=449).[210] This would equate to the supply of cameras to 1,901 GP practices versus 3,262 cameras to GPs in the base case analysis).

6.2.17 Quality assurance

Internal validation of the model was conducted in accordance with HIQA's internal Quality Assurance Framework. All model inputs, calculations and model outputs were reviewed by two other health services researchers and a statistician.

6.3 Results

In the following sections, the resource implications of implementing teledermatology is presented first, followed by the budget impact analysis.

6.3.1 Consultant capacity

In order to understand the implications of implementing a TD pathway, the impact of consultant capacity must be considered. Table 6.4 details the breakdown of attendances – new, return, and DNA, that on average a WTE dermatology consultant may see per annum, assuming that the available consultant capacity would increase by five WTE annually. For the same time commitment, a consultant dermatologist could manage an additional 211 new patients per annum within a TD pathway, whilst maintaining a similar number of follow-up appointments. This represents what might be considered as steady state figures; the first two years of implementation are expected to be associated with a learning curve which will result in some re-imaging.

Table 6.4 Estimated annual capacity for OPD attendances per WTE Consultant Dermatologist

Pathway	Current Pathway	Teledermatology Pathway*	Information
New referrals triaged by TD and returned to GP care	-	597	▪ Based on meta-analysis result of 50% in mixed dermatology populations (see section 6.2.11).
New FTF appointments	919	533	▪ Estimated DNA rate of 12.38%.
Return appointments	1,838	1,719	▪ Estimated DNA rate of 12.38%. ▪ Current pathway based on new:return ratio of 1:2. ▪ Teledermatology pathway based on increased ratio of 1:3.
DNA appointments	341 ▪ 114 new ▪ 228 return	243 ▪ 31 new ▪ 213 return	▪ Assume that approx. 50% of current DNAs are returned to waiting list. ▪ In TD, 100% of DNAs are returned to waiting list.
Total attendances completed	2,415	2,605	▪ Excluding DNAs.
Total capacity	2,756	2,848	▪ Including DNAs.

Key: DNA – did not attend; FTF – face-to-face; GP – general practitioner; OPD – outpatient department; TD – teledermatology; WTE – whole-time equivalent.
Footnote: Figures rounded to nearest whole number; *average figures presented for year 3-10 assuming an increase of five WTE consultant capacity each year.
Source data: Business Intelligence Unit (BIU) Acute – OPD monthly returns 2020-2025, supplemented with reported BIU figures for 2015-2019 on OPD new referrals, new attendances and return attendances.[1, 225]

6.3.2 Base-case analysis

The current demand-capacity gap for dermatology new appointments is large. The base-case analysis considers the implications of implementing TD, taking into account uncertainty in parameter values, assuming that the dermatology consultant workforce would increase by five WTE posts each year. Additional capacity scenario analyses are detailed in section 6.3.3. The incremental resource implications of implementing TD across the three capacity scenarios modelled are shown in Figure 6.8, Figure 6.9, Figure 6.10, and Figure 6.11.

6.3.2.1 Resource implications

Assuming that the capacity of the system increases incrementally by an additional five WTE dermatology consultants each year, it is estimated that significant efficiency gains could be realised across appointments and the waiting list compared with the current pathway. As of June 2025, there were 66,887 people on the dermatology waiting list. Under the current pathway, the waiting list will have increased to 397,449 people after 10 years (Table 6.5). In contrast, with a TD pathway, the waiting list would include 176,835 people at year 10. The waiting list will increase steadily over time under the current pathway, whereas in a TD pathway it will peak at year 10.

Initially, the additional time required to triage in the TD pathway would result in a reduction in the capacity for FTF appointments. However, over the 10 years modelled, significantly more people would be managed in a TD pathway than in the current pathway given increased resolution of cases by providing advice to the GP. It is estimated that TD would result in 285,360 fewer new patient FTF appointments over 10 years relative to current care. In the first year of a TD pathway, it was estimated there would be a demand-capacity gap of 19,749 referrals triaged to FTF but not given an appointment compared with 40,361 referrals in the current pathway. Given the demand-capacity gap and the assumption that dermatology capacity would increase by five WTE annually, waiting lists would initially continue to grow as the combined requirement for TD consultations and FTF appointments would continue to exceed available capacity. However within nine years of implementing TD, capacity within the TD pathway would exceed demand and would impact upon the waiting list backlog, see Figure 6.8. Given the ability of TD to potentially exceed demand, an adjusted workforce requirement of six fewer consultants would occur. There is some uncertainty around this figure though with TD workforce requirements ranging between no difference and 25 fewer consultants required over 10 years.

Over 10 years, it is estimated that there would be 76,452 fewer new patient DNAs within a TD pathway compared with the current pathway. This impact could speed up appointment times for those on the waiting list.

Table 6.5 Total and incremental resource implications over 10-year horizon if capacity were to increase by five WTE annually

	Current pathway n (95% CI)	Teledermatology pathway n (95% CI)	Incremental impact n (95% CI)
New patients dealt with*	733,391 (713,052 to 753,569)	1,005,932 (856,303 to 1,155,624)	272,542 (122,389 to 420,604)
New FTF appointments completed	733,391 (713,052 to 753,569)	448,031 (385,904 to 503,883)	-285,360 (-344,992 to -230,656)
Follow-up appointments completed	1,467,418 (1,172,637 to 1,769,585)	1,348,373 (1,030,874 to 1,674,624)	-119,045 (-257,104 to 2,227)
DNA appointments	103,856 (81,340 to 128,839)	27,404 (15,890 to 41,533)	-76,452 (-98,116 to -57,370)
Waiting list at year ten	397,449 (371,320 to 423,802)	176,835 (27,244 to 327,095)	-220,614 (-367,381 to -70,873)
Workforce requirement	50 (50 to 50)#	44 (25 to 50)	-6 (-25 to 0)

Footnotes: *Combined TD patients diverted back to GP without FTF and FTF appointments as appropriate; #Workforce requirements are fixed in the model if capacity does not exceed demand in simulations.

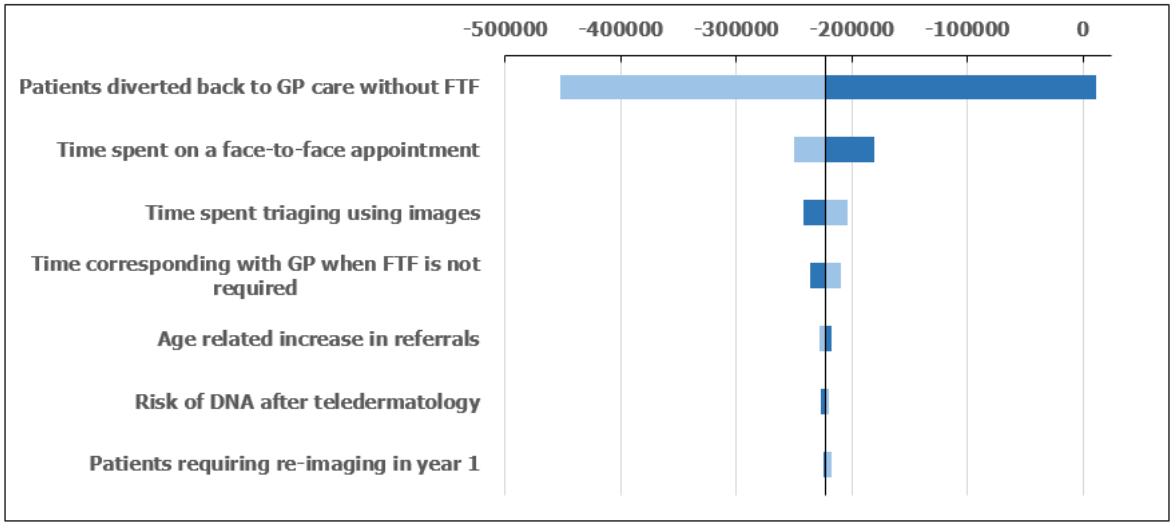
6.3.2.2 Sensitivity analyses resource implications

6.3.2.2.1 One-way sensitivity analysis (OWSA)

Figure 6.3 illustrates the impact of varying key parameters in OWSA on the size of the waiting list when five additional WTE consultant posts are added annually. The four parameters that were most influential on the magnitude of the impact on the waiting list were the number of patients diverted back to GP care without need for a FTF appointment; the time spent on FTF appointments; the time spent reviewing images for triage; and the time spent corresponding with the GP when FTF appointment is required. However, TD remained more efficient than standard care at reducing the waiting list in most cases. 11,919 fewer people were removed from the waiting list by TD relative to current care when 26% of patients were diverted back to the GP, and 452,121 more were removed when 74% were diverted back. The proportion of patients diverted back to the GP is discussed in greater detail in Scenario 1 (see Section 6.3.2.2.3). The remaining parameters had a limited influence over uncertainty in the estimated impact of TD on waiting list numbers. Setting the time spent seeing patients FTF at its extreme values (namely +/-20%) resulted in

between 181,243 and 250,561 additional people removed from the waiting list with TD relative to current care, while similar variation in the additional time spent reviewing images for triage would result in between 203,449 and 242,352 additional people removed with TD. Varying the additional time spent corresponding with a GP for patients for whom FTF is not needed would impact on the waiting list by between 209,271 and 236,586 additional people removed with TD. Setting other parameters at their extreme values resulted in a smaller variation (<10,500) in the number of people removed from the waiting list with TD relative to standard care.

Figure 6.3 Tornado plot of one-way sensitivity analysis of waiting lists implications with annual capacity increase of five WTE



Key: DNA – did-not-attend; FTF – face-to-face; GP – general practitioner; WTE – whole-time equivalent.

6.3.2.2.2 Worst-case sensitivity analysis

A worst-case sensitivity analysis was conducted where the parameters to which the waiting list was found to most sensitive to, as indicated by the OWSA, were simultaneously varied to their worst-case value (Table 6.3). In this analysis, it was estimated that the TD pathway would no longer deliver efficiencies in reducing the waiting list over 10 years with 24,393 fewer people removed off the waiting list. However this is in the context of a cumulative waiting list for TD that would reach 421,987 people after 10 years compared with 397,594 in the current pathway. If the worst-case scenario analysis is limited to setting just the TD duration parameters (such as the time to review an image and the time to correspond with a GP where not seeing a patient face-to-face) to their worst-case values, and varying these simultaneously, the TD pathway would continue to have a greater impact on reducing waiting lists than current care, but of a slightly lesser magnitude than previously detailed, with an additional 189,735 people removed from the waiting list over the 10-year horizon.

6.3.2.2.3 Resource implications scenario analysis

Scenario 1: if the proportion of patients returned to their GP without a FTF appointment was set to its lower bound of 26%, TD would no longer provide additional benefit and the waiting list would be greater by almost 12,000 patients. A threshold analysis highlighted that, at below 27.3% of patients returned to their GP without a FTF appointment, TD delivers no benefit above the current care pathway. Details of the resource implications of both situations are provided in Table 6.6 below.

Table 6.6 Resource implications of differing proportions of patients returned to their GP without FTF in TD relative to the current pathway

Proportion of patients returned to their GP	Number of FTF appointments completed	Total new patients dealt with	Waiting list at year ten	DNAs
26%	-250,223	39,912	11,919	-74,205
27.3%	-252,005	52,636	-805	-74,314
50%	-283,192	274,759	-222,929	-76,215

Scenario 2: if it is assumed that TD would not bring about any efficiency in new patient DNAs and would attract the same DNA rate as current dermatology FTF appointments, the direction of effect would remain the same, with an incremental reduction in waiting list of 211,139 people with TD to leave a cumulative waiting list of 186,455 after 10 years.

6.3.2.3 Total budget impact

Table 6.7 presents the total 10-year budget impact for the current and TD pathways (and disaggregated by care setting), and also the incremental budget impact of TD relative to current care.

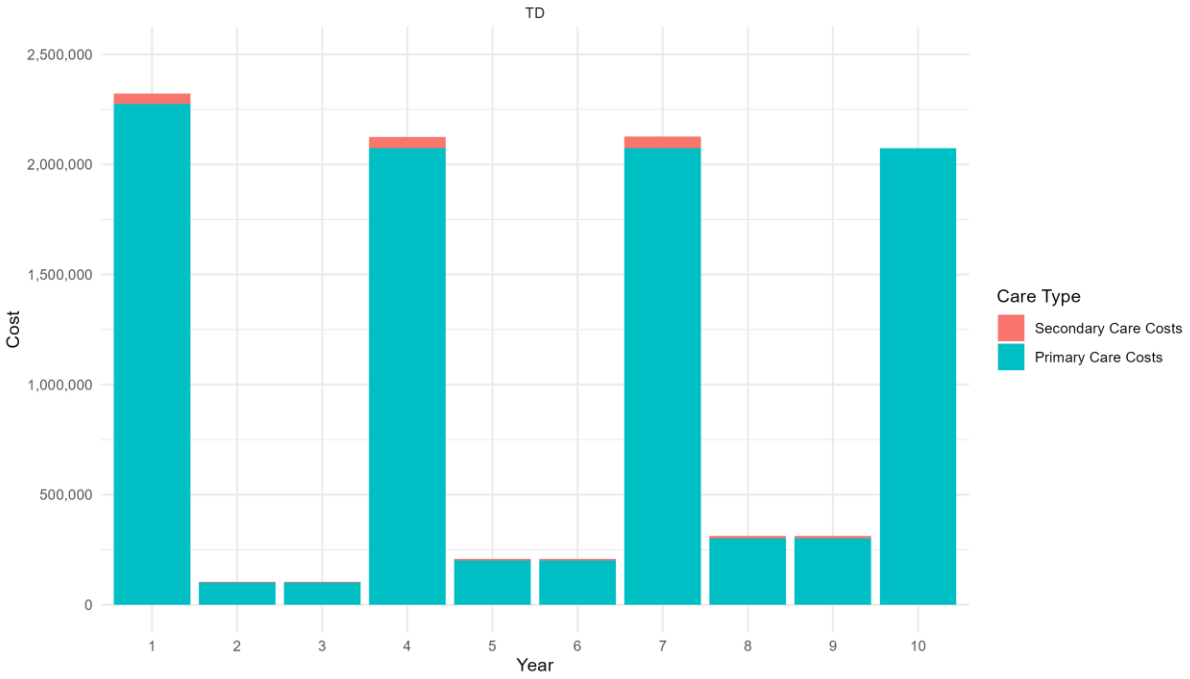
Table 6.7 Total budget impact of base case analysis over 10-year budget horizon

	Current pathway	Teledermatology pathway	Incremental 10-year budget impact
Primary care	€0	€9.8m (€8.0 m to €11.8 m)	€9.8m (€8.0m to €11.8m)
Secondary and tertiary care	€129.3m	€122.3m (€83.0m to €129.6m)	-€7.1m (-€46.3m to €0.3m)
Total	€129.3m	€132.0m (€92.5m to €141.0m)	€2.7m (-€36.8m to €11.7m)

Key: m – million. **Footnote:** Staff numbers and associated salaries in the current pathway are fixed.

The ability to meet demand would be impacted by a number of organisational considerations such as workforce availability and the capacity of the system to scale up to demand. Assuming that the capacity of the system is increased incrementally by an additional five WTE dermatology consultants each year, the five-year and 10-year incremental budget impact are estimated as €4,538,862 and €2,683,575, respectively. This comprised incremental primary care costs of €9,752,785 and reduced spending in secondary and or tertiary care of €7,069,210 over 10 years. The reduced spend in secondary and or tertiary care is driven by a reduced workforce requirement of six consultants arising out of reduced staffing requirements in later years where capacity could exceed demand without adjustments. However, there is substantial uncertainty around this figure such that the secondary and or tertiary care spend could be reduced by up to €46.3 million or cost almost €270,000 more. Figure 6.4 illustrates the components of the incremental total costs (such as incremental primary care costs plus incremental secondary and or tertiary care costs) for years 1 to 10. Incremental primary care costs were estimated at €2,274,267 in year one, and €2,073,171 in years four, seven and 10. This arises from costs associated with the periodic replacement of camera equipment associated with the initial implementation. Smaller costs are noted in primary care in the interim years related to buying cameras for new GP staff. Similarly, incremental secondary equipment costs were greater in years one, four, seven and 10 when costs were associated with replacing laptops for a larger proportion of consultants. Outside of these years, costs were associated with buying and or replacing laptops for additional consultants in that year. The annual costs for the base-case analysis are illustrated in Figure 6.4.

Figure 6.4 Disaggregated incremental costs with capacity increase by 5 WTE annually



6.3.2.4 Cost per patient

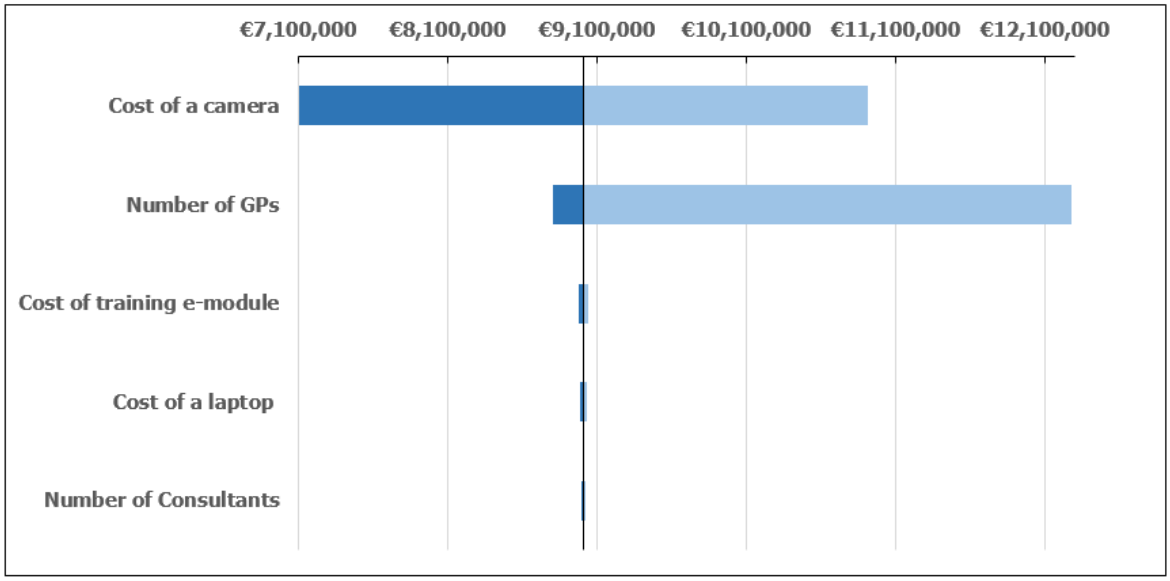
If the cost of implementing a TD pathway is presented relative to the number of patients that would be dealt with and removed from the waiting list above that achieved with current care, the result can be expressed as an incremental cost per patient. Over a 10-year budget horizon, the incremental cost per patient of implementing a TD pathway is estimated at €9.85 per additional patient if consultant capacity were to increase by five WTE annually.

6.3.2.5 Sensitivity analyses costs

6.3.2.5.1 One-way sensitivity analysis

Figure 6.5 illustrates the results of the OWSA, varying each cost parameter individually. The BIA was most sensitive to changes that impacted upon the provision of cameras in primary care, for example, the number of GPs or the cost of a camera. Varying the price paid for a camera by +/- 20% causes the BIA over 10 years to vary between €7,102,450 and €10,913,698. If the number of GPs is set at its extreme values, the BIA over 10 years would vary between €8,802,874 and €12,274,858. Varying the cost of a training module or laptop, or the number of consultants considered provided small variations in the BIA with incremental differences of +/- €34,447, €24,830 and €13,000, respectively.

Figure 6.5 Tornado plot of OWSA of costs with annual capacity increase of five WTE



6.3.2.5.2 Cost scenario analysis

Scenario 3: if dermatoscopes were to also be provided, the 10-year incremental budget impact would increase to €18.8 million. This is an increase of over €16.1 million on the base-case analysis driven primarily by the cost of dermatoscopic attachments.

Scenario 4: if it is assumed that cameras are allocated on a per-practice rather than per individual GP, that is, that one camera is provided for a GP practice with two or fewer GPs, and two cameras are provided to a GP practice with more than two GPs, the 10-year budget impact of TD is estimated at €6,224,961, a potential cost reduction of over €3.7 million on the base-case analysis.

6.3.3 Capacity scenario analyses

Two capacity scenario analyses were conducted to test the impact of TD within different consultant capacity contexts. The following section reports the resource implications and budget impact if:

- both pathways are delivered within the current capacity
- the consultant capacity to deliver dermatology services increases to meet the immediate demand in both pathways.

Table 6.8 details the resource implications while Table 6.9 shows the 10-year budget impact of both scenarios.

Table 6.8 Resource implications of capacity scenario analyses with TD relative to the current model

New FTF appointments completed n (95% CI)	New patients dealt with n (95% CI)	Waiting list at 10 years n (95% CI)	Consultant workforce requirement n (95% CI)	DNA appointments n (95% CI)
Within current capacity				
-253,455 (-307,934 to -204,613)	304,446 (154,907 to 451,996)	-181,942 (-334,204 to -32,317)	0	-56,685 (-71,900 to -43,131)
Increasing capacity to meet demand*				
-451,737 (-603,872 to -300,660)	106,164 (81,310 to 133,838)	-37,059 (-53,903 to -19,920)	-8 (-32 to 16)	-106,164 (-133,838 to -81,310)

Key: CI – confidence interval; DNA – did-not-attend; n – number; WTE – whole-time equivalent.
* In this scenario, the only people not seen are DNAs, therefore the incremental difference between TD and current care is entirely explained by the difference in DNAs.

Table 6.9 Total and disaggregated costs over 10-year budget horizon of capacity scenario analyses

	Current pathway	Teledermatology pathway	10-year budget impact
Within current capacity			
Primary care	€0	€9.7m	€9.7m
Secondary care	€0	€0.2m	€0.2m
Total costs	€0	€9.9m	€9.9m
Capacity increasing to meet immediate demand			
Primary care	€0	€9.8m	€9.8m
Secondary care	€253.5m	€206.2m	-€47.0m
Total costs	€253.5m	€216.0m	-€37.3m

Key: m – million.

6.3.3.1 Within current capacity

6.3.3.1.1 Resource implications

Assuming that the capacity for TD would remain the same as the current consultant capacity, TD could improve efficiency in the management of new referrals to dermatology by dealing with an additional 304,446 new referrals over 10 years. The capacity for new appointments would remain constrained in the current pathway. The additional time required to triage in the TD pathway would therefore result in a reduction in the capacity for FTF appointments. If capacity in the current dermatology pathway were to remain as it is currently, over 10 years more than 531,500 people would be referred to FTF dermatology, but would not receive an appointment causing the waiting list to grow from its current position (66,887 people in June 2025) to almost 550,000 people by year 10. If a TD pathway is implemented

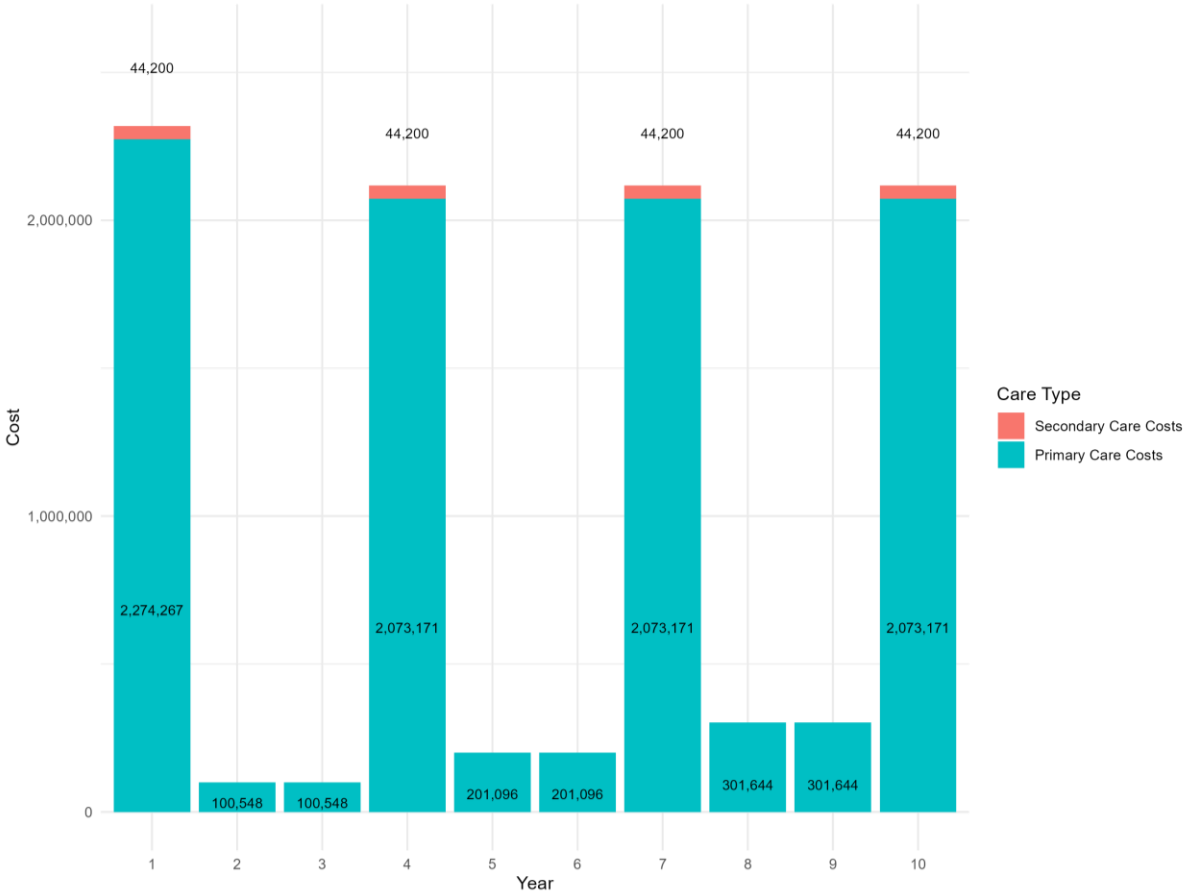
in the context of the current capacity constraints, over 10 years, almost 282,000 people would be referred for a FTF dermatology appointment and not be seen within the timeframe. This would cause the waiting list to grow from its current position to 364,574 people by year 10 (see Figure 6.8). TD would also reduce the number of new patient DNAs by over 56,500 appointments over 10 years.

6.3.3.1.2 Budget impact

If the capacity for TD were to remain the same as current capacity, the 5-year and 10-year incremental budget impact would be €4.9 million and €9.9 million respectively. Primary care costs would remain the same as the base case analysis totalling €9.7 million over 10 years. Equipment for consultants in secondary and tertiary care would cost €44,200 in year one, four, seven and 10, totalling €176,800 over 10 years.

As there would be no expected costs in the current pathway, Figure 6.6 illustrates the components of the incremental total costs, for example, incremental primary care costs and incremental secondary and tertiary care costs, for years one to 10.

Figure 6.6 Disaggregated incremental costs at current capacity



6.3.3.2 Consultant capacity increases to meet demand

6.3.3.2.1 Resource implications

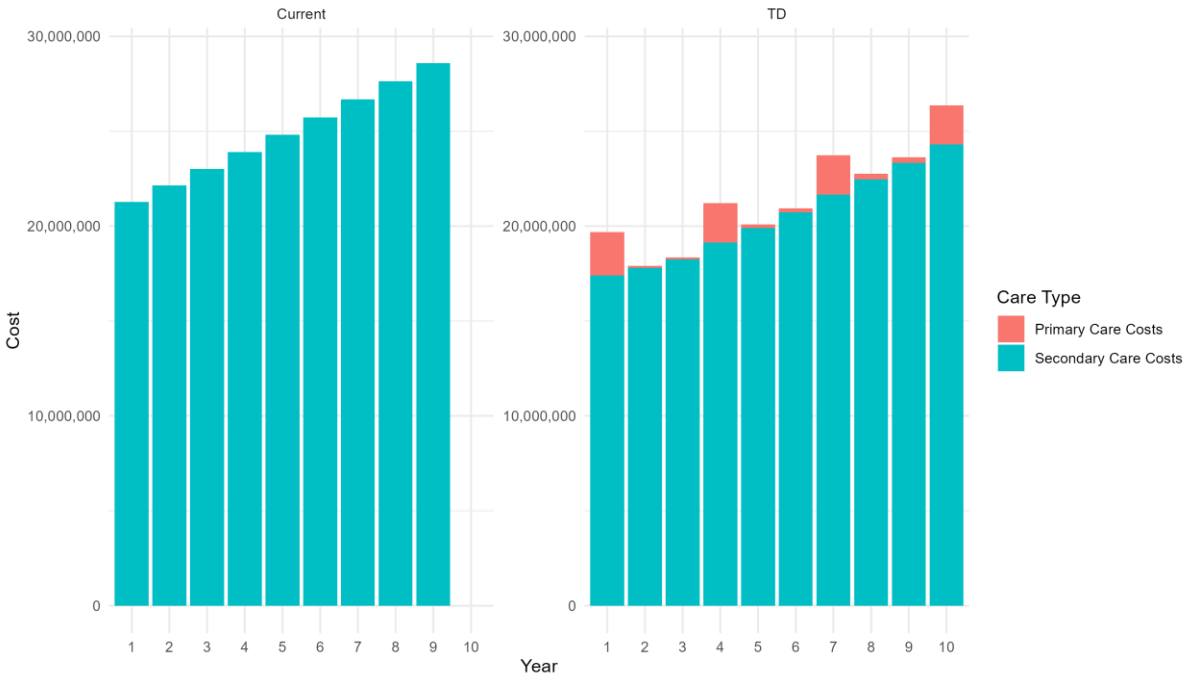
Assuming that the capacity of the system would increase in both pathways to meet referral demand, efficiency gains to the waiting list would be less obvious with an additional 37,059 people removed off the waiting list with TD. A reduction in the number of DNAs with the TD pathway would realise an incremental reduction of approximately 106,164 appointments. This is mostly as a result of an increase in the proportion of patients diverted away from FTF appointments (557,902 people) and a lower risk of DNA at FTF after TD. Within this scenario, waiting list growth is as a result of DNAs returned to the waiting list, culminating in an estimated waiting list for the current pathway of 135,992 by year 10 and 98,934 by year 10 for the TD pathway. However the number of consultants required to meet demand between the two pathways differ. In the first year, the current dermatology pathway would require approximately 45 additional consultant posts to meet the current unmet demand and the predicted increase in demand in year one. The predicted increase in demand for dermatology would then require on average two additional consultant posts each year to keep up with demand. In the current pathway, a total of 63 additional WTE consultant posts would be required over the 10-year horizon modelled if capacity were to increase to meet demand. In the first year of a TD pathway, approximately 37 additional consultant posts would be required to meet current and predicted demand, with an estimated two additional consultant post required each year. As such, in the TD pathway a total of 55 additional WTE consultant posts would be required over the 10-year horizon modelled if capacity were to increase to meet demand. Relative to a current care model, this equates to a smaller increase in workforce requirements with TD of eight WTE dermatology consultant posts over 10 years, with the majority of the reduced requirement occurring upfront in year one. There is substantial uncertainty in the workforce requirements for this scenario with the difference ranging between 32 fewer and 18 more WTE consultant posts required.

6.3.3.2.2 Budget impact

If the capacity of the dermatology system was to increase in both pathways to meet immediate referral demand, while the cost of both would pathways increase. Relative to current care, the 5-year and 10-year incremental budget impact for TD (including consultant salary costs) would cost approximately €17.2 million less over five years and €37.3 million less over 10 years. Incremental costs are driven by the difference in the number of consultants that would be required to deliver the services to demand. In reality, reductions in spending related to additional staff, overheads and capital assets may also be seen but quantifying large scale organisational recruitment and re-organisation was outside the scope of this HTA. Table A19 in the Appendix details the annual reduced spend that could be realised,

based on consultant salaries alone. Figure 6.7 illustrates the components of the total costs, for example, primary care costs plus secondary and tertiary care costs, for years 1 to 10 in both current and TD pathways.

Figure 6.7 Disaggregated incremental costs with capacity meeting demand



6.3.4 GPs

The impact on GPs was not formally assessed in this BIA or resource implications analysis. Analysis of durations reported in Chapter 4 and the targeted review (Table A 18) estimate that the total GP time required for a consultation and TD referral would be 11.5 minutes, with 5.25 minutes required for image taking and uploading. This is shorter than current estimates of overall duration for an average GP consultation currently in Ireland.[211, 220] As such, no additional time or opportunity cost was incorporated into the analysis. However, it was predicted that with current GP capacity and with predicted increases in demand, the average dermatology referrals per annum for a GP would increase from 32 in year one, up to 37 in year 10.

Figure 6.8 Impact on cumulative waiting list by intervention and scenario

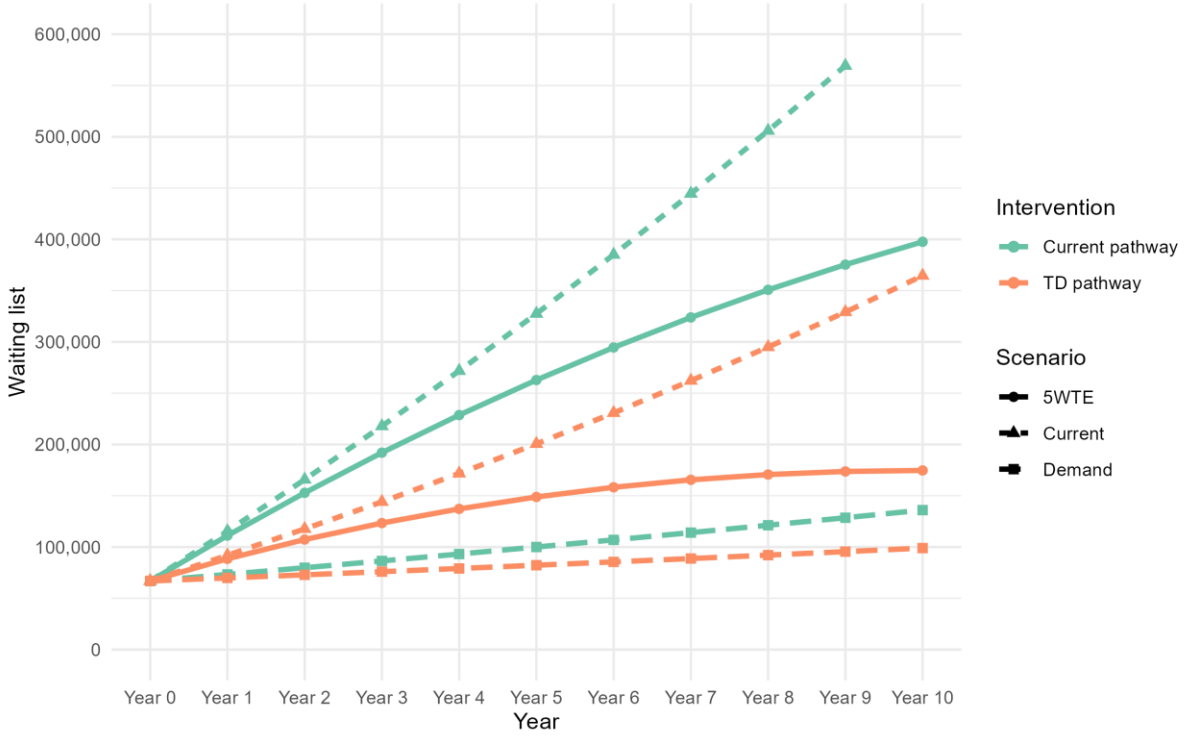


Figure 6.9 Number of patients removed off waiting list by intervention and capacity scenario

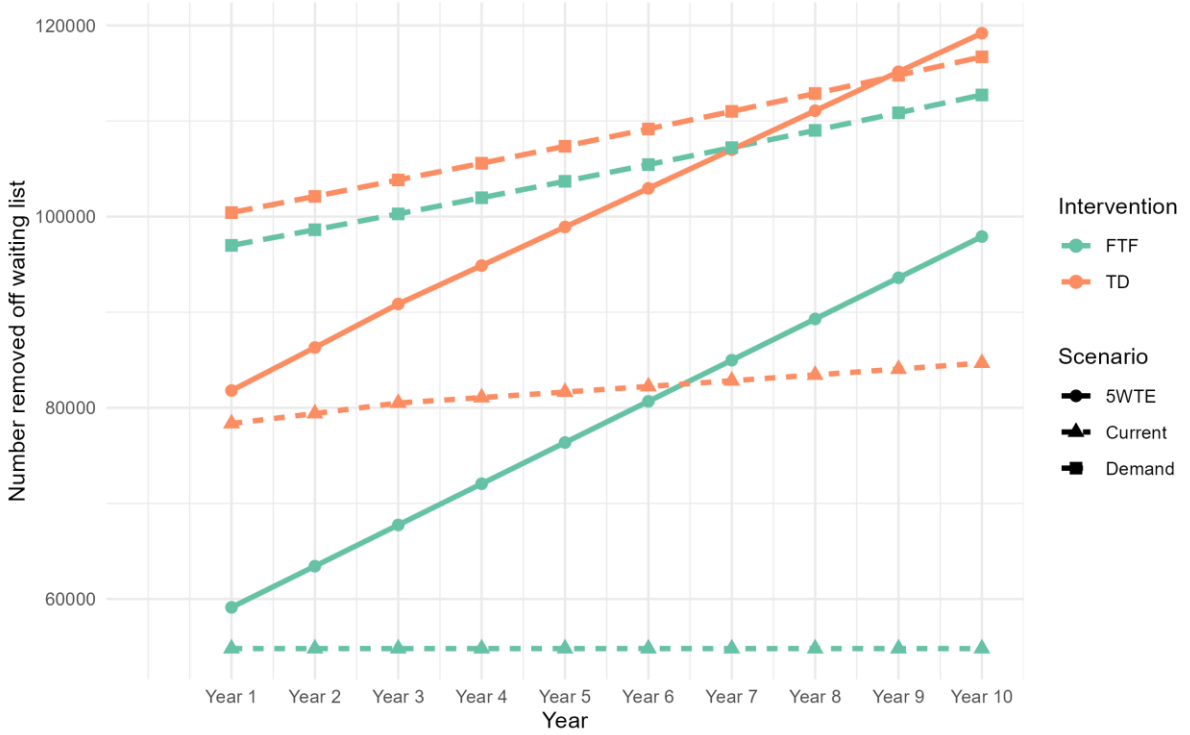


Figure 6.10 Number of FTF appointments completed by intervention and capacity scenario

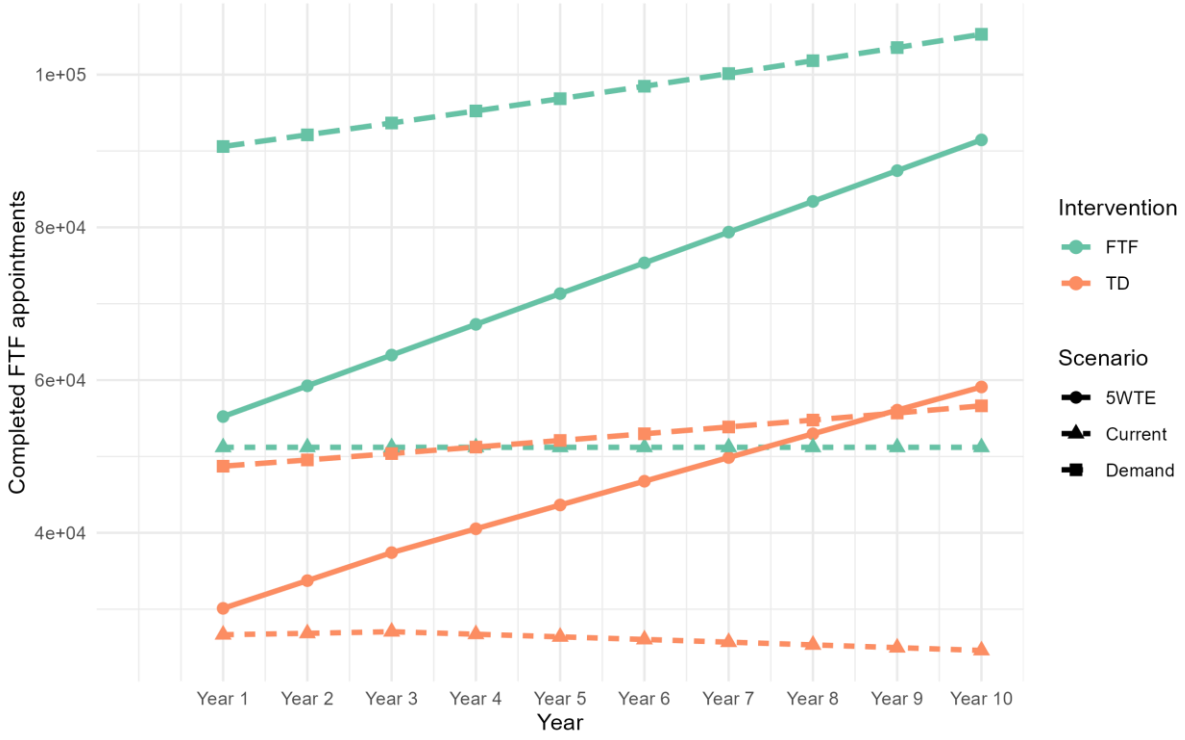
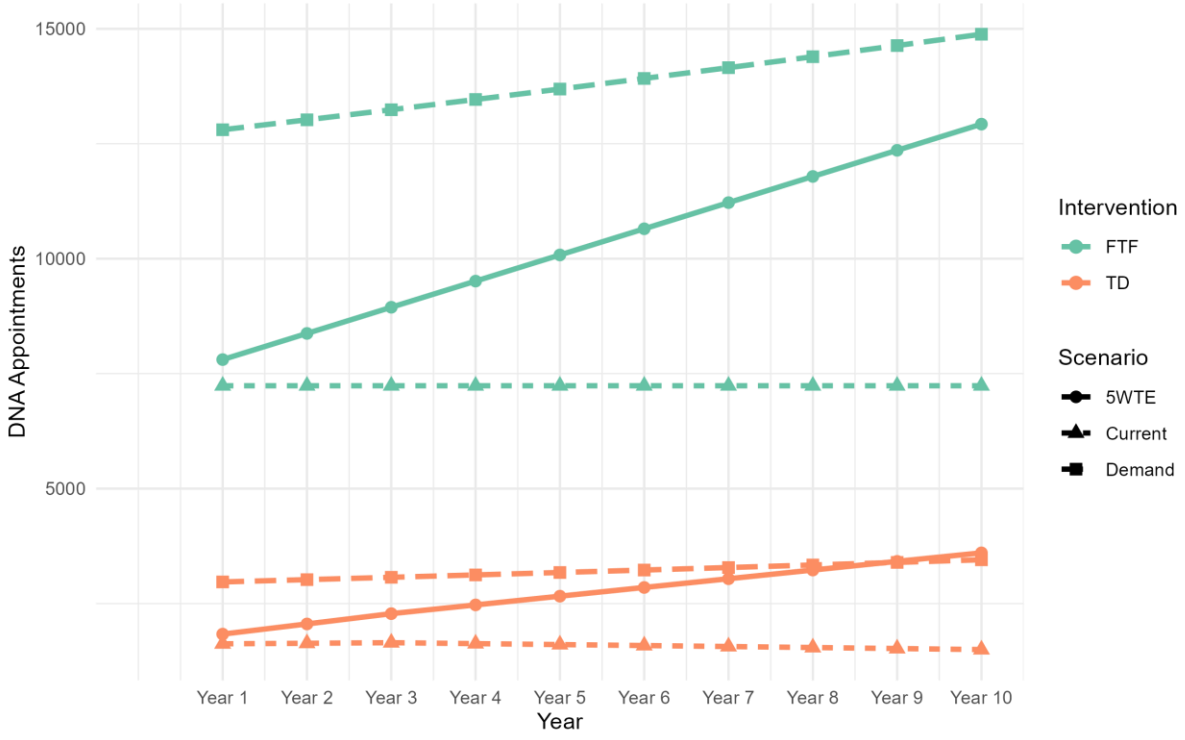


Figure 6.11 DNA appointments by intervention and capacity scenario



6.4 Discussion

The feasibility of adopting TD to support the management of primary care referrals is reliant on the cost of implementing the service and its impact on the system including on the numbers of patients dealt with and removed from the waiting list. As of June 2025, there were just over 66,800 people on the waiting list for a new patient dermatology appointment with an annual demand-capacity gap for new patient dermatology referrals of over 43,500 appointments. It is important to note that waiting list initiatives in recent years, such as additional funding for insourcing initiatives (such as additional weekend or evening clinics), or outsourcing initiatives (such as services subcontracted to private dermatology providers) have also impacted on the overall waiting list figure. Waiting lists are likely to continue to rise given predicted increases in demand unless there is a substantial increase in capacity either through additional recruitment, service reorganisation and or improvement initiatives.

The estimated incremental budget impact of implementing a TD pathway was €2,683,575 over a 10-year budget horizon. This could cost €9.85 per additional patient dealt with and removed off the waiting list. The cost of TD is primarily driven by the cost of equipment for GPs, while differences in workforce requirements compared with the current pathway contribute to reductions in spending. While costs could be further reduced by sharing of camera equipment in larger GP practices, this could also impact on uptake of TD if equipment is not easily accessible when required. However as, on average, a GP creates less than one dermatology referral per week, the impact on uptake may be negligible. In order to improve efficiencies with triaging and prevent image degradation through printing, a laptop per consultant dermatologist was included. In some cases, a tablet may be a viable, or indeed preferable, alternative to a laptop. However, as the cost of laptops forms a small portion of the overall budget impact, this would be unlikely to have an impact on estimates. Using the Healthlink referral system to deliver TD further leverages off existing systems in use and limiting additional expenditure. The cost of a training e-module has also been included. The additional time needed to review images during TD triage impacts upon the subsequent time available for FTF appointments. Adequate training for current staff and new recruits on TD, to include taking images and including them in the referral, minimal image standards and current referral guidelines to dermatology would be necessary to minimise the numbers of referrals sent back to GPs for re-imaging or inappropriate referrals. This analysis conservatively estimates that training would be available to all GPs and cameras would be funded for all GPs, which may overstate the cost. In reality, particularly in larger practices, GPs may effectively share resources. Of most concern is that

images are taken to an adequate standard, by a trained individual using appropriate equipment.

Changes to the organisation of an established healthcare pathway, such as is proposed with TD, may have unintended consequences. Within the context of a change to referral pathways and triaging, these consequences could include a change in the patient mix seen at FTF dermatology outpatient appointments and a change in the mix of new to return patients. The current capacity-demand gap within dermatology was estimated to equate to the workload of an additional 45 consultant dermatologists. Annual increases in referrals related to population growth and demographic changes would require on average two additional consultant dermatologists each year to meet demand. A large recruitment campaign for dermatology consultants, such as would be needed to meet immediate demand, may not be feasible considering the ability to identify and recruit a sufficient number of suitably trained doctors to fill consultant posts, the ability of the system to adapt to a sudden growth in capacity and the potential cost of a large recruitment campaign. Considering a more conservative recruitment approach that would incrementally increase capacity within the system may be more feasible. There are currently 32 dermatology trainees at various stages of their specialist registrar training, with five in their final year. Assuming that it is possible to recruit five new WTE dermatology consultants each year, a TD pathway would remove more patients off the waiting list over 10 years, would reduce the overall number of FTF appointments required and would reduce DNAs compared with the current pathway. For the same consultant capacity, an additional 300,000 or more people would be removed from the waiting list annually using a TD pathway to manage referrals compared with the current pathway. Furthermore, within the 10-year horizon modelled, TD would have a positive impact on the waiting list backlog from year nine. In this model, the capacity of the current pathway to see FTF appointments is constrained to incremental increases in the 2024 consultant capacity. This is a function of available new patient appointments and the number of WTE dermatology consultants. If capacity were to increase, there would be a noticeable difference between pathways in the number of patients seen FTF as approximately 50% of TD referrals could be diverted back to GP care with correspondence after triage. This may free up clinic spaces in busy OPDs where capacity is sparse, but may also negatively impact upon GP workloads. However, as current waiting lists for dermatology are lengthy, GPs are likely managing patients in the waiting period which may offset the impact on workload. If new treatments are started earlier than currently possible, it may also have a positive impact on GP resources. The analysis assumed a static GP workforce count. Considering the number of patients referred in 2024, this equated to each GP referring, on average, 31 patients to dermatology in a year. As such, the impact on individual GP workload is not likely to be large. Given that the population is

increasing and ageing, it may be reasonable to expect GP numbers to also increase. While this would reduce the burden of TD on individual GPs, the overall budget impact of TD would increase due to higher equipment costs.

DNAs across the scenarios tested are explicitly linked to the capacity to see FTF appointments. TD would have a positive impact on reducing DNAs. This would occur as a result of reduced numbers being triaged to FTF appointments and a decreased risk of DNAs after TD. Reducing DNAs improves productivity and may decrease the length of time that patients spend on a waiting list. However, time gained during clinics due to DNAs is currently filled with other duties, for example patient administration or teaching junior staff. If DNAs reduce, these activities would need to shift and may potentially impact on another part of a consultant dermatologist's workload.

If the consultant capacity remains unchanged, introduction of TD would have a positive impact on the waiting list and would reduce DNA appointments relative to the current model, but would be accompanied by a potentially reduced capacity for FTF appointments. In practice this would mean that referrals that could be diverted back to GP care, and are potentially less serious, would be dealt with at the triaging stage of referral management, cutting waiting times for patients who require FTF appointments. Patients with suspected cancers or more complex conditions are likely to be referred to a FTF appointment and prioritised within the available capacity. TD may also provide an opportunity to identify routine patients for whom a more urgent appointment is required. Routine patients requiring FTF appointments could potentially be disadvantaged by a move to TD if it is introduced without any increase in current staffing. However this is in the context of a service which cannot currently meet its demand and would have a demand-capacity gap of almost 45,000 new appointments in year one, while a TD service would have a demand-capacity gap of almost 23,500 appointments in year one.

If the consultant capacity of the dermatology service were to increase to meet predicted new referral demand, both pathways would see positive impacts on waiting list numbers and the numbers of patients seen. In a TD pathway, there would be a noticeable difference in the number of patients seen FTF and subsequent DNAs compared to the current pathway, potentially freeing up capacity in OPD clinic and allowing for more effective use of available clinic time. With TD, relative to the current care approach, eight fewer additional consultants (55 vs 63) would be required to meet demand over 10 years. However the bulk of recruitment to meet demand would be required in year one. A recruitment drive of this magnitude would be difficult and may not be feasible, while the associated salary costs for consultants in a single year would be large.

Results of the analyses were tested using OWSA, worst-case sensitivity analyses, PSA and scenario analyses. The overall results were robust to unilateral changes in parameter values in OWSA, with simultaneous variation in parameters in the PSA as detailed above and in scenario analyses. The worst-case sensitivity analysis highlighted that simultaneously setting the key parameters at their lowest efficiency would limit the ability of TD to achieve a substantial reduction in waiting lists. If a TD pathway were to be introduced, consideration should be given to what contingencies could be put in place to ensure the service could maintain efficiencies as modelled.

6.4.1 Limitations

There are limitations to this BIA and resource implications analysis. Inconsistencies in the overall increasing trend for dermatology referrals as a result of the COVID-19 pandemic impact on the ability to predict future referral rates. The analysis used an age-standardised rate of increase in line with predicted population growth and changes to the age demographic. There are likely a variety of factors that drive changes in demand, some of which may not be related to demographic change. There could, for example, be a degree of unmet need that will only become apparent if there is an increase in dermatology capacity. It is also possible that the introduction of TD may create additional demand, particularly if there is a perception that it may be possible to get a fast response through the referral review process with the inclusion of photos. There is no basis for determining how teledermatology may change patterns of demand and referral. However, if demand was to grow at a higher rate than modelled, then clearly additional capacity would be needed over and above what has been estimated here.

Durations for specific activities, such as the time for TD to triage a referral and return to their GP without a FTF appointment, are based on international data (Appendix Table A 18) and country specific guidelines for TD services.[427] The model considers a range between 8.3 and 11.7 minutes for this activity. The British Association of Dermatologists recommend that any TD triage and return to GP that will take longer than 10 minutes to complete should be converted to a FTF. It is possible that a proportion of TD triage appointments may take longer than five minutes to triage, up to 10 minutes, before the dermatologist decides to refer for a FTF appointment due to uncertainty. It is not possible to quantify the proportion of referrals in which this would occur. If TD is to be introduced, guidelines on how to manage these occurrences should be provided.

The available data on dermatology activity, for example, referrals and attendances, do not provide details on specific conditions. Therefore these analyses could not consider the impact of TD if it were to be considered for specific subgroups. It was assumed that there would be a ratio of new to return patients of 1:3 in a TD

pathway, in contrast to 1:2 in the current pathway. This is because patients that would typically be discharged after a single consultation would be more likely to be returned to their GP without a FTF consult in a TD pathway. Depending on the complexity of individual populations, hospitals may find that their individual rate would differ, as is the current case. An increasing ratio may impact upon the capacity to deliver new patient appointments, however indications from the model suggest that the national ratio could reach up to 1:5 while maintaining the overall direction of effect on the waiting list albeit to a lesser extent. National data on the current DNA rate for new patient attendances in dermatology was not available. An estimated DNA rate based on national data for outpatient attendances, new and return, and available DNA figures for 2022 was calculated. In reality, dermatology may attract a different DNA rate to this figure, and individual hospitals are likely to vary due to differences in populations and service delivery. However, sensitivity analysis shows that the DNA rate has minimal impact on the overall results. As discussed the model does not include a parameter to consider the impact of re-referral rates on TD efficiencies. In the absence of accurate data on the current re-referral rate and the inability to extricate this portion of referrals from current data, it was deemed that any analysis of the same would not be an accurate representation of the potential impact.

The addition of images to primary care referrals would create a digital storage burden for the HSE. While this has not been quantified, the cumulative burden of image storage must be considered, and HSE policies may need to be amended as a result of this consideration.

Finally, while projections of staffing requirements are provided as a means to illustrate the demand-capacity gap within outpatient dermatology services and the potential impact of TD, detailed workforce planning was not within the scope of this HTA. If TD-supported management of primary care referrals were to be introduced, workforce planning would be required to quantify the impact upon a dermatologists workplan, and to plan appropriate posts, for example, clerical staff, to support its implementation.

6.4.2 Conclusion

To conclude, the ability of TD to positively impact upon waiting lists and create efficiencies in dermatology is dependent on the capacity within the system to offer appointments and the proportion of patients that are returned to their GP without needing a FTF appointment. Over a 10-year horizon, TD may improve the ability to manage waiting list numbers, increasing the number of people removed off waiting lists and reducing DNAs relative to the current pathway.

7 Organisational considerations

Key points

- If implemented, consideration of the type of teledermatology (TD) model used would be important. A store-and-forward (SAF) model with images captured during the primary care consultation, and subsequently reviewed by a consultant dermatologist, who may provide management advice to the general practitioner (GP) or triage the patient for a face-to-face (FTF) appointment, would likely be the most feasible option to integrate TD into the existing referral pathways.
- TD-supported referral management would introduce additional steps in clinic workflow; implementation would need to be carefully planned to ensure that these changes ultimately lead to greater efficiency in the referral process.
  - Referrals through TD would require more time from GPs to capture and attach images to the referral and could result in more follow-up appointments when patients are managed in primary care with advice.
  - Introduction of TD would redistribute consultant dermatologist capacity; patients triaged via TD who are ultimately seen FTF require more consultant time compared with current practice, while those who do not require a FTF appointment following TD review require less time, offering potential for efficiency gains.
- While TD may offer efficiencies within the system, it is not a standalone solution to bridge the growing demand-capacity deficit.
  - Regardless of TD implementation, substantial additional consultant capacity is required to build a resilient dermatology service, supported by increased training capacity, retention measures, and proportional increases in clerical staff and infrastructure.
- Healthlink, the national e-referral system, allows the attachment of images to referrals, and could be leveraged to support SAF TD-supported referral management. Effective implementation would depend on key organisational and IT practices:
  - Universal adoption of electronic referrals via Healthlink across all referring general practitioners (GPs), replacing any use of post, email, and fax referrals.

  - Activation of image attachment capability for Healthlink referrals across all hospitals.
  - Consistent addition of images by GPs to appropriate dermatology referrals.
  - Digital review, triage, and management of referrals by consultant dermatologists, replacing the paper-based workflow currently used in many dermatology departments.
  - Sustainability of referral and image storage requirements within current policy frameworks.
- Appropriate equipment would be required to facilitate a SAF TD-supported referral management pathway:
  - General practices would need access to suitable imaging devices capable of producing high-quality photographs.
  - Consultant dermatologists would require appropriate digital infrastructure to efficiently review referrals and associated images.
- Consideration would need to be given to the development of TD guidance and training to support standardisation and quality across the pathway.

7.1 Introduction

This chapter aims to provide an overview of the potential organisational considerations associated with implementing a teledermatology (TD)-supported referral management system from primary care to dermatology departments in Ireland. Key considerations with cost and resource use implications include the type of TD model utilised, the system design, and its integration with existing referral infrastructure.

7.2 Teledermatology system design and infrastructure

7.2.1 Current referral process in Ireland

As described in Chapter 2, referrals from primary care to dermatology departments in Ireland are currently made via two pathways: standard referrals for dermatology assessment, and urgent pigmented lesion referrals for suspected melanoma cases to one of the National Pigmented Lesion Clinics. While most general practitioners (GPs) now use electronic referrals via the national system Healthlink, some still rely on

post, fax, or HealthMail. Pigmented lesion referrals may be directed to either dermatology or plastic surgery departments, depending on local service configurations. The pigmented lesion referral form, integrated into Healthlink and GP practice management systems, is the recommended method under the National Cancer Control Programme policy[428] for these referrals. The decision regarding which hospital to send the referral typically rests with the GP; however, factors such as the availability of dermatology services and waiting times at relevant pigmented lesion clinics often influence this choice. For example, at Roscommon University Hospital pigmented lesion referrals are frequently directed to the plastic surgery department. Although it operates a designated pigmented lesion clinic, the hospital does not have a dermatology department, and access to dermatologists in the wider region is limited. Overall, the volume of pigmented lesion referrals managed by plastic surgery departments varies across the country. While the scope of this HTA is focused primarily on dermatology departments, it is important to acknowledge that plastic surgery services currently handle a proportion of pigmented lesion referrals in many regions, predominantly facilitating excision of lesions, where appropriate.

Referrals are received mainly received via Healthlink and entered into the hospital's centralised Integrated Patient Management System (iPMS). To facilitate triage in line with the National Outpatient Waiting List Management Protocol,[6] referrals are typically printed from the system and reviewed by a consultant, who assigns a priority category. The paper copies are then returned to administrative staff, who update the relevant system and notify the referring GP via Healthlink. In most hospitals, a letter is issued to the patient advising them of the waiting list they have been placed on. A follow-up letter is typically sent six weeks prior to the scheduled appointment date, confirming the details and asking the patient to indicate whether they wish to proceed. It should be noted that some hospitals have variations in this process. For example, St Vincent's University Hospital includes the appointment date in the initial patient letter.[429]

In recent years, several national policy initiatives have been developed to address rising outpatient department (OPD) waiting lists which have influenced the structure and management of referral pathways. The Waiting List Action Plan (WLAP) 2024[430] mandated the establishment of centralised referral processes in all hospitals and across all specialties. In April 2024, a National Guidance Document[431] outlining a national approach to implement and deliver central referral offices (CROs) in Ireland was published. Any future implementation of TD-supported referral management will need to align with these processes. The CROs aim to enable central management of referrals at a community healthcare organisation, hospital group or regional health authority level, to ensure patients are on the most appropriate care pathway, and are seen as soon as possible.

7.2.2 Teledermatology models

Different models of TD exist, varying in how images are captured, how referrals are routed, and the type of clinical input provided. If a TD-supported referral management system were introduced in Ireland, it would be essential to select a model that is compatible with existing referral pathways, clinical infrastructure, and workforce capacity. As described in Chapter 2, the two primary models of TD are store-and-forward (SAF) and live interactive (LI). While LI TD replicates aspects of traditional face-to-face (FTF) evaluation and may benefit certain patients, as outlined in Chapter 4, there is limited evidence that it meaningfully improves management of new referrals, waiting lists, or access to specialist care. However, LI TD may have value in other areas of the care pathway, such as the follow-up of patients with chronic or stable conditions, or for patients transitioning from inpatient to outpatient care where virtual consultations can reduce the need for in-person reviews and support ongoing patient monitoring without adding pressure to outpatient clinics.[432, 433]

In contrast, SAF TD models are the most common form among countries that have implemented TD services,[35] with most of the available evidence presented in Chapter 4 pertaining to SAF models. A SAF model is likely to be more compatible with existing referral pathways and infrastructure in Ireland as they offer greater flexibility in resource-constrained environments and logistical advantages over LI models.[35] Because SAF is asynchronous, referrals and clinical images can be reviewed independently of the patient's or GP's schedule, allowing for greater flexibility and easier integration into existing clinical workflows. SAF also requires less technical infrastructure, as it does not depend on real-time video connections, which can be limited by bandwidth, hardware availability, or digital literacy.[432, 433]

Within SAF models, image capture can occur via dedicated imaging clinics or in general practice. While imaging clinics may offer standardised images, they would pose considerable implementation challenges. These include the need for additional infrastructure, trained staff (such as medical photographers or dermatology advanced nurse practitioners), and the coordination of additional patient appointments, all of which would contribute to increased complexity and cost. Requiring patients to attend a separate imaging appointment also increases the risk of a 'did not attend' (DNA); capturing images in general practice reduces this risk and allows for integration into existing workflows. This approach may be more scalable and more convenient for patients. GPs or practice nurses can conduct imaging during the initial consultation, ensuring that referral and triage can occur without requiring a separate visit or service pathway. This model also creates a direct dialogue with the consultant dermatologist and gives the GP control of the images sent with the referral which may not be possible with the use of imaging

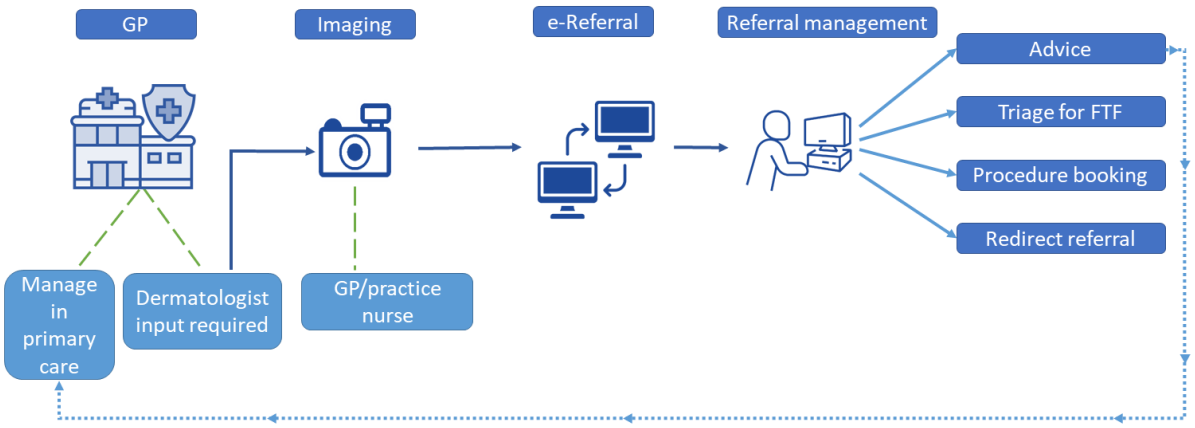
clinics. Moreover, the majority of the evidence considered in Chapter 4 related to direct capture in general practice rather than via dedicated imaging clinics. For these reasons, this chapter of the HTA and Chapter 6 Budget Impact and Resource Implications focuses on general practice-based image capture.

Referrals using SAF TD could be routed either directly to individual hospital dermatology departments or to a centralised TD hub for triage and management. While a national hub could provide consistency, it would require significant organisational changes including the establishment of shared referral protocols, staffing a dedicated TD team, and investment in IT infrastructure to ensure interoperability between hospitals. These factors would be associated with significant challenges that could delay implementation.

An additional feature that can be integrated into a SAF TD model is an advice service where the teledermatologist provides guidance to the GP on diagnosis and management, allowing for the continued management of some cases (where clinically appropriate) in primary care and potentially reducing unnecessary FTF appointments.

Given these considerations, and based on evidence reported in previous Chapters of this HTA, a SAF TD model with images captured in general practice and an advice service, as depicted in Figure 7.1, would likely offer a balance of feasibility and scalability in the current system. Importantly, this model is not intended to function as a standalone advice service for GPs, and existing referral thresholds would need to be maintained. Therefore, it would be important to ensure that appropriate guidance be developed to support such a system, details of which are discussed later in this chapter.

Figure 7.1 Teledermatology pathway



Key: e-Referral – electronic referral; FTF – face-to-face; GP – general practitioner.

7.3 Implementation within the current healthcare system

The potential implementation of TD must be considered within the context of existing healthcare structures, resources, and processes. To ensure feasibility and sustainability, any proposed model should aim to leverage current infrastructure where possible, while identifying areas that may require adaptation or investment. The following section describes key considerations for implementing a TD-supported referral management system into the current healthcare system.

7.3.1 Imaging

The quality and consistency of the images used is important for the effectiveness of TD. Consideration must be given to how and where the images are captured, the personnel involved, the technology used, and how image and clinical data are transmitted securely through existing referral systems.

Prior to capturing any clinical images, informed patient consent for their use in diagnosis and treatment must be sought and documented. This consent process should involve a clear discussion with the patient, explaining the purpose of the image capture and how the images will be used. Patients must be provided with clear information about their right to withdraw their consent (opt out) at any time, including the removal of images from health records, if requested. When images are intended for uses beyond direct patient care, such as training or research, written consent should be sought. In such cases, governance arrangements must be clearly defined, written consent should be sought and retained for the duration of image storage. Any images used for these secondary purposes should be anonymised to prevent patient identification. Images should be taken in a designated space within the general practice that ensures both visual and auditory privacy, ideally a private room or cubicle. Staff must be aware of and adhere to chaperone guidelines during image capture, particularly when photographing a child, young person, vulnerable adult or intimate areas. An informal chaperone, typically a parent or carer chosen by the child, young person or vulnerable adult, should be offered when non-intimate images are taken. For intimate areas, a formal chaperone should be present to safeguard children, vulnerable adults, and medical staff.[434]

Suitable imaging equipment can include digital cameras or smartphones, but it is essential to select, standardise, and maintain devices to ensure reliable performance. Referrals should ideally include both contextual and macroscopic images, and all images should be reviewed for quality before submission. Additionally, consideration should be given to the need, feasibility, and suitability of whole-body images to support referrals of suspicious lesions.

While dermatoscopic images may offer particular benefits, especially for suspected skin cancer cases,[435] they are not required for the implementation of standard TD pathways. Consideration should be given to the additional costs (outlined as a scenario in Chapter 6), training needs, and practical challenges associated with incorporating dermatoscopic imaging into routine practice. This HTA did not formally assess differences in TD performance between standard clinical images and dermatoscopic images, although some evidence[436] suggests that dermatoscopy can improve diagnostic accuracy in specific contexts. As such, the use of dermatoscopic images could be explored at a later stage, once standard TD processes are established. This could include piloting dermatoscopic imaging in selected hospitals or practices to evaluate feasibility, impact, and resource requirements before considering wider implementation.

As highlighted in Chapter 4, there is evidence that higher image quality is associated with improved diagnostic concordance.[316, 321, 330, 351, 356] Poor image quality and lack of standardisation can compromise diagnostic accuracy, delay care, and increase system burden through repeat imaging requests or unnecessary FTF referrals. To avoid this, minimum image standards would need to be defined. For example, the Service Guidance and Standards for the Use of Teledermatology by the British Association of Dermatologists (BAD)[437] recommends:

- one image to show the anatomical location of the lesion or skin condition on the body
- at least one close-up image of the whole lesion
- a lateral close-up image for lesions that are raised from the skin, to show the lesion in profile, if feasible.

The BAD further recommends that dermatoscopic images be included for urgent suspected skin cancer and their 'advice and guidance' referrals. Additionally, patient-supplied images may be used only if they meet the required quality standards in accordance with established guidelines.[437]

Regarding image size and resolution, the BAD advises that maximum file sizes should remain within the capacity of the referring system. It is recommended that images used for TD assessment should be at least 2000 × 1500 pixels (approximately 3 megapixels). This aligns with monitor specifications currently used within the National Integrated Medical Imaging System (NIMIS).[438] This is smaller than the standard resolution produced by many digital cameras, which often generate images at 4600 × 3450 pixels (around 16 megapixels). Careful consideration will be needed to ensure that images can be compressed to an

appropriate size without compromising quality.[416, 437] Images would also need to be uploaded in an appropriate format (for example, JPEG).

Alongside image quality, the completeness of accompanying clinical and patient history is important for effective referrals. The image alone is rarely sufficient for decision-making. Information such as lesion duration, evolution, associated symptoms, relevant medical history (for example, immunosuppression, previous skin cancers), and the GP's clinical impression should be included in the referral. Incomplete documentation may necessitate contacting the referring GP, leading to administrative burden and potential delays in care.

7.3.2 IT and workflow considerations

The successful implementation of TD requires a robust IT infrastructure that enables secure, efficient, and standardised transmission of referral information and clinical images. To function effectively, a SAF TD system should be supported by a platform that enables the following key capabilities:

- **Easy uploading of clinical photographs:** GPs must be able to easily transfer high-quality images into their GP practice management system and attach them to electronic referrals.
- **Clear referral categorisation:** The referral platform should allow for the selection of referral type in a dropdown menu (such as suspected pigmented lesion referral or standard referral), supporting appropriate triage and prioritisation.
- **Sufficient image capacity:** The platform must support uploading of multiple high-resolution images, without compromising on image quality or diagnostic value.
- **Secure electronic and standardised workflow:** All referrals must be electronic, with consistent protocols across sites to ensure compliance with data protection and clinical governance standards.
- **Accessibility for reviewing clinicians:** Consultant dermatologists must have timely and secure digital access to referrals and images, ideally through systems already used within outpatient settings.

A key consideration in the implementation of TD-supported referral management should be the effective use of existing infrastructure to avoid unnecessary financial investment and organisational complexity. Significant work has gone into establishing Healthlink, Ireland’s national electronic referral platform, which is now used by the vast majority of general practices. At its core, TD requires the secure

transmission of clinical images alongside referral information, functionality that Healthlink already supports. However, the ability to attach images is dependent on individual hospital enablement, governed by local IT and data protection policies. The introduction of TD-supported referral management would necessitate that this functionality is enabled across all hospitals that accept dermatology referrals.

Additionally, any technical limitations should be considered and addressed to ensure usability. Healthlink currently allows a maximum of three images per referral, with a file size of 4MB per image. This would require GPs to ensure that images are appropriately sized prior to attaching them to the referral which may add to their workload. Consideration would need to be given to functionality that automatically compresses or reduces the image size within Healthlink without compromising diagnostic quality. An easy process for creating SAF referrals would be important for user satisfaction and acceptability of the pathway.

In terms of communication, Healthlink supports a one-off consultant response via a structured form, which includes fields for triage category, the need for an outpatient appointment, and recommended actions for the GP, covering therapy, radiology, laboratory investigations, and space for further comments.[439] While this feature would allow consultant dermatologists to provide advice back to the GP, it may be necessary to assess whether the form is fully fit for purpose, particularly regarding word and character limits, to ensure that responses are sufficiently detailed. If further correspondence is required beyond the initial response, this currently takes place by telephone or via HealthMail, and not HealthLink.

While Healthlink offers a robust and widely adopted platform for electronic referrals from primary care, there remains a small cohort of practices that rely on post, fax, or email referrals. These practices would require either support to transition to electronic systems or alternative referral pathways that ensure their patients are not further disadvantaged. Additionally, the effective implementation of TD would also require a fundamental shift in how referrals are managed within hospitals, particularly at the point of consultant triage. Currently, many dermatology services rely on paper-based triage where electronically-received referrals are printed prior to review. TD, however, depends on the digital review of clinical images and referral information, which implies a move away from this paper-based model. To fully support TD workflows, hospitals would need to ensure that consultants can manage referrals digitally within a secure, integrated system. This system would also need to allow for timely feedback to be sent back to the referring GP via Healthlink. As noted previously, some hospitals have already upgraded to Version 8 of the iPMS, which allows for direct integration with Healthlink. This version facilitates digital triage. It would be important to ensure that all hospitals are able to upgrade to this system to ensure a standardised approach to review of referrals.

In terms of integration into the current referral system, Healthlink would provide the simplest option should TD be implemented, however, alternative options are also available. This includes the potential use of centralised TD management software platforms. As highlighted in Chapter 2, of 21 countries reviewed, 14 were using a form of TD management platform. In Scotland, for example, a third-party telehealth company is commissioned to support the national roll-out of TD via a secure SAF app. This app uploads clinical images directly to a secure cloud platform rather than storing them on individual mobile devices and is fully integrated with the NHS e-Referral Service (e-RS). If a similar model were adopted in Ireland, general practices would require access to approved, encrypted smartphones or tablets. Alternatively, if GPs were to use personal devices, stringent data protection protocols would be required. This may involve adopting guidance similar to that issued by the BAD, which outlines procedures for using personal phones in a GDPR-compliant manner.[440] The Netherlands offers another model, where TD services are outsourced to a centralised telemedical centre. In this system, GPs use a dedicated dermatology app that is fully integrated with the telemedical provider's platform, enabling efficient referral triage and communication. Notably, such systems are typically implemented in countries with fully integrated electronic health records (EHRs), which significantly enhances the usability and efficiency of the platform. While Ireland does not currently have EHRs implemented, this may be a more feasible option as advances are made in line with the 2024-2030 Digital Health Framework for Ireland.[441] Alternatively, the HSE could choose to develop its own national TD platform or app. While this would allow for greater control, integration, and customisation, it would also require significant investment, technical development, and ongoing maintenance. This approach has not been costed in the budget impact analysis of the HTA. Ultimately, any decision would need to consider interoperability, clinician workflow, cost, and alignment with national digital health strategies.

Currently, the HSE National Records Retention Policy[417] requires referral letters and clinical photographs to be stored for the lifetime of the patient plus eight years after their death. This may result in a significant storage burden over time if records for patients who do not require a face-to-face appointment are retained for this period. Consideration would need to be given to the sustainability of these storage requirements in the context of teledermatology-supported referral management pathway.

7.3.3 Referral pathway considerations

As highlighted in Chapter 2 and Section 7.2.1 above, referrals from primary care to dermatology departments in Ireland are currently made via two pathways: standard referrals for dermatology assessment, and urgent pigmented lesion referrals for

suspected melanoma cases to one of the National Pigmented Lesion Clinics. It would be important to ensure referrals from both of these pathways are facilitated through one system. The NCCP has launched a pilot project[9] in collaboration with the Mater Hospital to assess the introduction of a specialised GP referral guideline and electronic referral form for skin cancer services. This initiative allows GPs to electronically refer patients with suspected squamous cell carcinoma (SCC) or melanoma using a single, dedicated Healthlink form. The outcomes of this pilot will inform a planned national rollout and represent a step toward a more integrated dermatology referral infrastructure, replacing the current pigmented lesion pathway if successful. If TD-supported referral management is also implemented, consideration would be needed to ensure effective integration between TD and this referral pathway into a unified system.

With regard to pigmented lesion referrals to consultant plastic surgeons, the introduction of TD-supported referral management is not expected to have a significant impact on this pathway. In regions with low dermatology capacity, GPs may refer patients with dermatological issues to plastic surgery OPDs. Although outside the scope of this HTA, this practice is likely to continue unless access to dermatology services improves. The inclusion of images with referrals as best practice may ultimately support more effective assessment, but plastic surgeons may choose whether or not to review these images or adapt their existing triage and management protocols. In the future, if TD-supported referral management were to be extended to pigmented lesion referrals managed by plastic surgery services, consideration would need to be given to ensuring that consultant plastic surgeons have access to appropriate equipment, such as a tablet or laptop to conduct triage and management digitally.

7.3.4 Equipment considerations

For TD to be implemented effectively, GPs and consultant dermatologists would require adequate access to equipment. For GPs, both smartphones and digital cameras are viable options; however, the majority of studies reviewed in Chapter 4 used digital cameras. Digital cameras also offer advantages in data security, as they typically do not store images on cloud-linked personal accounts and can be configured for controlled use in clinical settings. If TD-supported referral management were implemented, all GPs would need to have access to a digital camera. Consideration would need to be given to the secure transfer of clinical images from cameras to general practice management systems. This process would need to be encrypted end-to-end to ensure compliance with data protection standards. Images should ideally be uploaded directly into the general practice management system and not stored locally on individual devices to reduce the risk of data breaches. Clear and standardised guides would be required to support

practices in the secure handling of images, define protocols for temporary image storage (if unavoidable), and prevent control breaks or breaches of GDPR.

Consultant dermatologists would also require access to certain equipment to digitally view referrals and images, this could be facilitated by ensuring consultants have access to a tablet or computer. According to the BAD quality standards, the common screen resolution that provides adequate viewing and magnification without noticeable loss in quality is 1280 x 1024 pixels.[416, 437] While some dermatology departments may be able to leverage off existing infrastructure, in some cases, procurement of new equipment may be necessary. For the purposes of the HTA, however, the budget impact model presented previously assumed that all consultant dermatologists would need to be provided with a new laptop to facilitate TD-supported referral management.

7.3.5 Cases where teledermatology may not be appropriate

Not all referrals will be appropriate for TD. The pathway relies on image quality and sufficient clinical context, and some conditions or patient scenarios may not lend themselves well to remote assessment. It is unclear what proportion of referrals may fall into these categories, although it is expected to be a small minority. Careful planning would be required to ensure that these cases are identified early, managed appropriately, and that equity of access is maintained across the system. As such, clear guidance would need to be developed and communicated to referring providers. According to international guidelines and evidence, potential exclusion criteria may include:[38, 416, 442]

- Lesions or rashes located in difficult-to-photograph or hard to visualise areas, such as the scalp or genitalia
- Images obscured by scars, tattoos, or significant hair coverage, which may compromise clarity
- Patients with a history of multiple skin cancers or extensive sun damage, who may require a more comprehensive full-skin examination
- Situations where the patient is unable or unwilling to have photographs taken (such as due to cognitive impairment, privacy concerns, or lack of consent)
- Skin conditions that do not photograph well, either due to subtle clinical features, changes that are not easily captured in a static image, or with widespread disease (particularly in the case of rashes and inflammatory skin conditions).

7.3.6 Training

To ensure consistent quality across general practice settings, appropriate training and support would need to be available to staff involved in image capture, typically GPs and practice nurses. Training would need to address both the technical and clinical aspects of dermatology imaging, including, for example how to capture clear, well-lit images in line with the considerations outlined previously. This would include training in the correct use of dermatoscopes if being used, as well as in image stabilisation, lighting, and magnification techniques. Staff would need to be familiar with standard imaging protocols and know what types of images are required for different referral categories, such as macroscopic overview images, close-ups, dermatoscopic views, or whole-body images where relevant. Understanding common imaging pitfalls, such as poor focus, glare, or incomplete views of lesions, would also be important to avoid compromising diagnostic quality. Additionally, training would need to include how to ensure images are securely stored and transmitted in line with data protection requirements and integrated appropriately with existing systems such as Healthlink. Ongoing access to support and refresher training would need to be provided to help maintain standards over time.

To ensure consistency across practices, a standardised training model would need to be developed, supported, and funded by the HSE. An e-learning module that GPs and practice nurses can complete at their convenience is likely the most practical and flexible format for delivery. While participation in the training may not be mandated, it should be encouraged. Additional approaches could include collaborating with professional GP bodies to promote and deliver the training. At present, structured courses specifically dedicated to dermatoscopy and image-taking are not routinely offered by the Irish College of General Practitioners, though the annual online dermatology certificate and diploma could be adapted to cover imaging competencies. Complementary to a standard training programme, additional content could also be delivered through alternative formats, including monthly live webinars, dedicated learning modules, or sessions organised by professional bodies such as the Primary Care Dermatology Society. Other established courses, such as those provided by the UK Primary Care Dermatology Society represent an additional option for GPs seeking accredited training.

There is likely to be a learning curve as GPs gain experience with image capture and develop confidence in recognising which cases are appropriate for TD referral. Over time, regular feedback and advice from consultant dermatologists can help GPs to refine their image-taking practices (which, as discussed in Chapter 6, may take two years to reach consistency and reduce re-imaging rates), and also build their clinical skills in assessing and managing common dermatological conditions within primary care.[408] This process not only supports the quality of referrals but can also

contribute to upskilling the primary care workforce, reducing the need for specialist intervention in straightforward cases and promoting more efficient use of healthcare resources.

7.3.7 Time, capacity, and efficiency considerations

The potential introduction of a TD pathway in Ireland would inevitably introduce additional steps into the traditional care process. While these steps, such as imaging, uploading images, and their review, are central to delivering effective TD-supported referral management, it is essential that implementation be designed in a way that minimises additional workload for both GPs and consultant dermatologists. Careful planning and considerations would need to be given to ensure that TD complements existing workflows rather than becoming a source of inefficiency.

7.3.7.1 General practice

From the perspective of general practices, the introduction of TD would require modifications to existing workflows, particularly through the incorporation of clinical photography and image uploading into the referral process. While it would introduce a new step in the consultation, it is not expected to significantly impact the day-to-day operations of general practice or the broader management of dermatology patients in primary care. As outlined in Chapter 3 and Chapter 6, close to 100,000 referrals to dermatology were made from primary care in 2024. With an estimated 3,262 GPs practicing in Ireland, this corresponds to approximately 30 to 36 dermatology referrals per GP per year and just under one a week on average. In the context of the considerable volume of patient contacts managed in general practice annually, dermatology referrals constitute a relatively small proportion of overall consultations per GP. However, as described in Chapter 6, when clinically appropriate, on average, 50% of referrals could be returned for management in primary care with advice rather than proceeding to a FTF appointment, potentially increasing follow-up workload. In such cases, the GP may need to schedule a follow-up appointment or initiate contact with the patient by phone to discuss their management plan. While these activities would add an additional layer of responsibility, they may also contribute to enhanced continuity of care and more efficient use of specialist resources. It should be noted, however, that for patients without a medical card, this could result in additional costs for GP consultations. In contrast however, if advice from a consultant is received within a short timeframe, instead of patients remaining on a waiting list for long periods of time with GP visits likely occurring during this time, TD could result in a net reduction in workload and burden to the patient. For patients that do not proceed to a FTF appointment after TD, they will potentially avoid repeat GP visits to manage the issue that may occur while waiting for a FTF consultation under the current system. Finally, it is important to emphasise that the quality of submitted images remains an important factor;

poor-quality photographs could lead to requests for resubmission or automatically schedule a patient for a FTF consultation, resulting in duplicate effort and delays for both patients and clinicians.

To avoid placing additional demands on patients, it would be important that images are captured during the same appointment as the consultation, rather than requiring patients to return for a separate imaging visit which increases the risk of a patient not attending their appointment (DNA). This would help reduce inconvenience, time commitment, and potential costs to the patient. It is not anticipated that any additional fees would be charged to patients for TD referrals, nor is it expected that GPs would be reimbursed on a fee-for-service basis for image acquisition.

Additionally, consideration would need to be given on managing re-referrals following TD advice. Although evidence presented in Chapter 4 indicates that re-referral rates are low, a clear, streamlined pathway would need to be specified for patients who do not respond to initial management, deteriorate, or require further diagnostic evaluation. This should include defined clinical triggers for re-referral, a mechanism to attach prior TD correspondence and images, and a means to prioritise these cases to avoid duplicate assessment and delay.

7.3.7.2 Dermatology departments

For consultant dermatologists, the introduction of TD would be expected to impact current clinical workflow, particularly in the triage and review stages. As discussed in Chapter 6, triage is generally a quick process, averaging around 1.5 minutes per referral and focused on prioritising clinical urgency based on the written referral information. Under a TD model, where clinical images are attached to the referral and a management plan can be developed for the GP to implement, the process would become more time-intensive. It is estimated that reviewing photographs alongside the referral letter adds approximately 3.5 minutes, and where a FTF appointment is not required, preparing advice for management in primary care adds a further five minutes. Under the current pathway, where all patients are seen FTF, the total time from triage to consultation is approximately 11.5 minutes. With TD, total consultant time increases to 20 minutes when FTF is required, and decreases to 10 minutes (in approximately 50% of referrals) where TD enables management in primary care without a FTF appointment. The BAD recommend that in cases where developing a management plan would exceed 10 minutes, the patient should be triaged for a FTF consultant. Any subsequent queries or clarifications from the GP would also require some consultant time to address.

These changes would redistribute consultant capacity, shifting a proportion of time from FTF consultation to TD review. While this would represent a significant shift from existing triage practice, requiring more consultant input per referral, these

changes also have the potential to yield important benefits. The overall impact on clinical efficiency using a TD model depends on whether the additional time required to review images with referrals is offset by the proportion of cases that can be managed without a FTF appointment. Based on analyses presented in Chapter 6, if half of referrals to dermatology can be appropriately managed without a FTF consultation, a TD pathway would remove more patients off the waiting list over 10 years, would reduce the number of FTF appointments, and would reduce did-not-attends (DNAs) compared with the current pathway. Within the 10-year horizon modelled, TD would also have a positive impact on the waiting list backlog from year nine. Accordingly, over time, reducing the number of avoidable FTF consultations could help free up clinic capacity and contribute to shorter waiting times for patients who do require in-person assessment. A potential unintended consequence of TD, however, is that the availability of specialist advice may lower the threshold for referral, encouraging some referrals for second opinions. It would be important to ensure that existing clinical thresholds for referral are maintained to avoid unnecessary demand. Conversely, as previously highlighted, as GPs receive feedback and advice through the system, there is an opportunity for learning and upskilling, which over time may support greater confidence in managing common dermatological conditions within primary care and potentially reduce the volume of referrals.

The use of TD could yield other efficiency gains; as outlined in Chapter 6, the risk of a patient not attending their FTF appointment after TD assessment is less than half the risk of not attending after direct referral to FTF consultation. This may be partly because patients triaged to FTF via TD are more likely to have conditions of greater clinical significance and less likely to resolve while awaiting review. By reducing non-attendance rates, TD could support greater clinic throughput and more efficient use of referral capacity over time. Notably, managing simpler cases within primary care may alter the case mix presenting in secondary and or tertiary care. Patients attending FTF appointments would likely have more complex or chronic conditions and require more follow-up visits to dermatology services. Consideration would be needed as to how best to accommodate this change within service planning.

In terms of administrative workload, TD is unlikely to change the core requirement for documentation and standard communication. Whether a referral is managed traditionally or via TD, it is expected that time would still be required to dictate and type letters or to complete structured electronic responses through platforms such as Healthlink. However, if all referrals were sent electronically and triaged digitally, the administrative burden associated with printing referrals for triage and subsequently digitising the triaging would be eliminated.

7.3.8 Workforce

As outlined in earlier chapters, while the number of whole-time equivalent (WTE) consultant dermatologists has increased in recent years, the growth has not been sufficient to keep pace with the increasing volume of referrals, resulting in persistent capacity pressures. The introduction of TD is not expected to necessitate additional staffing to implement the pathway, as it would primarily represent a reconfiguration of how referrals are managed rather than the introduction of an entirely new service. By enabling appropriate cases to be managed in primary care with advice from a consultant dermatologist, TD has the potential to redistribute capacity, allowing FTF clinic slots to be used for patients requiring them most. While TD could offer potential efficiency gains and help to optimise the use of existing capacity, it would not eliminate the need for additional consultant dermatologists to meet current and projected demand. Modelling presented in Chapter 6 indicates that over the next decade, meeting demand without TD would require 63 additional WTE consultants, compared with 55 if a TD model were implemented. Importantly, the increase in workforce would not eliminate the current waiting list but rather prevent it from increasing further. In either scenario, recruitment at this scale could not occur in a single phase and would instead require incremental expansion over several years. Importantly, modelling also shows that without TD, a phased increase of five WTEs per year would not produce a reduction in waiting lists within a 10-year horizon, whereas with TD in place, waiting list reductions could begin to materialise from year nine onwards. Achieving this would depend on increasing dermatology training capacity in Ireland, including additional registrar and specialist training places, as well as expanding the number of available consultant dermatologist posts available across the country. However, consultant recruitment remains a challenge.

Between 2016 and 2020, a total of 15 doctors completed a Certificate of Satisfactory Completion of Specialist Training (CSCST) in dermatology, with an overall retention rate in public and private practice in Ireland of 87% by 2024.[443] In the more recent period between 2021 and 2023, an average of six new consultant posts were created annually, while the average number of CSCST completions was three per year. Data on the proportion of recent CSCST holders in permanent consultant posts in Ireland further illustrates the variability and challenges in retention.[443] In 2021, three dermatologists completed CSCST, with 67% in a permanent post by 2024; in 2022, four completed, but only 25% were in post; in 2023, four completed, with 50% in post; and in 2024, 11 completed, with 45% in post.[443] These figures suggest that even when training output increases, not all newly-qualified consultants are entering or remaining in permanent consultant roles in Ireland.

At the end of 2024, the Medical Workforce report[407] noted that nine approved dermatology posts were vacant, although this was an improvement of the 12 vacant

by the end of 2023. Constraints in recruitment and retention are likely to remain an important consideration in the future planning and resourcing of services. Without an increase in consultant dermatology workforce, the impact of TD on reducing dermatology waiting lists and increasing timely access to care would likely be limited. Any expansion of the dermatology workforce would need to be matched by proportional increases in infrastructure and clerical staff.

7.3.9 Acceptability

Acceptability is a key consideration in the design and successful implementation and sustained use healthcare interventions.[444] For a TD pathway, the buy-in of both clinicians (GPs and consultant dermatologists) and patients would underpin whether such a pathway is integrated into routine practice and whether anticipated benefits, such as reduced waiting times and waiting lists, and more efficient referral management, are realised in practice.

Evidence from international implementation experiences[35, 445, 446] shows that successful integration benefits from deliberate efforts in change management, particularly through the engagement of clinical leads, frontline healthcare professionals, and operational staff from the outset. Involving GPs, consultant dermatologists, and nursing staff in the design and implementation stages would help ensure that workflows are realistic and clinically appropriate. Clinical leadership is particularly important to build trust in the process and support implementation. In parallel, engagement of operational managers and administrative staff would be important to address practical enablers such as clear referral protocols and IT support.

User satisfaction, particularly among clinicians, is often a key barrier or enabler in the adoption of technology.[35] Data presented in Chapter 4 did not identify significant differences in satisfaction among patients between traditional FTF consultation and TD experience. There were limited data on provider satisfaction with mixed findings: one study showed no statistically significant difference between the two modes and another reported lower satisfaction scores with TD compared with FTF evaluation.

Acceptability may also be affected by the requirement to adopt new digital processes, particularly in settings where processes are reliant on paper-based workflows. Ensuring that digital platforms are user-friendly, reliable, and well-supported would be essential to encourage consistent use. By capitalising on existing IT infrastructures such as Healthlink, GPs and dermatology departments would have familiarity with the system which could foster acceptability and faster implementation. The adoption of consultant-led advice within primary care would also introduce new responsibilities for GPs. While access to timely consultant input

could enhance GP confidence and reduce unnecessary referrals, some clinicians may initially be cautious about managing cases that would previously have been referred for specialist input.

A TD technology acceptance model[447] (based on the technology acceptance model[448]) was developed by Orruño et al. to determine which factors affect the intention of physicians to uses TD. In this model, acceptance is shaped not only by perceived usefulness and ease of use (technological factors), but also by personal attitudes and habits (individual factors) and by the presence of organisational enablers (organisational factors). Key determinants such as compatibility with existing practice routines, organisational infrastructure, and the presence of support systems through training strongly influence the likelihood of uptake and sustained use. In particular, the development of automatic habits whereby clinicians become comfortable with image capture and system navigation was found to improve long-term use.

To support this, as noted previously, training would need to extend beyond technical aspects such as image capture and secure transmission. It would also need to communicate the broader value of TD in enabling timely, equitable access to dermatology care and support clinical decision-making.

Additionally, the implementation of a new pathway would require significant change management. This could include clear communication about the purpose and benefits of the service, defined roles and responsibilities, and opportunities for staff to raise concerns and contribute to solutions. Active change management strategies, such as appointing clinical champions, setting realistic timelines, monitoring early implementation issues, and sharing examples of good practice, can help build confidence and momentum.[445] Without a structured approach, there could be a risk that TD initiatives may remain small-scale pilots rather than being fully integrated and sustained.

7.3.10 Teledermatology guidance

A lack of standards and guidance is a common barrier to programme adoption.[449] Strategies that support consistent, high-quality implementation of a new healthcare intervention or pathway are important considerations to ensure safety, effectiveness, and acceptability to patients and clinicians.[450, 451] If TD-supported referral management pathways were developed, comprehensive guidance would be critical to ensure that services are implemented consistently, safely, and effectively at a national level.

Guidance provides a framework for standardisation so that patients and clinicians can expect a consistent level of care regardless of location. Standardisation would be

important to ensure that TD services maintain high levels of clinical quality, patient safety, and data protection.[452-454] Clear guidance also supports effective training, reduces variability in practice, and facilitates monitoring and evaluation.[449] Additionally, formal guidance could help clarify roles and responsibilities, improve clinician confidence, and promote patient trust in remote models of care.

Based on guidance published in other countries, and particularly the BAD,[2, 117, 223, 416, 437, 455] key standards and elements that could be considered in the development of guidance to support safe and high-quality practice include:

- **Patient exclusion criteria:** specifying which patients and clinical scenarios are appropriate for TD referral and which cases should be seen in person.
- **Patient information and consent:** outlining how patients should be informed about the process, including data protection, image storage, and the potential need for subsequent FTF review, and how consent should be obtained and documented.
- **TD virtual review of patients:** detailing requirements for clinical assessment, triage, and documentation by dermatologists reviewing cases remotely.
- **Staff, training, and education:** specifying the training necessary for GPs, practice nurses, and dermatology teams to competently use TD systems and adhere to protocols.
- **Equipment and facilities:** describing minimum standards for imaging equipment, image quality, secure data transfer, and facilities that protect patient privacy during photography.
- **Governance, audit, and quality improvement:** setting expectations for service oversight, regular audit, outcome monitoring, and quality improvement processes to ensure continuous development and safe delivery.

Consideration would need to be given to the format and delivery of TD guidance in Ireland. Potential options include one, or a combination of the following: a National Clinical Guideline under the National Clinical Effectiveness Committee, which would provide a formal, evidence-based standard for practice; an HSE-led guideline; a dedicated model of care for TD to sit alongside the existing dermatology model of care; or HSE procedures and quality assurance standards which could be established to provide detailed operational requirements and facilitate local implementation.

4.1.2 Monitoring and evaluation

This HTA evaluates the potential for a TD-supported referral management pathway from primary care to secondary and tertiary care dermatology services. While a HTA does not set out a detailed implementation plan, it is essential to consider the organisational impact of introducing such a pathway into the Irish healthcare system. Monitoring programmes are essential to fully optimise TD implementation and to understand its value and patterns of use. Ongoing monitoring can help identify key barriers and facilitators, which may vary depending on the setting and stage of implementation. By providing timely feedback, monitoring enables services to adjust to emerging challenges and thereby supports sustainability and improvement of the pathway. Consideration would need to be given to the most appropriate model to facilitate monitoring and evaluation. The RE-AIM framework (Reach, Effectiveness, Adoption, Implementation, and Maintenance) has been used in TD programmes and offers a structured approach to guide implementation planning and evaluation across multiple dimensions.[449, 456, 457] Under the framework, the following key outcomes are suggested for monitoring and evaluation.

- **Reach**: Proportion and characteristics of patients referred via TD, with attention to equity across regions, age groups, and socioeconomic backgrounds.
- **Effectiveness**: Impact on access and clinical outcomes, including time to advice or treatment, reduction in unnecessary FTF appointments, and patient and provider satisfaction.
- **Adoption**: Uptake among GPs and dermatology services, and factors influencing clinician engagement such as training, usability, and workflow integration.
- **Implementation**: Consistency in use of referral protocols, image quality, platform reliability, and resource requirements including training and equipment. Feedback mechanisms could allow gaps in practice to be identified and any training modules updated accordingly.
- **Sustainability**: Ongoing use of the pathway beyond initial rollout, updates to protocols and systems, and long-term outcomes such as sustained reductions in waiting times and improved access to care.

While key performance indicators (KPIs) are required for monitoring and evaluation of new interventions, it is important that KPIs are not developed relating to the proportion of FTF avoided. Ultimately, the decision to see a patient FTF should be

based solely on clinical need to ensure patient safety and quality of care is prioritised. Any monitoring and evaluation framework assessing a teledermatology pathway should therefore avoid incentivisation of FTF appointments averted.

7.4 Discussion

This chapter explores the organisational requirements for implementing a TD-supported referral management system within the Irish healthcare system. While multiple TD models exist, the design of any implementation would need to be context-specific, ensuring alignment with existing workflows and infrastructure. In the Irish setting, a SAF model where images are captured during the GP consultation and reviewed asynchronously by dermatologists may be the most feasible and scalable option if TD were introduced. It likely would offer a lower technological burden compared to a LI model and better integration with current referral practices.

A key aim of this HTA is to evaluate whether TD can contribute to addressing the growing demand-capacity gap in dermatology services. As outlined in Chapter 3, although the dermatology workforce has expanded in recent years, demand for specialist dermatology care has risen at an even faster pace. As a result, outpatient waiting times remain long, and many patients face delays in receiving timely assessments and treatment. TD has the potential to improve efficiency by enabling suitable cases to be managed in primary care, reserving FTF appointments for patients with more complex or urgent needs. While this could reduce avoidable referrals, it may also carry unintended consequences. Specifically, the option to seek advice could encourage some GPs to refer more cases for second opinions. To prevent this, it will be important to maintain current thresholds for referral and ensure GPs continue to refer only where specialist input is clinically indicated. Conversely, over time, feedback from consultants may enhance GP confidence and skill in managing common conditions, leading to more appropriate referrals and better use of specialist resources.

The redistribution of capacity enabled by TD has both opportunities and implications. Under current arrangements, it is estimated that triage takes approximately 1.5 minutes per referral, with an additional 10 minutes for a new patient FTF consultation, that is, approximately 11.5 minutes of consultant time for each new patient. In a TD model, it is estimated that image review adds around 3.5 minutes, and when advice is provided to support GP-led management without FTF, this requires a further 5 minutes. This means that a patient seen FTF after TD triage would require approximately 20 minutes of consultant time, while a patient managed entirely in primary care following TD triage and advice would require only around 10 minutes. Organisationally, this highlights a trade-off as TD increases the time spent

per patient who is ultimately seen FTF, but it can reduce time for those managed in primary care, thereby freeing capacity for higher-priority cases. Patients triaged to FTF via TD may be more likely to present with conditions of greater clinical significance that are less likely to resolve spontaneously while on the waiting list, which may reduce DNA rates and improve throughput. At the same time, shifting simpler cases to primary care could alter the secondary and tertiary care case mix, increasing the proportion of complex or chronic presentations and potentially resulting in longer average consultations for those who are seen FTF.

Beyond the direct operational effects, workforce constraints remain a critical factor in determining the impact of TD and improving access to dermatology care. Modelling presented in Chapter 6 illustrates that while TD can moderate workforce requirements, it does not fundamentally resolve them, with 27 additional WTE consultants still needed over the next decade to meet projected demand, compared with 61.5 without TD. Crucially, this scale of recruitment could not be achieved in a single phase and would require incremental growth over time. The presence or absence of TD would change the trajectory of service pressures; without TD, a gradual increase of five WTEs per year would not reduce waiting lists within a 10-year period, whereas with TD, reductions could begin from year six. This suggests that while TD does not replace the need for workforce expansion, it could accelerate the point at which patients experience tangible improvements in access. Consideration would also need to be given to increasing training capacity, available posts, and ensuring retention within these posts.

Organisationally, implementing a TD pathway would necessitate three key considerations. First, that all referrals be submitted electronically through a single electronic platform such as Healthlink. While most GPs already use Healthlink, a small number still rely on post, fax, or email; these practices would require support to transition. Second, dermatology services would need to shift from paper-based triage to digital review systems, ensuring consultants can efficiently access referral information and provide feedback through integrated systems. Some hospitals, particularly those using iPMS V8, are already positioned for this integration, but further rollout would be needed. Lastly, equipment to facilitate SAF TD would be required; GPs would require access to appropriate imaging devices, and dermatology consultants would need to have a means of reviewing referrals digitally, through a tablet or laptop for example.

Healthlink offers a practical foundation if TD were implemented, given its widespread use and existing image upload functionality. Alternatively, third-party platforms or a bespoke HSE-developed system could be considered. Any decision should weigh interoperability, ease of use, cost, and long-term sustainability.

Regardless of the platform used, if implemented, training and support for GPs and staff involved in image acquisition would be essential to ensure images are captured in a consistent and clinically useful manner. To support the consistent delivery of high-quality care, the development of formal TD guidance would need to be considered. This guidance would need to cover both clinical and operational standards, including patient eligibility, consent, equipment, referral management and triage processes.

Ensuring acceptability of TD among patients and healthcare providers would also need to be considered. Clinical championing, stakeholder engagement, and change management strategies may play a central role in fostering adoption. Long-term success would also depend on robust monitoring and evaluation, using structured frameworks to assess the system's performance, identify areas for improvement, and ensure ongoing alignment with clinical and operational goals.

The considerations presented in this chapter are based on an extensive review of the clinical effectiveness and safety of TD, which included international single-centre experiences providing real-world experiences, ensuring an evidence-based approach. Additionally, insights gained from the international review of TD systems presented in Chapter 2 allowed for considerations to be contextualised against practice norms in countries where TD has already been implemented. Of note, however, the introduction of TD in Ireland would be within the context of a significant shortfall in capacity, which may not be reflective of experiences in other countries. The workforce considerations presented are based on detailed modelling presented in Chapter 6, which quantifies the potential impact of TD on service capacity under various scenarios. While the HTA approach assumes that the HSE would fund training and equipment for primary care, there is no reimbursement mechanism for capturing images, and depending on workload required for this process, some costs could potentially be passed on to private patients without a GMS or GP visit card. Although effort was made to ensure that current organisational practices are reflective nationally, regional variation is likely.

Overall, TD could play a role in alleviating pressure on dermatology services by redistributing capacity, reducing unnecessary FTF appointments, and supporting more efficient use of specialist time. However, its impact would be constrained without concurrent investment in consultant capacity, expansion of training pipelines, and careful management of the organisational changes required to support its integration into the Irish healthcare system.

8 Patient, social, ethics and legal considerations

Key points

- Skin conditions are associated with a broad range of patient symptoms that present a significant physical, psychological and economic burden.
- Access and equity of dermatology care may improve using teledermatology (TD) for those:
  - with suspected non-cancer skin conditions who may currently be waiting longest for dermatology consultations, through faster and more comprehensive triage and management of cases
  - living in underserved areas with higher burdens in terms of travel, time and costs to attend appointments in secondary and or tertiary care dermatology centres.
- Delivery of TD services should consider how best to accommodate those most affected by a 'digital divide' that risks increasing inequities of care and service delivery for:
  - the elderly, children, vulnerable or socially deprived groups who may require assistance to use basic digital services, if live interactive consultations are used
  - GPs or GP practices that are not digitally mature, if store and forward consultations are used
  - those living in more remote areas with lack of access to high-quality broadband.
- Clear communication with patients prior to TD consultations is essential to enable informed consent and to allow for appropriate management of patient expectations regarding potential benefits or harms of using TD, along with explanation of data protection and privacy safeguards.
- Clear communication is required regarding the patient cohorts that may require initial face-to-face rather than TD consultations. The autonomy of patients to optionally choose TD should be respected, but risks low uptake of the service. Benefits from TD may be reduced if suitable patient cohorts are not targeted appropriately.
- Replacing some face-to-face with TD consultations may challenge clinician autonomy by altering responsibilities for GPs and dermatologists regarding patient triage and management. Guidance should be developed based on current best practices that clearly define and communicate GP and

dermatologist roles and responsibilities in a collaborative TD triage and management process.

- Imaging equipment such as dermatoscopes or digital dermatoscopy used as part of a TD solution are subject to and must be compliant with current EU and Health Protection Regulatory Agency medical device regulations.
- Current legislation exists to manage clinician liability in a TD process. The risk of misdiagnosis is already present in the current system of referral to face-to-face consultations. Any legal risks to GPs and dermatologists associated with potential misdiagnosis can be mitigated through the implementation of TD processes that are governed according to best practice standards integrated into clinical pathways.

8.1 Introduction

This chapter discusses the patient and social, ethical and legal issues relating to the use of teledermatology (TD) to support referrals from general practitioners (GPs) in primary care to consultant-led dermatology services in secondary and tertiary care. As previously described in the description of technology in Chapter 2, this includes use of store-and-forward images and the provision of live interactive video consultations. This chapter was developed in line with the structure described in the European network of HTA (EUnetHTA) Core model.[458]

8.2 Patient and social issues

8.2.1 Symptoms, burden and living experience

Chapter 3 describes the wide range of skin conditions that are routinely referred from primary care to consultant-led dermatology services, including melanoma, non-melanoma skin cancer (NMSC), psoriasis, acne, eczema, hidradenitis suppurativa, vascular lesions, rosacea, and skin infections. This section describes the symptoms and burden associated with these conditions from an individual patient perspective.

The skin conditions considered in this HTA present with a wide range of patient symptoms. Conditions such as melanoma and non-melanoma skin cancer can be life-threatening. With the exception of acute skin infections, other conditions, although not life-threatening, are chronic conditions that may require management over many years or over a lifetime, representing a significant burden on the patient.

Patients may experience significant and diverse physical symptoms including: skin discoloration; boils; pustules; eye swelling; crusty, cracked or bleeding dry skin; scarring of skin; severe itching; pain; and, visible lumps, lesions or sores with

bleeding.[174, 459-464] For those with melanoma, symptoms may differ depending on the stage of development. In later stages, where melanoma has metastasised, additional symptoms related to the effects on other organs include hard lymph nodes, extreme fatigue, stomach pain, chest pain, shortness of breath, headaches and bowel problems.[465] Life-threatening conditions like melanoma and non-melanoma skin cancer may also require invasive treatments that include a combination of surgery, radiotherapy or chemotherapy.[466] These treatments may also come with additional associated symptoms and side-effects including pain, fatigue, nausea and restrictions on mobility related to recovery.

The need for psychosocial support, particularly for those with chronic skin conditions, is a recognised component of models of care for a wide range of skin conditions.[1] Associated psychological symptoms may include feelings of isolation, low mood, stress, anxiety and depression.[146, 157, 467] Although non-life-threatening, non-cancer related skin conditions have a significant psychosocial burden. Patients report feelings of lack of social support, low self-esteem, and feelings that the psychological impact on these particular patients may be underestimated, even by clinicians.[468-470]

Patients with skin conditions may also have an increased risk of associated comorbidities which can add an additional management or treatment burden on the patient. For example, psoriasis is associated with psoriatic arthritis, cardiovascular disease, type 2 diabetes, metabolic syndrome and obesity.[471, 472] Eczema is associated with asthma and a number of allergic conditions.[473] Those with metastatic melanoma have been shown to have a higher incidence of pre-existing autoimmune conditions that may complicate treatment using immunotherapy.[474]

Patients report that the physical and psychological burden of symptoms of their primary condition, along with associated comorbidities, impacts negatively on many aspects of everyday life including sleep disturbance, reduced participation in recreation activities, and negative effects on personal and work relationships.[475, 476] They report feeling self-conscious and embarrassed where physical symptoms of skin conditions may be highly visible to others. There is evidence that skin conditions can severely affect overall quality of life.[154, 475, 476] A survey of patients with inflammatory skin conditions for example, reported reductions in quality of life comparable to that seen with other chronic medical conditions such as cardiovascular disease and diabetes.[477]

Patients and carers of those with skin conditions report significant financial burdens relating to attendance at appointments, medications and ongoing treatments. A 2019 patient survey conducted by the Irish Skin Foundation reported that the average annual medical cost associated with clinical visits and medication for those

living with eczema was €2,300.[475, 476] The provision of TD may alleviate some costs for those whose condition can be managed through primary care. Attendance at local primary care centres rather than specialist centres may involve shorter travel distances and time commitments, with lower associated transportation and potentially accommodation costs; time commitments may also be lower, potentially reducing lost work time or financial costs sourcing carers. The model of TD implemented and whether images are taken in local primary care centres or dedicated imaging clinics is an important decision in this regard. The use of imaging clinic services may not alleviate this financial burden if those services are still located in more populated urban areas that require travel from underserved and more remote rural areas.

8.2.2 Patient expectations of TD

The use of TD gives rise to both expectations and concerns for patients. A study of research priorities as expressed by patients with melanoma from England, suggests that the adoption of TD and other technologies such as artificial intelligence (AI) are viewed positively by some patients as potential enablers to support more timely diagnosis that could reduce time spent on waiting lists.[478]

Concerns are also expressed by some patients that the use of TD may result in reduced or no opportunity for engagement with dermatologists regarding their conditions, particularly where store-and-forward rather than live video is used.[90, 93, 479] Existing dermatology models of care mean that patients may be used to face-to-face (FTF) consultations that allow for more detailed discussion of their concerns as well as facilitating immediate and direct feedback from dermatologists. In contrast, TD, when done asynchronously, will remove direct interaction with dermatologists in cases that are referred back to primary care without the need for a FTF consultation. In the case of live video consultations, physical interactions may be reduced or patients may have concerns about the privacy of these consultations.[480]

The systematic review in Chapter 4 covering health utilisation found evidence from seven studies comparing patient satisfaction of TD with FTF consultations, although only one of the studies used validated tools. Generally comparable levels of patient satisfaction were reported for TD with some variation across specific domains. Greater variation in reported patient satisfaction was noted specifically relating to the experience of waiting time for appointments with higher satisfaction expressed for TD than for FTF.[26, 312] Although evidence was limited, patient satisfaction was noted to potentially vary based on the model of TD employed. One study found lower levels of patient satisfaction with live interactive TD than for store-and-forward TD or FTF consultations.[481]

8.2.3 Social aspects

8.2.3.1 The digital divide

The term 'digital divide' is used to highlight differences between groups relating to a broad range of technical and human factors that influence the degree to which digital based solutions can be effectively used across a wide range of areas in everyday life, including healthcare.[482] If imbalances in the ability of different groups to effectively use such technical solutions are not considered during design of digital services, there is a risk of increasing rather decreasing inequity in healthcare delivery.[482]

The digital-literacy required of patients will be greatest where live interactive consultations are being used. Videoconferencing technology needs to configured and operated by the patient, carers or advocates participating in the consultation using their own equipment. Where store-and-forward is the primary modality, some digital-literacy may be required of the patient to understand how the consultation will be conducted to enable informed consent. In the case of store-and-forward consultations, the requirement for digital-literacy is largely taken on by staff in the GP practice or imaging clinics who take digital photographs that accompany the electronic referral. Consideration should also therefore be given to potentially different levels of digital-literacy and technology adoption among GP practices. Digital literacy of GPs may also influence which GP practices are currently registered for existing Healthlink or HealthMail services that could be used for implementation of TD services.

In a report by the European Commission, Ireland scored well compared with other European countries in terms of digital skills development, with the narrowest urban-rural divide in Europe.[483] The delivery of TD services still requires consideration of the impact that such services may have on those who lack access to basic digital services or those who may need assistance to use such services. This may include children or the elderly, those with diminished capacity to make their own healthcare decisions, those with physical or mental impairments, and those that are socially deprived.[484] The digital divide may also refer to infrastructural or socio-economic barriers that affect basic digital access.[482] Those living in more remote rural areas or who are more socially deprived may lack basic technical requirements or finances to pay for reliable digital access such as good quality broadband.[485, 486] If these issues are not addressed when implementing a TD service, there is potential that access to the service may be more limited in these groups. In the context of existing waiting lists for services, there is therefore a risk that those groups who may be less effectively able to use TD services will end up having to wait longer to access specialist dermatology services than those that can, thus increasing inequities.[482] As stated above, issues regarding digital literacy amongst patients will be most likely

to create inequities in the context of live interactive TD. In a store and forward system, there is limited onus on the patient regarding use of technology.

8.2.3.2 Impacts on carers

Carers of patients with chronic skin conditions report a high-level impact on their own quality of life.[475, 476, 487-489] This affects all carers but particularly those caring for children.[488, 489] They report feeling emotional and psychological stress along with the economic and time burden associated with helping those they are caring for to attend ongoing appointments and treatments. Balancing their own time commitments along with additional time for caring commitments may lead to caregiver burnout and feelings of sadness, tiredness, frustration and fatigue.[489] Those caring for children report feelings of anxiety, overprotectiveness and depression regarding the impact of skin conditions on their children, along with negative impacts on partner and other child sibling relationships.[489]

8.2.3.3 Current limitations of access to dermatology care

8.2.3.3.1 Access to dermatology services and prioritisation of waiting lists

As discussed in Chapter 2, patients are prioritised based on an interpretation by the consultant dermatologist of the clinical information provided by the GP. As also outlined in Chapter 2, a separate clinical pathway exists for suspected melanoma cases. For those with melanoma or non-melanoma skin cancer, early diagnosis, treatment and management is critical with delays potentially impacting on their longer term prognosis. Chapter 3 previously highlighted that given the appropriate prioritisation of patients with potentially life-threatening skin cancer conditions, those with non-cancer skin conditions face longer waiting times, with Irish data indicating waiting times exceeding three years for some patients. Across a 10-year period from January 2015 to January 2025, urgent cases accounted for 68.5% of attended appointments, while non-urgent referrals made up just 13.1%. This suggests that urgent cases are being prioritised and lower-acuity cases are increasingly deprioritised resulting in progressively longer waiting times for access to care. This non-urgent case cohort may therefore benefit most from TD in terms of reductions in overall waiting times.

8.2.3.3.2 Rural access to dermatology services

As reported in Chapter 3, GP attendance in Ireland is frequent with an estimated average of 4.4 visits per person for all presenting conditions. The estimated proportion from Irish data relating to skin conditions ranged from 7.6% to 8.6% of visits. For those with a diagnosed chronic skin condition, frequent visits may be needed over the course of many years or over the course of their lifetime for ongoing management of the condition. Ongoing management of patient symptoms

may be provided though both primary and secondary and or tertiary care services, with combinations of health prevention advice and education, medications (oral, topical and parenteral), psychosocial supports, cryotherapy, phototherapy, and surgical interventions.

For those patients with skin conditions that cannot be initially diagnosed, treated or managed in primary care, consultation with dermatology specialists in secondary and or tertiary care is required. As described in Chapter 2's description of technology, in Ireland patients are currently referred to one of 14 dermatology departments (hub) or 16 peripheral clinics (spoke) for non-melanoma related skin conditions. Suspected melanoma cases are referred to one of 14 National Pigmented Lesion Clinics. These secondary and tertiary care centres are located in more heavily populated urban regions, which may require significant travel to attend for those in more remote rural regions.

For those living in underserved rural areas that are geographically remote from specialist dermatology services, there is an additional economic and time burden associated where attending these centres.[490] This may require absences from work or school, which may discourage attendance due to the time and associated economic burden involved.[475, 476]

8.2.4 Patient communication and adherence with TD

Existing guidelines from the Medical Council of Ireland, the NHS and the British Association of Dermatologists highlight the importance of best practice regarding clear communication of patient options and managing patient expectations in relation to the provision of telemedicine services.[23, 38, 437, 491, 492] This gives patients an informed choice and helps set expectations regarding the TD consultation that can promote better adherence by making clear to patients what clinical and technical prerequisites are needed to ensure a more successful TD consultation. In order to deliver this, they highlight that clinicians should:

- communicate the differences, limitations and risks of telemedicine with respect to FTF consultations
- explain patient rights with assurance of how data protection, privacy and security will be maintained for patient data, images or videos
- seek informed consent from patients to conduct the consultation using telemedicine
- discuss whether patient consultations will or will not be recorded for live video consultations
- ensure timely follow-up and communication of telemedicine consultation decisions made regarding triage, management and treatment back to the appropriate primary care practitioner.[23, 38, 437, 491, 492]

8.3 Ethical issues

Chapter 4 describes the systematic review that was undertaken to assess clinical efficacy, effectiveness, impact on service utilisation, and safety of TD-supported management of primary care referrals compared with traditional direct referral to FTF dermatology. In this section the results of the review are considered from an ethical perspective and specifically the benefit-harm balance of TD compared with FTF consultations.

8.3.1 Benefit and harm balance

The benefit-harm balance of TD for managing dermatology referrals from primary care needs to be established in the context of patients, clinicians and the wider health system. The Health Service Executive (HSE) Model of Care for Dermatology highlights potential benefits of appropriate use of TD.(1) The model identifies that TD is a potential enabler to reduce waiting times and waiting lists, and to provide more equitable access to dermatology care more generally, if implemented appropriately.(1) As was outlined previously in Chapter 2, the description of technology, there has already been successful implementation of TD on a limited scale in Ireland with local implementation of pilot schemes for TD services in Cork University and Roscommon University hospitals.(1, 41, 187) The Cork pilot demonstrated potential benefits related to increasing access to paediatric dermatology care for underserved rural areas.(4, 187) In the Roscommon pigmented lesions clinic, benefits included reductions in waiting times and waiting lists, through referral of up to 25% of cases back to GPs for management.(41)

8.3.1.1 Benefit and harms for individuals

8.3.1.1.1 Reducing travel time and burden for patients

As estimated in Chapter 6, TD would avert the need for FTF specialist dermatology consultation in approximately 50% of referred cases. The need to travel for FTF appointments may force patients or carers to take additional time off work.(475, 476) TD can therefore reduce patients' travel requirements when FTF appointments are averted. TD may also ease the logistical burden on caregivers and parents by removing the need to arrange transportation and accompany family members to appointments.(490) This reduction in logistical burden for patients and carers may have contributed to the lower risk of missed appointments with TD observed in the health utilisation review.

8.3.1.1.2 Increasing access to care through reduced waiting times

As previously described in Chapter 3, the demand and waiting lists for dermatology consultations have increased significantly since 2019. The number of referrals for

dermatology consultations has increased by 55% since 2019, with 99,994 referrals in 2024. In January 2025, 48.3% of patients had been on the dermatology wait list for over six months. The rising trend in referrals to dermatology outpatient departments along with an aging population at greater risk of skin conditions suggests that demand will continue to outstrip available capacity. This increased demand for referral to dermatology services will be in the context of anticipated increases of up to 30% in attendance at GP practices for all health conditions by 2040.[493]

The health utilisation review in Chapter 4 assessed the impact of triaging patients using TD and the associated effect on waiting time related outcomes. The review found that TD may reduce unnecessary FTF appointments and also reduce the time spent waiting for definitive treatment, biopsy and consultations. As discussed in Chapter 2, patients are prioritised based on an assigned urgency basis and their associated need for timely care. For those with melanoma or non-melanoma skin cancer, early diagnosis, treatment and management is critical, with delays potentially impacting on their longer-term prognosis. The appropriate prioritisation of skin cancer conditions puts pressure on capacity for FTF consultations, with a substantial proportion subsequently confirmed to be non-cancer cases. The use of TD with appropriate referral of these cases back to primary care may free up capacity for FTF consultations to be allocated for non-cancer skin conditions. Patients referred with non-cancer skin conditions currently experience waiting times of up to three years for FTF appointments.

A current waiting time of up to three years to get access to diagnosis, treatment or support from dermatologists is likely to further exacerbate already stressed or anxious patients with ongoing chronic skin conditions. Patients with suspicious skin lesions often experience significant psychological distress while awaiting a diagnosis.[494] TD may help reduce the burden of patient anxiety by providing shorter time to assessments and reassurance for cases that can be managed in primary care.

8.3.1.1.3 Health utilisation outcomes of TD compared with FTF care

A primary harm-related concern for patients is that in the absence of a FTF appointment there is a loss of the physical in-person view of the patient.[90, 93, 479] The use of palpation to physically examine skin lesions for example, is a recognised technique used by dermatologists in FTF consultations.[495] Patients may worry that without such physical contact and interaction, there is an increased risk of diagnostic and therapeutic errors, resulting in delays, incorrect treatments and poorer prognosis, particularly in cases that might benefit from physical inspection.[90, 93, 479]

The health utilisation review in Chapter 4 assessed safety outcomes by measuring triage, diagnostic and management concordance between TD and FTF consultations.

The review concluded that there was high triage concordance, substantial to high diagnostic concordance, and high management concordance relating to surgical and biopsy decisions. The review also assessed safety by comparing detection rates for incidental findings, frequency of misdiagnosis, re-referral rates and the clinical impact of incorrect diagnoses. The evidence found from the review did not suggest any major safety concerns related to the use of TD-supported referral management. While the studies documented instances of misdiagnosis, of note, this was typically in the context of a lack of concordance with a single primary diagnosis. In clinical practice, a wider set of potential differential diagnoses may be presented, so that a lack of concordance may not result in a difference in decision making (for example, to proceed with a FTF consultation).

Where there is a lack of diagnostic concordance, the consequences in terms of potential for severe adverse events are greatest in those skin conditions that are considered life-threatening. The review found that diagnostic concordance in melanoma populations was similar when TD was enhanced with the addition of dermatoscopic images, but that a risk of both overdiagnosis and underdiagnosis remain. As was discussed in the health utilisation review, an overly risk-averse application of TD could result in cases being unnecessarily sent for FTF appointments. A subsequent follow-up may then establish that these cases could have been more appropriately triaged and referred back for primary care management, resulting in duplication of clinical effort. In a more risk-averse model, diagnostic concordance may be less important than final management concordance when comparing safety outcomes with TD and FTF consultations. Our review found high management concordance between TD and FTF. Striking a suitable balance as to how risk averse the TD triage process should be is an important decision that could impact on the appropriate management of cases, but could risk overdiagnosis if too risk averse.

The review also assessed the clinical efficacy and safety of TD compared with FTF consultations. Data on clinical course outcomes were limited to six studies with high heterogeneity. Based on these limited data, the review concluded that there is no evidence to suggest a significant difference in clinical course outcomes between patients assessed through TD-supported referral management compared with traditional FTF consultation.

8.3.1.2 Benefit and harms for society

8.3.1.2.1 Reductions in dermatology waiting lists

As outlined in Chapter 6, the use of TD to support management of referrals from primary care can lead to faster triage and a reduction in the proportion of patients requiring FTF appointments. The degree to which this might translate into reductions

in dermatology waiting list times is reliant on the ability to successfully recruit consultant dermatologists to fill the new positions that are required.

8.3.1.2.2 Reducing travel and time burden for carers

As previously discussed, use of TD can lead to a reduction in the proportion of patients requiring FTF appointments as well as a reduction in overall waiting times, thereby benefiting patients. These differences likely also benefit carers of those with chronic skin conditions given reports of a significant impact on them in taking time off for appointments.

8.3.1.2.3 Climate change and carbon emissions

The HSE Climate Action Strategy (2023-2050) outlines Ireland's climate action goals and commitment to sustainable healthcare by reducing travel-related emissions.[496] The strategy outlines seven strategic objectives currently being developed, one of which is the delivery of 'greener models of healthcare'. As part of the delivery of that objective the report specifically highlights the need to 'build awareness and promote use of digital health modalities such as telehealth, remote technology, online therapies and social prescribing where clinically appropriate, and as per the eHealth Strategy'.

As previously described in Chapter 6, the use of TD could lead to an approximate 50% reduction in the proportion of patients requiring FTF appointments. Any reductions in the requirement for FTF appointments would likely come with associated reductions in travel times and costs for both patients and carers.[496] A 2024 New Zealand study (n=484) reported that the use of TD compared with FTF consultations led to a reduction in average travel distances by 48km and the associated carbon dioxide emissions by an average of 11.17kg.[497] TD may have potential to reduce the healthcare sector's carbon footprint, particularly benefiting underserved areas that require longer travel distances to dermatology centres.

8.3.2 Autonomy

8.3.2.1 Supporting patient autonomy

Autonomy refers to an individual's right to make informed and voluntary decisions regarding their healthcare. The provision and use of a TD service could either be mandated based on the decision of treating clinicians alone, or optional based on a shared agreement involving both patients and clinicians. Any decision to provide a mandated service would negatively impact on patient autonomy to choose how they wish to be treated, for example whether or not they will have a FTF appointment. An optional service respects patient autonomy, but risks poor uptake if patients are not persuaded of the benefit and safety for them in using the TD service. Any decision to

use TD consultations with a patient should be based on their informed consent and agreement to do so. The HSE 'National Consent Policy' outlines the process for obtaining and documenting informed consent in all healthcare settings.[498] Consent is a fundamental ethical and legal obligation that ensures respect for patient autonomy. The Medical Council's 'Guide to Professional Conduct and Ethics' states that practitioners should obtain informed consent from patients for telemedicine consultations and subsequent treatments. [499]

Informed consent is also important for individuals that may face additional difficulties in understanding healthcare information, such as those with cognitive impairments, language barriers, or low health literacy. TD as a digital health intervention does not specifically target these groups, but could be used by them or with carers or advocates for them. The Assisted Decision-Making (Capacity) Act 2015 provides a legal framework to support patients with diminished capacity in making healthcare decisions. When necessary, family members or legally-appointed decision makers may be involved while ensuring patient privacy and confidentiality are maintained. [500] Consideration should be given to obtaining informed consent from children aged under 16 years. Shared decision-making could be considered relevant even where children are unable to give a valid consent for themselves, as even young children may have opinions about their healthcare. This principle is in keeping with international standards and ethical guidance which provide that the child's wishes should be taken into account and, as the child grows towards maturity, given more weight accordingly.[498] Some research on TD has specifically excluded vulnerable groups from their research, with one study for example, specifically excluding 'patients with dementia, learning disability, hearing impairment, lesions at sensitive sites or lesions covered with dressings'.[311] This suggests that the applicability of the available research is therefore uncertain for these groups.

Best practice to support patient autonomy is achieved by effective communication that manages patient expectations with respect to the differences and limitations of a TD service compared with a FTF consultation.[437, 491, 492] The NHS in England also highlights the importance of respecting patient preferences, especially regarding the use of photographs for diagnosis and treatment.[23] According to the telemedicine guidance developed by the Medical Council's Telemedicine Working Group, patients must be fully informed about how telemedicine consultations are conducted and how the process may differ from a traditional FTF consultation.[492] Patients should also be made aware of potential limitations, such as the inability to perform a physical examination and the possibility of needing an in-person consultation for further assessment.[1] As will be discussed in section 8.3.3.2, communication should also include what measures are in place to ensure data security and privacy relating to patient data, images or video.

8.3.2.2 Autonomy of healthcare professionals

Existing guidelines state that a patient should expect the same level of care and professional conduct from clinicians in the telemedicine environment as they would for a FTF consultation.[437, 499] Dermatologists may make diagnostic, treatment or management decisions relating to patients in the absence of a direct FTF consultation. Initial management and treatment responsibility for some patients may change and be passed back to referring GPs based on the management guidance communicated by dermatologists. The use of dedicated imaging clinics outside of general practice to take and review images may also constitute a significant change in who is responsible for review and triage of patients. The need for healthcare professionals to share clinical triage and management in a collaborative TD process may influence their satisfaction with the process.

As described in Chapter 4, evidence of provider satisfaction was limited to two studies with the studies variably reporting comparable [26] or consistently lower [481] satisfaction rates with TD compared to FTF consultations. One of the studies also reported provider satisfaction relating to time to time definitive treatment, with the results favouring TD. This may reflect differing opinions of dermatologists regarding the potential impact TD has on their autonomy to make patient triage and management decisions where roles and responsibilities change in a revised TD clinical pathway.

As outlined both in Chapter 2 (description of technology) and Chapter 4 (clinical efficacy, safety and health utilisation), the effectiveness of TD may also be influenced by many different technological factors like image quality, the equipment and environment used to capture the images, and whether the images are accompanied by referral case notes. In the potential absence of a FTF consultation, the autonomy of dermatologists to make accurate clinical assessment may also be more constrained by limits of technological considerations such as image quality in particular. Studies included in the Chapter 4 review that explored the impact of image quality reported a pattern of higher diagnostic concordance with higher image-rated quality. There was limited evidence relating to enhanced store-and-forward methods that also used dermatoscopic images, clinical notes, or live interactive TD, with this evidence suggesting that enhanced store-and-forward methods yield better results than store-and-forward with standard images alone.

8.3.3 Respect for people

8.3.3.1 Religious or cultural issues

According to the HSE's National Healthcare Charter, healthcare services must respect diversity in beliefs, values, and characteristics, such as age, gender, sexual

orientation, faith, and disability, while aligning with clinical decision-making. Digital healthcare should not undermine a patient's moral, religious, or cultural integrity.[501] Patients may have cultural or religious concerns that should be taken into account relating to exposure of skin and related skin conditions. These concerns may be most apparent when digital images are required from parts of the body that may be considered most sensitive.[502] In such cases, the patient may feel more comfortable with a FTF consultation. Based on an informed discussion of the available alternatives, an opt out from teleconsultations may be considered for these patients.

8.3.3.2 Patient privacy and data security

The Irish Medical Council guidelines for telemedicine state that the same standards of care pertain as per face-to-face healthcare, with the aim of ensuring confidentiality, safety, and security of information. TD involves the transmission of dermatological images or live video consultations. Any processing of such data must be done according to current General Data Protection Regulation (GDPR) and the Irish Data Protection Act 2018 legislation to ensure privacy and security of patient data.[503, 504] Patient healthcare data are considered sensitive personal information under GDPR and good practice recommends the conduct of a data privacy impact assessment (DPIA) for all clinicians who will be adopting telemedicine to ensure the necessary data protection safeguards are sufficient and in place.[491, 505]

As was discussed in section 8.3.2.1, patient communication is essential to ensure that patients understand their rights relating to their data and the legitimate purposes for which it can be used or stored. Only then can patients provide informed consent regarding the use of their data relating to photographic, video, or audio recordings.[491] This said, the Medical Council's guide to professional conduct and ethics for registered medical practitioners highlights that while doctors have a professional and ethical duty to protect patient confidentiality, there are specific situations where disclosure may be necessary for patient care, legal obligations, or public interest.[499]

8.3.4 Justice and Equity

8.3.4.1 Prioritisation of cases

Chapter 2 (description of technology) outlines the current clinical pathways for managing dermatology referrals in the Irish healthcare system. Dermatology services have limited capacity and as such, cases are triaged and prioritised based on their severity, urgency and associated need for timely care. In effect, there are two separate clinical referral pathways, one for suspected melanoma cases and one for all non-melanoma dermatology cases. A situation arises where a proportion of

suspected melanoma cases will be prioritised but will be subsequently confirmed as non-melanoma cases. Likewise there will be a proportion of suspected non-melanoma cases that are not prioritised and subsequently confirmed to be melanoma cases, with potential for adverse impact on prognosis caused by delays in diagnosis and treatment. Equity of access to care may be constrained by limited dermatology capacity that does not allow for prioritisation of all cases equally through a single referral pathway. This limited capacity necessitates the prioritisation of suspected melanoma cases above all others to manage increasing demand for dermatology care.

Limited dermatology capacity may also negatively impact on the introduction of a referral pathway that includes TD consultations. The use of TD may change the time that dermatologists spend triaging non-urgent cases including those cases that are referred back to primary care for management. As well as dealing with urgent cases as a priority, the dermatologist will have to make time for providing guidance and management advice for non-urgent referrals that are sent back to primary care without a FTF consultation.

8.3.4.2 Resource impact on the wider health system

This HTA included a review of economic evaluations and a budget impact analysis (BIA) relating to implementation of TD, described in Chapters 5 and 6. This was done with a view to estimating the potential resource impact for the wider health system. As described in those chapters, the implementation of TD would necessitate substantial financial investment in technology, training, and infrastructure, raising questions about opportunity costs and equitable resource allocation. Equity demands that resources are used to maximise benefit for the broader population, not just patients requiring dermatology review, and to avoid exacerbating existing healthcare disparities. The budget impact analysis estimated financial resources required to implement TD over a 10-year budget horizon – introducing TD-supported referral management would cost the HSE approximately €10 million over 10 years, representing a significant financial investment. The review of economic evaluations found international evidence to support that TD reduces costs or is cost effective relative to current care but, due to limitations of evidence quality and differences in health systems, this evidence could not be used to inform the cost effectiveness of TD in the Irish context. The BIA modelling also concluded that TD can positively impact on dermatology waiting lists through reductions in 'did-not-attend' appointments.

8.3.4.3 Cost of treatment for alternative pathways

As was already described in Chapter 3, the HSE has implemented a number of initiatives to provide alternative treatment pathways to address the current waiting

list and waiting times for dermatology consultations. As was described, three schemes allow for sourcing access to care outside of Ireland as part of the Cross-Border Directive (CBD), the Northern Ireland Planned Healthcare Scheme (NIPHS), and the Treatment Abroad Scheme (TAS).

While these schemes may help address issues around timely access to care, they may come with additional costs to the patient that raise questions around both access to and equity of care. Reimbursement of patients using these schemes is limited to the lower cost of either equivalent treatment in Ireland, or the actual treatment cost as provided through the alternative treatment pathway, potentially resulting in out-of-pocket costs for the patient. As highlighted in Chapter 3, between 2019 and 2024, the average additional out-of-pocket treatment cost incurred per patient, calculated from a relatively small sample of data, was €311 for those treated on the CBD scheme, and €393 for those availing of treatment through the NIPHS scheme. Moreover, the data show the average submitted patient cost was €446 and €470, respectively. The combination of both high upfront costs and a shortfall in reimbursement costs may significantly limit equity of access for those who are not in a financial position to bear these costs.

8.3.5 Ethical consequences of HTA

8.3.5.1 Heterogeneity of clinical outcomes for HTA

Assessing the clinical efficacy, effectiveness, impact on service utilisation, and safety of a TD model for Ireland required review of a complex evidence base. The systematic review found significant heterogeneity in terms of models of TD used, health systems implemented, conditions and clinical outcomes assessed. The evidence is based on a large number of primarily store-and-forward studies, a broad range of skin conditions, with a large number of reported outcomes, making interpretation of the effectiveness and safety of TD compared to FTF difficult. Despite those limitations a positive trend overall was found by considering all of the assessed health outcomes collectively, reflecting implementation as part of a broader clinical pathway, rather than assessing each outcome on its own individually.

8.3.5.2 Timing of HTA

The review of healthcare utilisation described in Chapter 4 necessarily applied a cut-off for inclusion of additional new studies that arose during the conduct of the HTA. The evidence base for TD is dynamic and evolving and could change over time. New TD implementations were identified after that cut-off that are currently being rolled out in Scotland for example, but as a new initiative no outcomes data are currently available regarding its use or potential impact.[102] Given the similarity in the

populations and healthcare systems, evidence from the Scottish initiative may be particularly relevant to the Irish context.

8.3.5.3 Data sources and economic model assumptions

A number of the parameters in the economic model were subject to substantial uncertainty. Some of the parameters, such as national rates for 'did-not-attend' dermatology referrals are not known and had to be estimated based on other reported data such as outpatient attendances. Other parameters such as re-referral rates were not available or estimable and as such were not included in the model. Parameters were not available at an individual condition level, so subgroup analysis of how financial impact varies based on different dermatology conditions was not possible.

8.3.5.4 Future impacts of artificial intelligence image interpretation

The clinical pathways in this HTA considered referral and manual review of patient images or video consultations directly by dermatologists. The use of automated AI tools to independently review and diagnostically interpret images has not been considered at this point in time. Any consideration of AI tools in this HTA is on the basis of it complementing clinician judgement with added decision support and guidance rather than replacing it.[506] This area is still developing, but its influence on TD will likely grow as research evolves and tools are more closely integrated as part of clinical workflows.

8.4 Legal issues and governance

8.4.1 Misdiagnosis, delayed diagnosis and liability

In TD, clinical accountabilities are collaboratively shared by a number of parties to the consultation:

- GP – responsible for the quality and accuracy of the case history and associated images provided with a store-and-forward referral.
- Consulting dermatologist – the dermatologist who triages the referred case information deciding on either a FTF consultation (possible live interactive consultation), or referral of case back to the GP with a management plan and no direct FTF consultation.
- TD service and platform provider – the technical platform facilitating the TD consultation, responsible for communications of images or videos along with associated data protection, security and privacy. This may be the HSE using Healthlink for public referrals or it could be a dedicated imaging service where technical infrastructure outside of general practice and secondary and tertiary care is used.

The possibility of misdiagnosis or a delayed diagnosis due to time on waiting lists is already present in the current dermatology referral process and clinical pathways. From a legal perspective, the adoption of a TD referral process with associated clinician liability for misdiagnosis or delayed diagnosis does not change this. The current referral process already involves the sending of relevant case history information via Healthlink to the dermatologist for triage, diagnosis or management. The referral of additional case detail in the form of imaging data in a store-and-forward system only adds to the case information upon which clinical triage, diagnosis and management decisions can be made.

The primary change in a store-and-forward model is that a patient may be referred back to the GP for ongoing management without the need for a FTF dermatology consultation. This change requires mitigation of the risk of misdiagnosis and associated liability, by clearly describing the responsibilities of each clinician with respect to triaging the patient or following the dermatologist's suggested management plan. The risks for the dermatologist may arise where a clinical decision is made based on insufficient referral detail or poor quality images or video. The risk for the GP may be where there is failure to correctly follow the management advice of the dermatologist in the case where no FTF consultation is deemed necessary.

It is possible that any legal risks associated with potential misdiagnosis could be mitigated or reduced through the implementation of TD as part of a broader defined clinical pathway, with appropriate best practice guidance and standards for its use. These should set out the responsibilities of all clinical parties with respect to the TD referral and consultation process and identify patient cases that are not suitable for TD consultations. Examples include skin conditions that do not photograph well due to skin colour, or chronic cases that are not localised and cover multiple body sites making image taking difficult.[437] The availability of clear guidance may reduce legal risks both from a GP and dermatologist perspective by clearing defining criteria and minimum requirements for the delivery of a TD service. An example of such a document is the 'Service Guidance and Standards for the use of Teledermatology' published by the British Association of Dermatologists (BAD).[437]

From a GP perspective, BAD guidance may reduce legal risks by defining the:

- clinical criteria used to identify patient cases that may initially require referral to FTF consultations rather than TD (BAD standard 1: Patient Criteria for TD)
- minimum clinical and dermatological case data that must be sent as part of a referral for TD (BAD standard 3: TD Virtual Review of Patients)

- training and minimum technical, environmental standards and equipment for ensuring sufficient quality imaging or live video consultations (BAD standard 4: Staff, Training, and Education, BAD standard 5: Equipment and Facilities).

From a dermatologist perspective, guidance may reduce legal risks by defining:

- clear guidance on when to reject referrals or request additional patient information from GPs if they do not meet minimum requirements in terms of referral detail or image/video quality (BAD standard 3: TD Virtual Review of Patients)
- minimum requirements to establish clear and timely communication to the referring GP and patient of the triage, diagnostic or management outcome and the basis for it (BAD standard 3: TD Virtual Review of Patients)
- clear and timely communication of advised management plan to the GP and patient, when patients are referred back for management in primary care (BAD standard 3: TD Virtual Review of Patients).

8.4.2 Medical device regulation

The Medical Device Regulation (MDR) (Regulation EU 2017/745) serves as the legislative framework that underpins regulation and approval of medical devices in Europe.[507] Each EU member country appoints a 'competent authority' that is responsible at a national level for implementation of that legislation in that country. The Health Products Regulatory Agency (HPRA) is the competent authority with responsibility in Ireland for the regulation of a wide range of health related areas. This includes use of medicines for humans and animals, use of medical devices for humans, conduct of clinical trials, use of controlled drugs, animal testing in research, and use of blood and blood products.[508]

One objective of the MDR is to enhance patient safety by improving the overall quality, safety, and performance of medical devices.[507] Medical devices are classified by the MDR based on medical device classes with associated level of risks depending on their use (classes I, II, IIa, III). The regulatory requirements for each device class vary depending on its classification. Class I devices are subject to the least regulatory control, while class III devices have the most strict regulatory control and are classified as 'high risk', typically supporting or sustaining human life.[507]

Dermatoscopy devices, used to observe or capture detailed images of skin lesions, fall under the classification of medical devices according to the MDR:

- handheld dermatoscopes are manually operated and interpreted by the dermatologist and considered low-risk and classified as Class I devices.

- digital dermatoscopes, which capture digital images that can be stored and analysed using software that contributes to a diagnosis, are classified as Class IIa devices.
- dermatology software that is used such as TD apps or AI image interpretation apps that provide 'risk scores' or classify/diagnose lesions in any way, are subject to Class IIa regulations.[509]

The systematic review in Chapter 4 found greater diagnostic concordance for store-and-forward was associated with image quality, and the provision of additional dermatoscopic imaging. Any use of such equipment for TD should be restricted to equipment that has given appropriate consideration of the regulatory requirements with respect to the MDR. This is particularly important if there are digital or software elements associated with equipment that may have a diagnostic function. Any possible future use of AI image interpretation software should also be carefully considered on this basis.[506, 509]

8.4.3 Relevant legislation and healthcare governance policies

The following pieces of legislation have already been referred to previously. Their impact should be considered in relation to potential implementation of TD. A summary is provided here for clarity:

- the Assisted Decision-Making (Capacity) Act 2015 provides a legal framework for supporting patients with decision-making impairments [500]
- the Data Protection Act 2018 and EU General Data Protection Regulations define requirements for ensuring appropriate levels of data protection, privacy and security that apply to the storage, sharing and recording of images or video. [503, 504]

In addition to legislative guidance, the following governance policies were also discussed:

- the HSE National Consent Policy outlines the process for obtaining and documenting informed consent in all healthcare settings[498]
- the Medical Council's Guide to Professional Conduct and Ethics for Registered Medical Practitioners reinforces the importance of upholding dignity and respect in all medical interactions, including telehealth services[499]
- the HSE National Records Retention Policy outlining requirements in relation to record storage.[417]

8.5 Discussion

This chapter considered the patient, social, ethical and legal issues that might arise with the use of TD to support referrals from primary care. The primary ethical

concerns regarding use of TD centre on the potential impacts regarding patient and clinician autonomy, ensuring equity of access for those who may have limited access to technology, and the significant financial and technical resources required to implement it and establishing the safety and efficacy of TD as an alternative to FTF consultations.

The importance of respecting patient autonomy through delivery of an optional TD service has been discussed in this chapter. However, the risk of an optional service may be that some patients, who might benefit most from TD consultations, will continue to seek a FTF dermatology appointment. This risks undermining the benefits of a TD programme through minimal reductions of unnecessary FTF appointments with continued impact on waiting times and waiting lists. Deciding how risk averse clinical triage using store-and-forward should be is an important consideration to deliver the most benefit, in order to optimally balance any risks of misdiagnosis or overdiagnosis. These risks are best mitigated through clear clinical criteria to identify patient cohorts that may require immediate referral to FTF consultations rather than TD. Mitigating risk also requires clear communication to patients of the benefits and limitations of TD to enable them to provide informed consent. Best practice guidelines highlight the need for ongoing audit and monitoring of the performance of the TD in reducing waiting times and unnecessary FTF appointments. Such processes can facilitate visibility of benefit and service improvement.

The existing referral process risks harm to patients through poorer prognosis as a result of delayed diagnosis for those waiting longest for dermatology consultations. A new TD referral process also risks harm to patients from potential misdiagnosis using TD. It is not possible, without reference to relevant Irish legal case history, to establish if liability relating to the risk of harm for a TD referral pathway is greater for clinicians and the HSE, than that of the current referral pathway. On balance, however, any liabilities in a new TD pathway should be mitigated with appropriate governance and communication and do not require new legislation to manage.

The benefit and harm balance as described in this chapter, and supported by the health service utilisation, effectiveness and safety review in Chapter 4, favours the introduction of TD with potential benefits for individuals and society that outweigh evidence of potential harms. The BAD guidelines for TD describe three models for the implementation of TD: SAF only, live video in place of FTF consultations, or a combination of SAF and live interactive. The benefits and harms may differ depending on the model of TD used, and the degree to which that model is fully integrated with existing clinical care pathways. Although the overall risks of harm appear to be low, it should be noted that the evidence-base is largely centred on a SAF model of TD. While no major ethical obstacles were identified, should TD be

adopted then it should be in the context of informed consent, clear roles and responsibilities, and appropriate governance.

9 Discussion

This HTA assessed the use of teledermatology to support the management of primary care referrals. The HTA considered the current burden on patients and the healthcare system, clinical effectiveness and safety, impact on healthcare resources, the budget impact, organisational issues, patient and social issues, and ethical/legal considerations.

Teledermatology involves the use of static images or live videoconferencing technology by dermatologists to support the diagnosis, management, or monitoring of skin conditions without the patient being physically present. There are two main types of teledermatology: store and forward, and live-interactive. Many countries have some form of teledermatology in place, but it is typically adapted to the local health system context. Store and forward teledermatology is more commonly used in the context of patient triage and referral management.

Dermatology capacity

There is a substantial unmet need for dermatology services in Ireland. Skin conditions are managed in both primary, and secondary and tertiary care in Ireland. There are approximately 1.6 to 1.8 million skin-related visits each year with a general practitioner (GP). Although most patients are managed in primary care, in 2024 there were almost 100,000 referrals to secondary and tertiary dermatology services. Demand for secondary and tertiary care dermatology services has increased by 55% from 2019 to 2024. Capacity has not kept pace with demand despite increases in workforce; between 2019 and 2024, the number of new patients seen per year increased by 21% at a time when referrals increased by 55%. The referral data presented reflect demand for dermatology services only. As some suspected pigmented lesion referrals are directed to plastic surgery, and these were not quantifiable, the overall demand for specialist assessment is likely underestimated. This implies that management of dermatology capacity requires recognition of plastic surgery resources and demand. Within this context of an ongoing substantial capacity-demand deficit, the proportion of patients being seen within the recommended timeframe is very low for all categories of referral. Only 10% of those triaged as 'urgent' were seen within the HSE waiting list protocol recommended timeframe of 28 days from the date of referral and no patients triaged as 'routine non-urgent' were seen within the recommended 26 weeks from referral, across the 10 years (January 2015 to January 2025). In the same 10-year period, 'urgent' cases accounted for 68.5% of attended appointments, while 'routine non-urgent' referrals made up just 13.1%. A substantial proportion of outpatient capacity is occupied by return visits; between 2019 and 2024, return attendances consistently outnumbered new attendances. In 2024, there were two return

attendances seen for every new attendance, indicating that there were twice as many return patients attending OPD appointments than new patients, despite the increasing referral volume.

While the prioritisation of patients with urgent care needs is clinically appropriate, it is likely that those with chronic conditions, who typically require routine care, are left waiting the longest to be seen. A failure to deliver timely care may be associated with a significant loss of quality of life for these patients, while others may experience significant disease progression during the interval, resulting in more intensive treatment than may otherwise have been required and or a change in their acuity status. There may also be instances where those who were triaged as 'routine non-urgent', and are waiting a significant amount of time to be seen, would actually be considered an 'urgent' referral had more information been available through the referral letter or if the person was immediately seen by a dermatologist. Action is urgently needed in secondary and tertiary care dermatology services to address the imbalance between capacity and demand.

Considering the number of new patient appointments delivered each year and the available workforce, it is estimated that, on average, a consultant dermatologist within the HSE has capacity for approximately 900 new patient appointments each year. Given that a single dermatologist can see approximately 900 new referrals in a year, addressing the backlog of 66,887 referrals (as of June 2025) will clearly require substantial resources. That is without considering the follow-up specialist care that some of those patients will need after their first visit. Assuming that referral rates for new patient dermatology appointments rise in line with population growth and demographic changes, referrals will grow by a predicted 1.7% each year, reaching 120,163 new referrals each year by 2035. Without action, under the current pathway, the waiting list will increase to over 500,000 people after 10 years. Even with the annual recruitment of five whole-time-equivalent consultant dermatologists, under the current pathway given the existing waiting list and predicted referral rates, there will still be almost 400,000 people on the waiting list in 10 years. This is a significant unmet need which must be addressed.

Evidence base

A systematic review was undertaken of the clinical efficacy, effectiveness, impact on service utilisation, and safety of teledermatology-supported management of primary care referrals compared with traditional direct referral to face-to-face dermatology. Most studies evaluated store and forward teledermatology, with limited evidence for LI approaches. The store and forward studies mostly considered images taken in a primary care setting, however, a small number of studies looked at store and forward using images taken at a secondary location, such as an imaging clinic. In a

store and forward teledermatology-supported model for referral management, the dermatologist can use the images to supplement the clinical referral. This may allow them to make a diagnosis and provide advice based on the information provided, removing the need for a face-to-face appointment for patients whose care can continue to be managed in primary care. For other patients, the images may support a triage decision regarding the urgency of the referral or to direct the referral to either another service or, for example, a see-and-treat clinic. In cases of unclear diagnosis or where the dermatologist requires additional tests to confirm the diagnosis, they can refer the patient to a face-to-face appointment. The outcome with the most comprehensive evidence base in the systematic review was diagnostic accuracy. Accurate diagnosis with store and forward is possible in the majority of cases, based on the evidence of concordance between teledermatology and face-to-face consultation. Within the context of the proposed pathway, which would continue to allow patients to be referred to face-to-face appointments where appropriate or in cases where there is diagnostic uncertainty, this suggests that teledermatology could safely be used for referral management. Diagnostic concordance was positively influenced by higher image quality, and more years of teledermatology experience.

A limitation of this review is that HIQA did not identify data on the use of artificial intelligence (AI) to support decision-making in teledermatology. It is likely that AI will be used in this area as technologies develop and in recognition of this, and the need for further evidence in this area, NICE in the UK have recommend the use of AI technology within the context of a teledermatology service to identify and triage non-cancer skin lesions out of the urgent suspected skin cancer pathway.[510] The use is limited to the next three years, and is contingent on its use within the context of evidence generation and receipt of appropriate regulatory approval, including NHS England's Digital Technology Assessment Criteria. AI-supported image review is an emerging field which may impact on the use of teledermatology in dermatology in the future, although at present only human review of images and videos in teledermatology is considered appropriate.

Organisational and resource use considerations

Considering existing pathways and infrastructure in the HSE, the most feasible model to implement teledermatology-supported referral management is store and forward (images captured at GP appointment) with digital review by consultants at the point of triage. This pathway has been modelled in both budget impact and resources implications analyses. In this pathway, consultant dermatologists have the ability to provide advice to the referrer when, based on written referral information and accompanying images, they consider a face-to-face appointment is not clinically required. At its core, teledermatology requires an image to be attached to the

referral. Currently, the HSE's e-referral system, Healthlink, has the ability to facilitate this, however, this functionality would need to be activated consistently across all sites. Aside from capturing the images in primary care, the biggest organisational shift would be ensuring all referrals are done electronically, and that triage of referrals moves from paper-based to electronic. The majority of referrals are managed through the e-referral system; factors for its non-adoption by the minority of individual GPs and or GP practices would need to be considered to identify barriers to its use and enable support, where required, so that individual patients are not disadvantaged. Cameras for GPs and laptops for consultants have been costed in the BIA to facilitate the required steps for TD-supported referral management. Consideration would need to be given to the development of guidance and training to support the implementation of teledermatology, so to improve standardisation and quality across the pathway; this should include support regarding minimum equipment standards and the approach to imaging.

While teledermatology may offer efficiencies within the system, it is not a standalone solution. Substantial additional consultant capacity will still be required given the existing and projected capacity demand deficit, necessitating phased growth supported by increased training capacity, retention measures, and targeted workforce planning. Within store and forward models, image capture can occur via dedicated imaging clinics or in general practice. While imaging clinics may offer standardised images of consistent good quality, they would pose considerable implementation challenges. These include the need for additional infrastructure, trained staff (such as medical photographers), and the coordination of additional patient appointments, all of which would contribute to increased complexity and cost. Requiring patients to attend a separate imaging appointment also increases the risk of non-attendance.

A cost-effectiveness analysis was not undertaken as part of this HTA. Due to a lack of suitable health utility data, and long-term clinical effectiveness data to underpin such an analysis, it was not considered feasible. Although several cost-effectiveness models were identified through a systematic review, they were not considered directly applicable to Ireland due to differences between the Irish healthcare system and the health systems the models were developed for. However, internationally almost all studies reported that teledermatology leads to reduced costs relative to usual care.

A budget-impact analysis for the Irish healthcare system estimated that introducing a teledermatology-supported referral management pathway would cost approximately €10 million over 10 years. Given the existing substantial demand-capacity gap, the analysis assumed the successful addition of five whole-time-equivalent consultant dermatologists each year for both the current care and

teledermatology alternatives. In this context, the likely impact of teledermatology-supported referral management on the significant unmet need in secondary and tertiary care dermatology services was also modelled. It was estimated that a teledermatology pathway would remove more patients off the waiting list over 10 years, and would reduce the need for face-to-face appointments, with the latter achieved through the provision of advice to GPs on the basis of image-supported referrals. Within the 10-year horizon modelled, and with the assumption that the consultant dermatologist workforce would increase by five whole-time-equivalents each year, teledermatology would begin to reduce the waiting list after six years. In contrast, the waiting list would continue to grow with the current model of care even with the same increase in consultant dermatologist numbers, as the increased capacity would still be insufficient to match the growing demand.

It is emphasised that the ability of teledermatology to positively impact upon waiting lists and create efficiencies in dermatology is dependent on the capacity within the system to offer appointments. Without a major increase in the number of consultant dermatologists in Ireland, the demand-capacity gap will continue to expand. As noted, the main analysis of the resource implications model is built on the successful addition of five whole-time-equivalents each year. Considering part-time positions and staff turnover, this would likely mean recruiting more than five consultant dermatologists some years. There are currently 32 dermatology trainees at various stages of their specialist registrar training, with five in their final year. The training programme may need to be expanded or international candidates sought to bridge this gap. Workforce planning would need to be carried out to accurately determine exact numbers of staff required to support dermatology services into the future. The ability to identify and recruit a sufficient number of suitably-trained doctors to fill consultant posts will be a challenge. Recruitment challenges may not affect all locations equally, in which case capacity shortages may continue to affect some hospital departments and or health regions more than others. The primary impact of inequities in capacity is that some patients have to travel further for specialist care. Teledermatology would be beneficial in that context as it lessens the travel burden on referred patients by reducing the number that require face-to-face consultations.

The resource implications model of teledermatology outlines a change to the distribution of time spent by dermatologists on the management of new referrals and new face-to-face appointments. While all referrals will be seen by a dermatologist through teledermatology, in the first years after the introduction of the new pathway, fewer new patients will be seen at face-to-face appointment compared to the current care pathway, although there will be an increase in patient throughput overall. This increase in patients moving through dermatology will also be accompanied by a decrease in average waiting time for patients compared with the current pathway. It is plausible that there will be a shift in triage categorisation

with the addition of images to referral process – some referrals that are currently classified as 'urgent' or 'semi-urgent' based on the referral letter alone might now get classified as 'routine' or be managed without the need for a face-to-face consult. Evidence from the review of effectiveness and safety suggests that triage will be more accurate with teledermatology (using images and a referral letter) compared with usual care (referral letter only).[289] While there would be a shift in distribution of some dermatology interactions away from face-to-face, there is no evidence from the review of clinical effectiveness and safety that this would have an adverse impact on patient safety. Inefficiencies in the referral pathway may contribute to the burden on dermatology clinics, with two Irish single-centre studies suggesting that a substantial proportion of pigmented lesions referrals result in benign diagnoses.[228, 229] Another Irish study also reported that a proportion of referrals received may be unnecessary or could be managed appropriately in primary care.[230] In the context of a limited dermatology workforce, this results in clinic appointments being filled by patients who do not require specialist care, limiting availability for those who do.[247] It is recognised that in the first instance, introduction of teledermatology will likely reduce the capacity for face-to-face appointments given the increased time spent triaging referrals and the time spent providing advice to GPs for patients whose care can be managed in the primary care. However, this would be balanced with more efficient prioritisation of patients and overall shorter waiting times for those referred to secondary and tertiary care dermatology services.

As outlined above, the demand-capacity gap in dermatology affects all patients, but those triaged as 'routine non-urgent' are likely disproportionately impacted, experiencing the longest delays in receiving a face-to-face appointment. Access and equity of dermatology care may improve using teledermatology for those with 'routine' dermatology needs such as those with chronic dermatology conditions, who may currently be waiting longest for dermatology consultations, through faster triage and management of cases referred back to primary care. It may also benefit those living in underserved areas with higher burdens in terms of travel, time, and costs to attend appointments in secondary and or tertiary care dermatology centres. Any legal risks to GPs and dermatologists associated with potential misdiagnosis can be mitigated through the implementation of teledermatology processes that are governed according to best practice standards integrated into clinical pathways. Guidance should be developed based on current best practices that clearly define and communicate GP and dermatologist roles and responsibilities in a collaborative TD triage and management process.

Limitations of the HTA

The aim of this HTA was to evaluate teledermatology to support the management of referrals to secondary and tertiary care dermatology services. The studies identified

as part of the reviews (clinical and safety, and cost effectiveness) mostly evaluated the use of teledermatology as part of a larger pathway – the impact of teledermatology on triage outcomes cannot be separated in these studies. However, there is a significant body of evidence in relation to the use of teledermatology to support the diagnosis and management of dermatology conditions and this is considered applicable to this HTA. Whilst most of the evidence in the systematic review of clinical efficacy, effectiveness, healthcare service utilisation, and safety came from non-randomised comparative studies, including many single centre experiences, it is unlikely that there will be many additional randomised controlled trials (RCTs). This partly relates to the fact that the technology has already been widely adopted in the international setting. Moreover, RCTs are expensive to run and, as there is often no proprietary technology involved, it is unlikely that an RCT would be funded in this area. Therefore, with the exception of the addition of further single-centre studies, the evidence base is unlikely to change over time.

The review of evidence considered a variety of implementations of teledermatology. There was, however, limited evidence in relation to third-party imaging clinics. Coupled with heterogeneity in how those services were integrated into the GP referral process, it was challenging to evaluate how those services affected patient management. It should be acknowledged that the focus of this HTA was on how teledermatology could be adopted within the publicly-funded healthcare system in Ireland. Establishing imaging clinics within that framework would be a departure from how dermatology services have been organised to date, and would require substantial investment in facilities and staffing.

The scope of this HTA was national-level dermatology services. However, it must be noted that there is significant geographic variation in dermatology capacity in Ireland. This geographic variation means that in certain regions, people have to travel large distances to get to a dermatology department. Those patients who have regular appointments in dermatology services, for example those with chronic dermatology conditions, are likely most affected by this. Teledermatology options for follow-up care were outside the remit of this HTA. However, there is the potential that teledermatology, particularly live-interactive, may offer opportunities to reduce the burden on patients who would otherwise be required to attend follow-up appointments at a centre that is potentially a long distance from their home.

The HTA evaluated teledermatology as a means to address long waiting lists in Ireland. However, it did not evaluate other interventions that may also reduce that unmet need. Other initiatives that could be considered include insourcing (funding temporary additional capacity within the public system) and outsourcing (utilising capacity in the private system), or large-scale dermatologist recruitment. Given the

significant unmet need, it is likely that several approaches taken together will be needed to robustly address the shortfall in capacity.

Conclusions

This HTA outlined the significant burden on secondary and tertiary care dermatology services in Ireland, culminating in large waiting lists. This unmet need will continue to increase over time unless some action is taken to increase capacity in the current dermatology pathway in Ireland. Without action, it is predicted that there will be more than 500,000 people on dermatology waiting lists in 10 years. This HTA showed that teledermatology-support management of referrals could help reduce the unmet need in Irish dermatology services, however, other actions will be needed to fully address capacity shortages in this area. More consultant dermatologists are required, in all scenarios, although recruiting suitably qualified doctors is a persistent challenge. As teledermatology can be adopted into current referral-management systems with relative ease, it could potentially be considered the starting point of a suite of actions to target the demand-capacity gap in dermatology services.

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