Health Information and Quality Authority

An tÚdarás Um Fhaisnéis agus Cáilíocht Sláinte

A review of international evidence regarding interventions to address emergency department overcrowding

Work stream 6a of the Review of urgent and emergency healthcare services in the Health Service Executive Mid West health region

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Conflicts of Interest

None reported.

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Background

The HSE Mid West region covers Limerick, Clare and North Tipperary and is called the Mid West in this report. In 2024, the Minister for Health asked HIQA to look at how urgent and emergency healthcare is working in this region. Like other parts of Ireland and many countries, overcrowding in emergency departments (EDs) is a serious issue. It can lead to delays in treatment and put pressure on hospitals.

This report looked at international research on actions to reduce ED overcrowding. We looked for systematic reviews, which are studies that pull together all the available research on a particular topic.

Key findings

We included 84 systematic reviews, covering 887 research studies. Actions we found that could help with ED overcrowding include:

- having an area in the ED for assessing and treating people with mental health concerns
- carrying out a detailed assessment to find out which patients need to be seen soonest
- using telemedicine for assessing and treating patients
- having time-based targets (such as, how long after arriving at the ED should a patient either be kept in overnight or sent home)
- making changes to the services paramedics provide
- supporting older people with congestive heart failure leaving hospital (through telephone follow-up combined with home visits, clinic follow-up, and or video follow-up)
- helping patients plan their healthcare when they are leaving after a hospital stay.

A number of these actions are already in place, in some form, in the Mid West. These include:

- in University Hospital Limerick (UHL) ED:
  - patient experience times (which are time-based targets)
  - advanced nurse practitioners to assess patients with less serious injuries.
- in UHL:
  - a telemedicine programme, called the National Virtual Ward Programme, which is helping patients return home from hospital sooner
  - bed managers and discharge coordinators to help patients move through, and leave the ED.
- in the Mid West:

- the Pathfinder Programme and the Alternative Pre-Hospital Pathway Car programme, which care for patients with less severe health issues in the community
- the ED in the Home service, which provides emergency medical and occupational therapy to adults aged 65 years and older in their home.

Conclusion

- Overall, we found many possible actions to reduce ED overcrowding. It is likely that, depending on local and regional circumstances, a number of actions will be required to reduce ED overcrowding in any hospital. If any of the actions found are going to help reduce ED overcrowding in the Mid West, it is important to remember the local situation and what is already being done. Any new action needs to be workable in the Mid West.

Key Points

- In 2024, the Minister for Health requested HIQA to conduct a review of urgent and emergency care in Ireland's HSE Mid West health region with the primary objective of ensuring safe quality acute care in the region. As a part of this overall review, HIQA agreed to review the international evidence to provide an evidence-based rationale to inform the potential future configuration of comparable urgent and emergency healthcare services. This review aimed to explore the evidence on the effectiveness and safety of interventions to address emergency department (ED) overcrowding.
- In 2023, Canada's Drug Agency (CDA-AMC) published a comprehensive series of reports on ED overcrowding. This included a summary of systematic review evidence on the effectiveness of different interventions to alleviate ED overcrowding, with the interventions categorised according to whether they were implemented inside the ED (relating to input, throughput or output), outside of the ED (post-hospital discharge case management; hospital-wide collaboration with ED; policy reform) or were multicomponent interventions. An update of this summary of systematic reviews was undertaken to build on this substantial existing evidence base.
- A total of 84 systematic reviews (containing 887 unique, relevant primary studies) met the inclusion criteria for the combined original and updated summary of systematic reviews. The interventions included from these reviews were assigned into the following CDA-AMC categories:
  - ED throughput (for example, accelerated diagnostic protocols), identified in 56 systematic reviews
  - ED input (for example, GP use in non-critical emergency medical services), identified in 21 systematic reviews
  - post-hospital discharge case management (for example, telephone delivery of post-discharge contact) in 15 systematic reviews
  - multicomponent interventions, in nine systematic reviews
  - policy reform (for example, time-based targets) in five systematic reviews
  - ED output (for example, discharge planning) in four systematic reviews
  - hospital-wide collaboration with the ED interventions (for example, process improvement teams) in two systematic reviews.

- Evidence for each identified intervention and outcome was assessed to determine the effect (favourable, neutral, mixed or unfavourable) on a variety of outcomes and the certainty of the evidence (conclusive or inconclusive).
- The following types of interventions were found to demonstrate a favourable effect on specific ED overcrowding-related outcomes:
  - a short-stay, hospital-based, crisis unit for mental health on ED LOS, ED-related wait times, ED boarding, and patient safety
  - advanced triage protocols, on ED LOS and patient satisfaction
  - telemedicine for triage and patient care in the ED, on ED LOS, patient satisfaction and treatment time
  - time-based targets, such as the number of hours after arriving at the ED within which a patient should be admitted or discharged, on ED LOS and the number of patients who left the ED prematurely
  - enhanced paramedic or emergency care practitioner services, on ED-related wait times, admissions or transfers to the ED and patient satisfaction
  - transitional care interventions (which consisted of telephone follow-up combined with home visits, clinic follow-up, and or video follow-up) aimed at supporting older adults with congestive heart failure following hospital inpatient discharge, on ED readmissions and visits
  - care coordination strategies, which were defined as 'the deliberate organisation of patient care activities between two or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of health care services', on the proportion of older adults who visited the ED
  - discharge planning and coordination of services on the number of ED return visits.
- Interventions that demonstrated a neutral effect on ED overcrowding-related outcomes included post-hospital discharge case management (with elements of telemedicine) in an adult population on the number of subsequent ED visits or patient satisfaction, rapid viral testing on ED LOS and nurse-initiated X-rays on ED-related wait times and ED return visits.
- No intervention with evidence of an unfavourable effect was identified in the current update or in the CDA-AMC summary of systematic reviews.
- When considering the applicability of the interventions identified, a number of these are currently implemented in some form in the Mid West, including:

- in University Hospital Limerick (UHL) ED, the use of:
  - patient experience times (which are time-based targets)
  - advanced nurse practitioners to triage patients presenting with minor injuries.
- in UHL:
  - a telemedicine initiative, the National Virtual Ward Programme, which is supporting patients who would otherwise be in hospital to get home sooner
  - processes involving bed managers and discharge coordinators to support patient flow and discharge, as well as a dedicated liaison person to support and coordinate discharge for patients with social complexities.
- in the wider Mid West health region:
  - initiatives such as the Pathfinder Programme and the Alternative Pre-Hospital Pathway Car programme, which aim to provide care to low-acuity patients in the community, thereby acting as an alternative to attending the ED
  - the ED in the Home (EDITH) frailty response service to provide emergency medical and occupational therapy to adults aged 65 years and older in their own home.

- Overall, a broad range of interventions were identified in this review. This may be reflective of the heterogeneous causes of ED overcrowding. It is likely that a range of actions, taking into account specific local and regional circumstances, may be needed when trying to alleviate ED overcrowding in any given hospital.
- The majority of systematic reviews included interventions, which were categorised as ED throughput (56 of the 84 systematic reviews included in total). However, a 2024 guidance document published by the UK's Royal College of Emergency Medicine highlighted that while improving ED throughput is important, there will be limited effects overall if there is still an issue with flow of patients out of the ED.
- If consideration is given to the use of any of the interventions outlined, as a means to alleviate ED overcrowding in the Mid West, implementation would need to take account of the specific regional circumstances, including the initiatives already in place. Specifically, a decision to introduce any of these complex interventions, which were found to be effective in one setting, must

consider whether they will also be acceptable, implementable, cost effective, scalable and or transferable to the Irish context.

List of abbreviations used in this report

AMSTAR 2	A MeaSurement Tool to Assess systematic Reviews 2
AMU	Acute Medical Unit
CDA-AMC	Canada's Drug Agency (L'Agence des médicaments du Canada)
CADTH	Canadian Agency for Drugs and Technologies in Health
ED	Emergency Department
EMS	Emergency Medical Services
GRADE	Grading of Recommendations, Assessment, Development and Evaluations system
HIQA	Health Information and Quality Authority
HSE	Health Service Executive (Ireland)
LOS	Length of Stay
LWBS	Left Without Being Seen
NRS	Non-Randomised Study
PCM	Pharmacist Case Manager
PICOS	Population, Intervention, Comparator, Outcome and Study Design
PRIOR	Preferred Reporting Items for Overviews of Reviews
RCT	Randomised Controlled Trial
TCI	Transitional Care Interventions
UHL	University Hospital Limerick

1 Background

In May 2024, the Minister for Health requested that the Health Information and Quality Authority (HIQA) conduct a review of urgent and emergency care in the Health Service Executive (HSE) Mid West health region with the primary objective of ensuring safe, quality acute care in the region. The Terms of Reference for the conduct of the HIQA review (linked here) state that current relevant national and international evidence will be reviewed to ensure an evidence-based rationale to inform the potential future configuration of comparable urgent and emergency healthcare services.[1] The evidence-synthesis approach to deliver on this term of reference is outlined in the *Protocol for the evidence synthesis to inform the review of urgent and emergency healthcare services in the Health Service Executive Mid West region of Ireland.* For clarity, within this review the term 'Mid West' specifically refers to the HSE Mid West health region. The Mid West is distinct from the Mid West Region of Ireland which covers the geographical area of counties Limerick, Clare and Tipperary.

This report reviews international evidence regarding interventions to address emergency department (ED) overcrowding. National public bodies and policy-makers across a number of countries have outlined challenges with managing capacity demand deficits in emergency services, and have explored interventions to address ED overcrowding. For example, across the 2019 to 2022 period in France, reports commissioned by the Ministry of Health and Prevention[2] and the Senate[3] provided recommendations to support the rebuilding and relieving of pressure on emergency healthcare services. In 2023, the National Health Service England published a *Delivery plan for recovering urgent and emergency care services*.[4] This was followed in 2024 with the publication of updated guidance on *The Management of Emergency Department Crowding* by the UK's Royal College of Emergency Medicine Service Design and Configuration Committee.[5] In January 2025, the Scottish Government published the findings of the evaluation of the Redesign of Urgent Care pathway,[6-8] a pathway which aims to improve the way members of the public access urgent and unscheduled care in non-life-threatening situations.

In the last five years, a number of evidence syntheses have been published summarising the impact of interventions in addressing ED overcrowding.[9-12] For example, in 2020, an overview of 15 systematic reviews identified a range of interventions for which there was evidence that they were effective in reducing ED overcrowding.[9] These interventions were: use of a physician and or nurse to perform and supervise triage and flow of patients; strengthening the care team through the use of nurse practitioners; implementation of new areas for caring for patients with acute non-critical conditions or areas to medicate and observe patients

before assessing severity; and the use of Lean methodology and full capacity protocols.[9] The authors identified concerns, however, with both the quantity and quality of the evidence underpinning these systematic reviews and the quality of the systematic reviews themselves. In 2024, a scoping review, which included 48 different evidence reviews, investigated the effectiveness of 10 (pre-specified) high-impact initiatives for improving urgent and emergency care services, primarily in terms of ED wait times and ambulance response times.[11] Results suggested that some initiatives, such as same-day emergency care, acute frailty services, care transfer hubs with multidisciplinary teams and telestroke services may effectively reduce ED wait times or ED length of stay (LOS). However, the impact of inpatient flow interventions on this outcome was generally inconclusive, with some studies reporting reductions in ED wait times and or ambulance response times, and others showing no difference or even an increase.

In Ireland, in 2023, an evidence summary was produced by the HSE Library addressing the question *"What strategies or interventions are effective in reducing the impact of seasonal/temporal surge in demand for unscheduled or urgent care in emergency departments or other acute hospital services?"*[13] This summary identified that there is no single intervention or explicit series of interventions to resolve the problem of seasonal or temporal surges in demand for emergency services within a multi-scalar health architecture.[13] This evidence summary indicated that a broad spectrum of potential incremental contributors are required for an overall amelioration of the problem.[13]

This review aims to build on the substantial existing evidence base currently available, through exploring the effectiveness and safety of interventions to address ED overcrowding.

2 Topic scoping

During initial topic scoping, a number of published evidence syntheses that brought together the findings of systematic reviews on interventions to address ED overcrowding were identified. This included overviews of systematic reviews, such as *Interventions in overcrowding of emergency departments: an overview of systematic reviews*,[9] umbrella reviews such as *Patient flow in emergency departments: a comprehensive umbrella review of solutions and challenges across the health system*[14] and or summaries of reviews such as *Emergency Department Overcrowding: An Environmental Scan of Contributing Factors and a Summary of Systematic Review Evidence on Interventions*.[15]

To ensure all recent, relevant overviews, umbrella reviews and or summaries of reviews were identified during topic scoping, a search for literature published from

January 2022 to January 2025 was conducted in PubMed (see Appendix 1). The international HTA database (https://database.inahta.org/) was also searched to identify any relevant published or ongoing work by international HTA agencies.

Evidence syntheses identified were then reviewed and deemed relevant if two reviewers agreed that they self-identified in their title, abstract or executive summary as being an overview of reviews, umbrella review, or summary of reviews, and if they were broadly focused on interventions to address ED overcrowding. Evidence syntheses deemed relevant are outlined in Appendix 2.

During scoping, the summary of systematic reviews published by the CDA-AMC, *Emergency Department Overcrowding: An Environmental Scan of Contributing Factors and a Summary of Systematic Review Evidence on Interventions*,[15-18] was reviewed and found to have conducted the most recent search for included evidence syntheses. The initial literature search was conducted on 27 March 2023, with database updates and supplemental searches up until 23 June 2023. Literature published since 01 January 2013 was included. The summary of systematic reviews was also deemed to be focused on interventions to address ED overcrowding. While a formal quality appraisal of the CDA-AMC summary was not conducted, given the comprehensive nature, relevance, timing, and applicability of the summary, and in light of the time constraints for this project, a targeted update of the CDA-AMC summary of systematic reviews was the adopted approach.

3 Methods

The methods used within this review reflect the methodology used within the CDA-AMC summary of systematic reviews. Any notable deviations are noted in Appendix 3. This review is reported in accordance with the Preferred Reporting Items for Overviews of Reviews (PRIOR) guidelines, where appropriate (Appendix 4).[19]

3.1 Research question

The following research question was addressed by this review:

- *In the general population who access ED services, what is the effectiveness and safety of interventions to address ED overcrowding compared with usual or standard care, another intervention or no intervention?*

The population, intervention, comparators, outcomes and study designs (PICOS) for this review, as well as the language and publication time-frame of articles eligible for inclusion, are outlined in Table 3.1.

Table 3.1 Population, intervention, comparators, outcomes, study designs (PICOS) language and time frame of articles eligible for inclusion

Population	The general population.
Intervention	Any intervention, implemented in any setting, intended to address ED overcrowding.
Comparators	Any comparator (including no intervention, usual or standard care, and or another intervention). *Excluded:* No comparator.
Outcomes	Effectiveness: ▪ Boarding and or access block outcomes (that is, outcomes related to patients who have been admitted but are waiting for an inpatient bed) ▪ ED length of stay ▪ ED occupancy (that is, ratio of registered ED patients to available care spaces) ▪ ED-related wait times (for example, time before seeing a healthcare professional, time from triage to care space, time to diagnosis, time from consultation to disposition, ambulance offload time, ED offload delay) ▪ Healthcare provider capacity (for example, provider burnout, workload, staffing insufficiencies) ▪ Mortality within the ED ▪ Number and or proportion of ED visits (including return visits to the ED, recurrent revisits, and return visits to the ED requiring admission) ▪ Number and or proportion of patients in the ED waiting room ▪ Number and or proportion of patients who left the ED prematurely (for example, left without being seen, left against medical advice) ▪ Patient satisfaction. Safety: ▪ Patient safety outcomes (for example, harms, adverse events).

Study designs	*Included:* ▪ Systematic reviews that included randomised controlled trials, non-randomised trials of interventions and or comparative observational studies.* *Excluded:* ▪ Overviews of reviews ▪ Scoping reviews ▪ Integrative reviews ▪ Narrative reviews ▪ Systematic reviews that include only study designs that are not randomised controlled trials, non-randomised trials of interventions and or comparative observational studies ▪ Systematic reviews that only include case series, simulation studies, mathematical modelling approaches and or theoretical studies ▪ Clinical practice guidelines ▪ Cost-effectiveness studies ▪ Primary studies ▪ Protocols and trial registry entries ▪ Editorials, letters and commentaries ▪ Conference abstracts and presentations.
Language	Articles available in the English language.
Time frame	Articles published between March 2023 and the final search date (27 February 2025) (as the initial Cochrane Canada search was performed in March 2023).

Key: ED = emergency department.
*If a systematic review includes primary studies with both eligible and ineligible designs, the systematic review is eligible for inclusion only if results from eligible study designs are reported and or can be extracted separately.

For the purposes of this update, a study was identified as a 'systematic review' if it explicitly reported or included all of the following:

- a research question
- sources that were searched, with a reproducible search strategy (to include naming of databases, naming of search platforms and or engines, search date and complete search strategy)

- inclusion and exclusion criteria
- study selection methods
- critical appraisal and reporting of the quality and or risk of bias of the included studies
- information about data analysis and synthesis that allows the reproducibility of the results.[20]

3.2 Search strategy to identify additional relevant systematic reviews

A targeted search was undertaken to identify any additional relevant systematic reviews that had been published since the initial search date stated in the CDA-AMC summary of systematic reviews (March 2023).[15-18]

A literature search was conducted in MEDLINE and Embase (both via Ovid), CINAHL (via Ebscohost) and the Cochrane Database of Systematic Reviews. The search strategies for each database are presented in Appendix 5, and largely reflect those used in the summary of systematic reviews carried out by the CDA-AMC.[17] Grey literature sources were also searched, as outlined in Appendix 6. Reference lists from all included systematic reviews were searched for potentially relevant citations. Forward citation searching of included reviews was undertaken, with searches limited to systematic reviews.

3.3 Study selection and data extraction

Citations for records returned from all searches were imported to Endnote and duplicates were removed. The remaining records were uploaded to Covidence for screening. For both title and abstract, and full-text screening, all documents were screened against the eligibility criteria (Table 3.1) by two reviewers independently. Disagreements were resolved by discussion, or with the involvement of a third reviewer, if required.

Following this, similar to the methods undertaken by the CDA-AMC, additional screening criteria were applied to included documents to narrow the scope. Documents needed to meet the following criteria for inclusion in the final dataset:

1. Focus on ED overcrowding (for example, clearly state that the systematic review was addressing ED overcrowding or that interventions were aimed at alleviating ED overcrowding)
2. Use satisfactory methods for assessing and reporting risk of bias; specifically, methods that assessed allocation concealment and blinding for randomised controlled trials (RCTs) and confounding and selection bias for non-

randomised studies (NRSs) (as in, fulfilled AMSTAR 2 item #9 [see Section 3.5]), and
3. Report numerical findings for the outcomes of interest in the majority of relevant primary studies.

An electronic data extraction template was developed (see Appendix 7), the contents of which were based on the data items extracted by the authors of the CDA-AMC summary of systematic reviews.[15, 17] Data extraction was completed by one reviewer and checked by a second reviewer. Disagreements were resolved by discussion, or with the involvement of a third reviewer, if required.

3.4 Overlap

Overlap of primary studies, both within the systematic reviews included within this update and those included in the CDA-AMC summary, was identified and reported (see Section 4.1.3).

3.5 Appraisal of included systematic reviews

All included systematic reviews were assessed by two reviewers independently using A MeaSurement Tool to Assess Systematic Reviews (AMSTAR 2).[21] Disagreements were resolved by discussion or a third reviewer, if necessary. AMSTAR 2 comprises 16 items covering domains that can affect the validity of a systematic review, such as the risk of bias from individual studies included in the review, the impact of publication bias, the literature search strategy and the appropriateness of meta-analytical methods. Each item is coded as 'yes' or 'no' or, for some items, 'partial yes'. An overall rating of the confidence in the results of each included review ('High', 'Moderate', 'Low' or 'Critically low') was applied according to the approach outlined by Shea et al.[21] (see Section 4.1.4).

3.6 Intervention effectiveness

Based on the methodology used by the CDA-AMC summary of reviews, interventions were identified as having evidence (conclusive or inconclusive) of effect (favourable, neutral, mixed or unfavourable effect) using a four-step process (see Appendix 8):

1. The direction of the effects was identified (as reported by the systematic review authors[1] in the discussion and or conclusion) — whether the findings were favourable (effect in favour of the intervention), neutral (neither intervention nor comparator was favoured), unfavourable (effect in favour of the comparator), or mixed (evidence for both directions of effect).

2. The certainty of the evidence was ascertained — data on assessments of the certainty of evidence were extracted from the included systematic reviews. Where reported by the authors, data items extracted included the assessment approach used (for example, the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) approach[(22)]) and the overall assessment of the certainty of evidence for each relevant comparison and outcome. Where the certainty of evidence was not reported by the authors, and keeping with the approach described in the CDA-AMC summary of systematic reviews,[(15)] we informally considered aspects that can affect the certainty of evidence (as reported in the included systematic reviews) and assigned each intervention with a level of certainty: certain, some uncertainty, or very uncertain. The level of certainty was assigned considering factors including the risk of bias of the included studies, inconsistency of results, imprecision, and dissemination bias. Where results of an intervention were based solely on non-randomised primary studies, the baseline was set at 'some uncertainty', due to concerns of selection bias and confounding. The applicability of the evidence to the Irish context was not considered in assigning the level of certainty, but was considered and discussed when interpreting the evidence.

3. Based on the results of Steps 1 and 2, an intervention was then categorised to one of eight effectiveness categories (Favourable; Favourable inconclusive; Neutral; Neutral inconclusive; Mixed inconclusive; Unfavourable; Unfavourable inconclusive; No evidence). At this stage, interventions assigned as certain or some uncertainty in Step 2 were deemed to have conclusive evidence, and interventions assigned as very uncertain in Step 2 were deemed to have inconclusive evidence.

[1]The conclusions of the systematic review authors may consider the direction of effect for primary studies not relevant to this update (for example, a primary study that does not meet the inclusion criteria). Where this occurs it will be noted.

4. The AMSTAR 2 appraisal of the systematic review (see Section 3.5) was considered alongside the effectiveness category, and an overall effectiveness was assigned. Here, if we deemed the methodological quality of the systematic review to be low or critically low, the overall intervention effectiveness was then deemed to have inconclusive evidence. If we deemed the methodological quality of the systematic review to be moderate to high, but the certainty of evidence in Step 2 was assigned as very uncertain, the overall intervention effectiveness remained as inconclusive evidence.

3.7 Synthesis approach

The findings were synthesised narratively. In line with the CDA-AMC summary of reviews,[15] the interventions found in the literature were categorised according to an adaptation of the conceptual model developed by Asplin et al.[23] (see Table 3.2). Characteristics of the included systematic reviews are presented in Section 4.1. To focus on the totality of the evidence for interventions with evidence of favourable effect, neutral effect, and unfavourable effect, results from the current update are combined with summary information from the CDA-AMC summary of systematic reviews (see Section 4.2). A summary of other evidence identified in the current update is provided in Section 4.3.

The overall findings are then discussed in relation to urgent and emergency care in the Mid West (see Section 5.2).

Table 3.2 Categorisation of findings on the effectiveness of interventions (as reproduced from Canada's Drug Agency summary of systematic reviews†)

	Category	Description
ED	**Input**	Interventions related to how people make contact with the ED
	Throughput	Interventions within the ED
	Output	Interventions related to leaving the ED
Outside the ED	**Hospital-wide collaboration with ED**	Collaboration in the provision of physical resources, staff, or leadership across the hospital to support the ED
	Post-hospital* discharge case management	Helping people manage their health after they leave hospital*
	Policy reform	Policies for performance metrics (for example, time-based targets), payment models, and staff mix
	Multicomponent	Two or more interventions from any of the previous categories combined

Key: ED = emergency department. *Adapted from the CDA-AMC to include discharge from the wider hospital and ED. †CDA-AMC summary of systematic reviews[15]

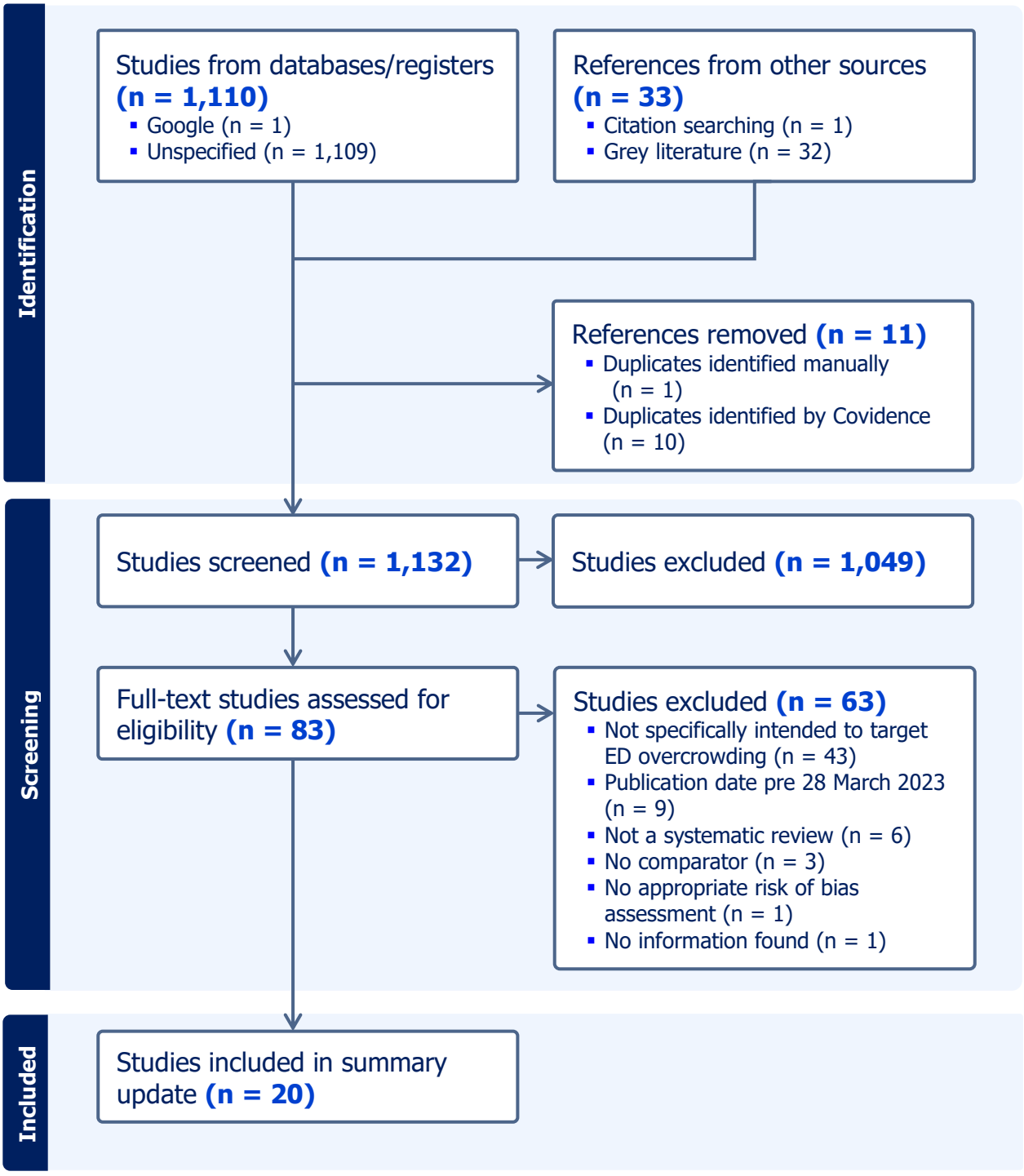
4 Findings

4.1 Systematic reviews identified

4.1.1 Search results

The collective search up until 27 February 2025 resulted in 1,143 citations. Following removal of duplicates, 1,132 citations were screened for relevance, with 83 full texts assessed for eligibility and 20 subsequently included. See Figure 4.1 for a PRIOR flow diagram of the systematic reviews included in this summary update. Reasons for exclusion following full-text review were documented and summarised (see Appendix 9).

Figure 4.1. PRIOR flow diagram.



4.1.2 Characteristics of included systematic reviews

A total of 20 systematic reviews, which included 76 different interventions, met the inclusion criteria and were included in this update. The interventions included from the systematic reviews were assigned into the CDA-AMC categories as follows (see Table 3.2):

- ED throughput, 27 interventions identified in 13 systematic reviews[24-36]
- post-hospital discharge case management, 34 interventions in five systematic reviews[24, 29, 37-39]
- ED input, 14 interventions identified in five systematic reviews[33, 40-43]
- hospital-wide collaboration with the ED, one intervention in one systematic review.[33]

No systematic reviews included relevant evidence for interventions that could be categorised as output, policy reform, or multicomponent interventions.

In terms of the broad focus areas of the interventions looked at within the systematic reviews:

- five focused on the use of specific healthcare professionals[32, 34, 37, 41, 43] (such as allied health practitioners in the ED[34] or community[43])
- four included studies on a range of interventions for addressing ED overcrowding[25, 29, 33, 36]
- three focused on the use of units within or outside the ED,[27, 28, 40] (such as rapid-access chest-pain clinics[40])
- two focused on post-hospital discharge[38, 39] (such as post-hospital discharge contact[38])
- two focused on the use of diagnostics or diagnostic protocols in the ED[26, 31] (such as rapid molecular diagnostic tests[31])
- two focused on the use of telemedicine[24, 42]
- one systematic review each focused on triage implementation in the ED,[30] and early initiation of palliative care in the ED.[35]

The included, relevant evidence was based on RCTs as well as non-randomised studies (including: pre and post studies, prospective cohort studies, retrospective cohort studies, and non-randomised trials). Outcome measures identified included:

- ED LOS, in 11 systematic reviews[24-26, 28, 29, 31-33, 35, 36]
- ED visits, in eight systematic reviews[25, 27, 29, 37-39, 42, 43]
- patient satisfaction, in eight systematic reviews[29, 30, 38, 39, 42, 43]
- ED re-attendance, in four systematic reviews[25, 29, 38, 39, 42, 43]
- patients who leave without being seen, in three systematic reviews[30, 33, 36]

- other ED-related wait times (such as time to treatment and time to triage[24]) in five systematic reviews[24, 30, 32, 34, 36]
- ED referrals;[27, 37] early ED discharge;[40] ED non-conveyance;[41] ED mortality;[30] ambulance diversions;[33] and adverse events,[43] each in one systematic review.

The evidence included was reported for the following age groups:

- adults, in 14 systematic reviews[24, 26-29, 31, 32, 34, 35, 37-40, 42]
- both adults and paediatrics, in three systematic reviews[30, 36, 43]
- paediatrics only, in one systematic review.[25]

Age groups were not reported in two systematic reviews.[33, 41]

The evidence included was collected from the following countries:

- Australia, in 11 systematic reviews[25, 26, 28, 29, 31, 32, 34, 36, 39, 42, 43]
- US, in 11 systematic reviews[24, 26, 28, 29, 31, 33, 36-39, 43]
- Canada, in 10 systematic reviews[25, 26, 28, 29, 31, 32, 36, 39, 42, 43]
- UK, in nine systematic reviews[26, 29, 31, 32, 34, 36, 41, 43]
- Sweden, in five systematic reviews[26, 29, 31, 41, 43]
- Denmark, in four systematic reviews[29, 38, 39, 43]
- China,[30, 32, 39] Switzerland[26, 29, 38] and the Netherlands,[29, 31, 43] each in three systematic reviews
- Belgium;[26, 29] France;[31, 36] New Zealand;[26, 38] Norway;[41, 43] South Africa;[30, 36] Spain;[29, 36] Taiwan;[29, 39] and Thailand,[26, 36] each in two systematic reviews
- Botswana;[30] Brazil;[24] Egypt;[30] Finland;[43] Germany;[24] Hong Kong;[43] India;[30] Iran;[30] Italy;[38] Malta;[32] Mozambique;[30] Oman;[39] Portugal;[29] Singapore;[29] Tunisia;[24] Turkey[36] and Uganda,[30] each in one systematic review.
- The country in which interventions were implemented was not reported in three systematic reviews.[27, 35, 40]

Detailed findings for each included systematic review can be found, displayed by intervention category (ED input, ED throughput and so on), in Appendix 10.

4.1.3 Overlap

A total of 266 relevant primary studies were included in the 20 systematic reviews. Of these primary studies, one study[44] was included in two systematic reviews[37, 39] (as in, overlapped), resulting in 265 unique, relevant primary studies. Forty-five of the 265 unique, relevant primary studies in the 20 systematic reviews (17%) were included in the 667 unique primary studies outlined in the CDA-AMC summary of

reviews (7% overlap) (see Appendix 11). When combined, the totality of evidence from this update and the CDA-AMC summary of reviews therefore included 887 unique primary studies.

4.1.4 Appraisal of included systematic reviews

AMSTAR 2 results are presented in Table 4.1 below. We did not have high confidence in the results of any of the included systematic reviews. We had moderate confidence in the results of five (25%)[24, 32, 37, 38, 40] of the 20 included systematic reviews, and low or critically low confidence in the results of nine (45%) [25-28, 30, 34-36, 43] and six (30%) [29, 31, 33, 39, 41, 42] of the included systematic reviews, respectively.

Table 4.1 AMSTAR 2 ratings for each included systematic review

	AMSTAR 2 Item Number																
Reference (Year)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**Overall Confidence**
Ahmed *et al.*[24] (2024)	Y	O	N	O	Y	Y	N	Y	Y	N	No MA	No MA	Y	Y	No MA	Y	Moderate
Bai *et al.*[37] (2025)	Y	Y	N	O	Y	Y	N	Y	Y	N	Y	Y	Y	Y	Y	Y	Moderate
Black *et al.*[40] (2024)	Y	Y	Y	O	Y	N	N	O	Y	N	No MA	No MA	Y	Y	No MA	Y	Moderate
Boggan *et al.*[38] (2025)	Y	Y	Y	O	Y	N	N	Y	Y	N	Y	N	Y	Y	Y	Y	Moderate
Burrell *et al.*[41] (2023)	Y	Y	Y	N	Y	Y	N	O	Y	N	No MA	No MA	N	N	No MA	Y	Critically low
Chartrand *et al.*[39] (2023)	Y	Y	N	N	Y	Y	Y	O	Y	N	Y	N	N	Y	N	Y	Critically low
Dick *et al.*[25] (2024)	Y	Y	N	N	Y	N	N	Y	Y	N	No MA	No MA	Y	Y	No MA	Y	Low
Hill *et al.*[26] (2024)	Y	Y	N	O	Y	Y	Y	O	Y	N	Y	N	Y	Y	N	Y	Low
Huber *et al.*[27] (2024)	Y	Y	Y	O	Y	Y	N	O	O	N	No MA	No MA	N	Y	No MA	Y	Low
Kim *et al.*[42] (2023)	Y	Y	N	O	Y	N	N	Y	Y	N	N	Y	Y	Y	N	Y	Critically low
Magarey *et al.*[28] (2023)	Y	Y	Y	N	Y	N	N	Y	Y	N	No MA	No MA	Y	Y	No MA	Y	Low
Memedovich *et al.*[29] (2023)	Y	O	N	N	Y	N	N	Y	Y	Y	No MA	No MA	N	Y	No MA	Y	Critically low
Mitchell *et al.*[30] (2024)	Y	Y	Y	N	Y	Y	Y	O	Y	N	No MA	No MA	Y	Y	No MA	Y	Low
Mojebi *et al.*[31] (2024)	Y	O	N	N	N	N	N	Y	Y	N	No MA	No MA	N	Y	No MA	Y	Critically low
Rolving *et al.*[32] (2025)	Y	Y	N	O	Y	Y	N	O	Y	N	No MA	No MA	Y	Y	No MA	Y	Moderate
Shahabian *et al.*[33] (2024)	Y	O	N	N	Y	Y	N	O	Y	N	No MA	No MA	N	N	No MA	Y	Critically low
Tian *et al.*[43] (2024)	Y	Y	Y	N	Y	N	N	Y	Y	N	No MA	No MA	Y	Y	No MA	Y	Low
Vella *et al.*[34] (2024)	Y	Y	Y	O	Y	N	N	Y	Y	N	Y	Y	Y	Y	N	Y	Low
Wong and Teoh[35] (2024)	Y	O	N	N	N	N	N	O	Y	N	No MA	No MA	Y	N	No MA	Y	Low
Youssef *et al.*[36] (2024)	Y	Y	Y	Y	Y	Y	N	O	Y	N	Y	N	Y	Y	N	Y	Low

Key: Y = yes; N = no; O = partial yes; No MA = no meta-analysis conducted; N/A = not available.
*No studies were identified meeting the eligibility criteria of the systematic review.
Note: Domains of the AMSTAR 2 tool, critical domains are in bold: 1 = eligibility criteria contained all PICO components; **2 = contained a statement that the methods were established a priori and noted deviations from the protocol;** 3 = explained selection of study designs; **4 = comprehensive literature search strategy;** 5 = study selection done in duplicate; 6 = data

extraction done in duplicate; 7 = list of excluded studies with justification; 8 = included studies described in detail; **9 = satisfactory technique for appraising study-level risk of bias;** 10 = reported funding sources of included studies; **11 = if meta-analysis was performed, methods were appropriate;** 12 = if meta-analysis was performed, potential impact of study-level risk of bias was assessed; **13 = accounted for risk of bias of included studies when interpreting results;** 14 = satisfactory explanation for and discussion of heterogeneity in results; **15 = if a quantitative synthesis was performed, there was an adequate investigation of publication bias;** 16 = reported conflicts of interest.

4.1.5 Totality of evidence

When combined with the findings of the CDA-AMC summary of reviews, 84 systematic reviews published since 2013 met the inclusion criteria and contributed to the totality of evidence. Briefly, the interventions included from these reviews were assigned into the following categories:

- ED throughput (for example, accelerated diagnostic protocols), identified in 56 systematic reviews
- ED input (for example, GP use in non-critical emergency medical services), identified in 21 systematic reviews
- post-hospital discharge case management (for example, telephone delivery of post-discharge contact) in 15 systematic reviews
- multicomponent interventions, in nine systematic reviews
- policy reform (for example, time-based targets) in five systematic reviews
- ED output (for example, discharge planning) in four systematic reviews
- hospital-wide collaboration with the ED interventions (for example, process improvement teams) in two systematic reviews.

4.2 Interventions with evidence of effect

Following implementation of the four-step process outlined in Section 3.6, one intervention was identified with evidence of a favourable effect and one intervention was identified with evidence of a neutral effect. These are combined with the results from the CDA-AMC summary of systematic reviews and discussed in Sections 4.2.1 and 4.2.2. No intervention with evidence of an unfavourable effect was identified either in the current update or in the CDA-AMC summary of systematic reviews.[15]

4.2.1 Interventions with evidence of favourable effect

In the current update, one intervention was identified with evidence of a favourable effect. A systematic review by Ahmed et al.[24] presented a narrative synthesis, (which included four relevant RCTs[45-47]) of the effectiveness of telemedicine in an adult population on a range of outcomes (ED LOS, treatment time, and patient

satisfaction), in a variety of ED settings. Briefly, the results of this review suggest that telemedicine can enhance diagnostic accuracy, reduce re-consultation rates, improve treatment adherence, and streamline ED workflows, ultimately leading to better patient outcomes. For detailed information on the relevant RCTs included by Ahmed et al.[24] (see Appendix 12).

When combined with the results of the CDA-AMC summary of systematic reviews[15] (see Table 4.2), interventions found to have a favourable effect on specific ED overcrowding-related outcomes included:

- A short-stay, hospital-based, crisis unit for mental health.[48] These included 24-hour and 48-hour behaviour or psychiatric assessment units. This type of intervention demonstrated a favourable effect on ED LOS, ED-related wait times, ED boarding, and patient safety.

- The use of advanced triage protocols, whereby the nurse or physician in triage initiates diagnostic or therapeutic actions in a specific group of patients before they are seen by a physician.[49] This type of intervention demonstrated a favourable effect on ED LOS and patient satisfaction.

- The use of telemedicine for triage and patient care in the ED.[24] The type of telemedicine used varied and included the use of imaging for remote evaluation for dermatological emergencies, and the use of real-time video calling with a remote physician for non-emergency complaints. This type of intervention demonstrated a favourable effect on ED LOS, patient satisfaction and treatment time.

- Time-based targets, such as the number of hours after arriving to the ED within which a patient should be admitted or discharged, demonstrated favourable effect on ED LOS and the number of patients who left the ED prematurely.[50]

- Enhanced paramedic or emergency care practitioner services, in which practitioners received additional training.[51] Examples included training to assess and treat, or to refer older patients with a range of conditions, as part of prehospital care. This type of intervention demonstrated a favourable effect on ED-related wait times, admissions or transfers to the ED and patient satisfaction.

- Transitional care interventions aimed at providing support to older adults with congestive heart failure following hospital inpatient discharge.[52] This type of intervention demonstrated a favourable effect on ED readmissions and visits.

- Care coordination strategies, which were defined as 'the deliberate organisation of patient care activities between two or more participants (including the patient) involved in a patient's care to facilitate the appropriate delivery of health care services'.[53] This type of intervention demonstrated a favourable effect on the proportion of older adults who visited the ED.

- Discharge planning and coordination of services.[54] This included planning for discharge with either a nurse liaison or a patient navigator in the ED. This type of intervention demonstrated a favourable effect on the number of ED return visits.

Of these interventions which demonstrated a favourable effect, two were categorised as throughput,[48, 49] two were categorised as post-hospital discharge case management,[52, 53] and one each as input,[51] output[54] and policy reform.[50] The systematic review on telemedicine by Ahmed et al.[24] was included in both throughput and post-hospital discharge case management categories.

Table 4.2 Interventions found to have a favourable effect on ED overcrowding-related outcomes (adapted from the CDA-AMC summary of systematic reviews)

Category	Authors Year Number of relevant studies	Intervention details Comparator	Population(s)	Findings
ED LOS				
Throughput	Anderson et al.[48] 2022 2 studies included in the meta-analysis for ED LOS.	**Intervention:** The use of short-stay, hospital based, mental health crisis units, these included 24-hour behavioural or psychiatric assessment units; 48-hour psychiatric assessment units; emergency psychiatric assessment, treatment and healing units; 48-hour crisis assessment linkage and management services; and short-term psychiatric decisions units. **Comparator:** Usual care.	Adults experiencing mental health challenges.	The meta-analysis found a reduction in ED LOS of 164 minutes (95% confidence interval (CI): -261 to -67 minutes) with a short-stay crisis unit for mental health.
Throughput	Soster et al.[49] 2022 7 studies included in the meta-analysis for ED LOS.	**Intervention:** The use of advanced triage protocols (ATPs) (with or without Ottawa Ankle Rules (OAR)). These are standard face-to-face approaches whereby the nurse or physician in triage initiates diagnostic or therapeutic actions in a specific group of patients before they are seen by a physician. **Comparator:** Conventional triage, Canadian Triage and Acuity Scale or the Manchester Triage System.	Adults and children.	The meta-analysis found a 36-minute reduction in ED LOS (95% CI = -55 to -17 minutes) with the implementation of ATPs. The meta-analysis also found that ATPs that used OARs for imaging exams were effective at reducing ED LOS, as were ATPs that did not use OARs, compared to other triage interventions.
Throughput	Ahmed et al.[24] 2025 2 randomised controlled trials narratively synthesised.	**Intervention:** The use of telemedicine (in any form) for triage and patient care in the ED. **Comparator:** In-person evaluation and or treatment (usual care).	Adults attending the ED. Specific conditions in the two studies were those with respiratory tract infections, and those with non-	In 1 study average ED LOS was similar in both groups (80.8 minutes for telemedicine versus 97.9 minutes for face-to-face, p = 0.167), indicating telemedicine as an effective alternative for managing low-risk patients. In 1 study the telemedicine group had a shorter average throughput time (106

Category	Authors Year Number of relevant studies	Intervention details Comparator	Population(s)	Findings
			emergency complaints.	minutes) compared to the control group (117 minutes).
Policy reform	Jones et al.[50] 33 studies narratively synthesised.	**Intervention:** The use of timed patient disposition targets (such as, the number of hours after arriving to the ED within which a patient should be admitted or discharged) to improve the timeliness of ED care. **Comparator:** No intervention.	Admitted patients.	Moderate certainty evidence that national and provincial time-based targets in Australia and New Zealand (but not England) reduced ED LOS in patients who were admitted after their introduction. ED LOS for all patients and for patients who were discharged was also favourable but with low and very low certainty, respectively.
ED-related wait times				
Input	Huntly et al.[51] 2017 1 randomised controlled trial.	**Intervention:** Enhanced emergency care and or paramedic training. Examples of enhanced training included paramedic practitioners receiving additional training to "assess and treat", or to refer old patients with a range of conditions, as a part of prehospital care. **Comparator:** Standard paramedic practitioners, and or standard emergency care practitioners.	Older adults.	This intervention reduced the time from receiving the emergency call to ED discharge by 42.2 hours (95% CI = -25.0 to -59.5 hours).
Throughput	Anderson et al.[48] 2022 2 nonrandomised studies.	**Intervention:** The use of short-stay, hospital based, mental health crisis units, these included 24-hour behavioural or psychiatric assessment units;, 48-hour psychiatric assessment units; emergency psychiatric assessment, treatment and healing units; 48-hour crisis assessment linkage and management services; and short-term psychiatric decisions units. **Comparator:** Usual care.	Adults.	The introduction of a short-stay mental health crisis unit resulted in a shorter wait time to be seen by a clinician (from a median of 68 minutes in the control group to 40 minutes in the intervention group), shorter wait time for a mental health review (from 139 minutes to 117 minutes), and fewer patients who waited in the ED for longer than 24 hours.

Category	Authors Year Number of relevant studies	Intervention details Comparator	Population(s)	Findings
Boarding				
Throughput	Anderson et al.[48] 2022 1 nonrandomised study.	**Intervention:** The use of short-stay, hospital based, mental health crisis units, these included 24-hour behavioural or psychiatric assessment units; 48-hour psychiatric assessment units; emergency psychiatric assessment, treatment and healing units; 48-hour crisis assessment linkage and management services; and short-term psychiatric decisions units. **Comparator:** Usual care.	Adults.	Psychiatric boards (as in the time waiting in the ED for a bed or transfer) was decreased by a mean difference of 189 minutes (95% CI = 50 to 228 minutes) with the use of a short-stay mental health crisis unit.
ED visits and or use				
Input	Huntly et al.[51] 2017 1 randomised controlled trial and 2 non-randomised controlled trials.	**Intervention:** Enhanced emergency care and or paramedic training. Examples of enhanced training included paramedic practitioners receiving additional training to "assess and treat", or to refer old patients with a range of conditions, as a part of prehospital care. **Comparator:** Standard paramedic practitioners, and or standard emergency care practitioners.	Older adults.	Across the three studies, the intervention resulted in less subsequent transfers to the ED and or less admissions to the ED when compared with standard ambulance care. High risk of bias was noted in the 2 non-randomised controlled trials.
Post-hospital discharge case management	Vedel et al.[52] 2015 5 studies for meta-analysis on al cause ED visits.	**Intervention:** Transitional care interventions (TCI) which consisted of telephone follow-up combined with home visits, clinic follow-up, and or video visits with older patients with congestive heart failure who were discharged from hospital inpatient departments to home. **Comparator:** Usual care.	Older adults with congestive heart failure.	TCIs significantly reduced risks of readmission and ED visits by 8% and 29%, respectively (relative risk = 0.92; 95% CI = 0.87 to 0.98; p = 0.006 and relative risk = 0.71; 95% CI = 0.51 to 0.98; p = 0.04).
Post-hospital discharge case management	Tricco et al.[53] 2014	**Intervention:** Care coordination strategies defined as "the deliberate organization of patient care activities between 2 or more participants (including the patient) involved in a	Older adults who access the ED often.	The proportion of older adults who visited the ED was significantly different between the intervention and control groups (RR = 0.69, 95% CI =

Category	Authors Year Number of relevant studies	Intervention details Comparator	Population(s)	Findings
	2 studies included in the meta-analysis for ED visits.	patient's care to facilitate the appropriate delivery of health care services". **Comparator:** Usual care.		0.54 to 0.89). This significant difference was not observed in the wider group.
ED return visits				
Output	Van den Broek[54] 2023 1 randomised controlled trial and 2 nonrandomised studies narratively synthesised.	**Intervention:** Discharge planning and coordination of services in the ED prior to discharge. Examples include a nurse liaison developing an ED discharge plan and arranging referrals to community services. **Comparator:** Usual care.	Older adults and those of all ages who access the ED often.	Overall, the intervention reduced the number of ED return visits compared to usual care.
Patients who left prematurely				
Policy reform	Jones et al.[50] (2021) 33 studies narratively synthesised.	**Intervention:** The use of timed patient disposition targets (such as, the number of hours after arriving to the ED within which a patient should be admitted or discharged) to improve the timeliness of ED care. **Comparator:** No intervention.	People attending the ED.	Time-based targets in Australia and New Zealand reduced the number of patients who did not wait in the ED to complete assessment or care.
Patient Satisfaction				
Input	Huntly et al.[51] 2017 1 randomised controlled trial.	**Intervention:** Enhanced emergency care and or paramedic training. Examples of enhanced training included paramedic practitioners receiving additional training to "assess and treat", or to refer old patients with a range of conditions, as a part of prehospital care. **Comparator:** Standard paramedic practitioners, and or standard emergency care practitioners.	Older adults.	The intervention group were very satisfied with care, RR 1.16 (95% CI = 1.09 to 1.23).
Throughput	Soster et al.[49] 2022	**Intervention:** The use of advanced triage protocols (ATPs) (with or without Ottawa Ankle Rules (OAR)). These are	Adults and children	Overall, ATPs were effective for increasing patient satisfaction in those

Category	Authors Year Number of relevant studies	Intervention details Comparator	Population(s)	Findings
	4 studies narratively synthesised for patient satisfaction.	standard face-to-face approaches whereby the nurse or physician in triage initiates diagnostic or therapeutic actions in a specific group of patients before they are seen by a physician. **Comparator:** Conventional triage, Canadian Triage and Acuity Scale or the Manchester Triage System.		who receive the interventions compared to other triage instruments.
Throughput	Ahmed et al.[24] 2025 1 randomised controlled trial.	**Intervention:** The use of real-time telemedicine for triage and patient care in the ED. **Comparator:** In-person evaluation and or treatment (usual care).	Adults attending the ED for non-emergency complaints.	Patient satisfaction was high in both groups, with telemedicine patients slightly more satisfied with the care received.
Post-hospital discharge case management	Ahmed et al.[24] 2025 1 randomised controlled trial.	**Intervention:** The use of telemedicine after ED discharge. The telemedicine group received follow-up at home via structured telephone calls on days 2, 7, 15, and 30 after ED discharge. Interventions included adjusting treatment, changing dosage, stopping treatment, or referring patients to specialists. **Comparator:** Standard care with a follow-up phone call only on day 30 after ED discharge.	Adults attending the ED for non-emergency complaints.	Significantly more patients in the telemedicine group were satisfied with their care, compared to the control group (90% versus 37.5%, $p < 0.05$).
Treatment Time				
Throughput	Ahmed et al.[24] 2025 1 randomised controlled trial.	**Intervention:** The use of telemedicine for triage and patient care in the ED. For this study telemedicine was used for the imaging of skin lesions, which were sent to a remote dermatologist for evaluation. **Comparator:** In-person evaluation and or treatment (usual care).	Adults attending the ED with a dermatological emergency.	Treatment time was significantly shorter in the telemedicine group (43 ± 38 minutes) compared to the conventional group (151 ± 71 minutes, $p < 0.001$).
Safety				

Category	Authors Year Number of relevant studies	Intervention details Comparator	Population(s)	Findings
Throughput	Anderson et al.[48] 2022 1 nonrandomised study.	**Intervention:** The use of short-stay, hospital based, mental health crisis units, these included 24-hour behavioural or psychiatric assessment units; 48-hour psychiatric assessment units; emergency psychiatric assessment, treatment and healing units; 48-hour crisis assessment linkage and management services; and short-term psychiatric decisions units. **Comparator:** Usual care.	Adults	Code grey event rates (ED security responses) and the use of restraints in patients (for example, physical or mechanical restraints and or therapeutic sedation) were reduced with the introduction of short-stay mental health crisis units.

Key: ATP = advanced triage protocol; CI: confidence interval; OAR = Ottawa Ankle Rules; p = probability value (used in statistical tests).

4.2.2 Interventions with evidence of neutral effect

In the current update, one intervention was identified with evidence of a neutral effect. A systematic review by Boggan et al.[38] presented a meta-analysis of eight relevant RCTs that measured the impact of various post-hospital discharge case management programmes (with elements of telemedicine), on ED visits (five RCTs[55-59]) and patient satisfaction (four RCTs[59-62]). An interrupted time series study which provided data for ED visits was also described narratively.[63] Briefly, the review found no evidence of effect of post-hospital discharge telemedicine case management on ED visits or patient satisfaction. For detailed information on the relevant studies included by Boggan et al.[38] (see Appendix 13).

When combined with the results of the CDA-AMC summary of systematic reviews[15] (see Table 4.3), interventions found to have a neutral effect on specific ED overcrowding-related outcomes included:

- Rapid viral testing for children with an acute respiratory infection presenting to the ED.[64] This type of intervention demonstrated a neutral effect on ED LOS.

- Nurse-initiated X-rays, compared to physician-initiated X-rays for distal limb injuries in the ED.[65] This type of intervention demonstrated a neutral effect on ED-related wait times (specifically, time from triage to medical assessment for both adults and children) or ED return visits (specifically, ED re-attendance within 28 days in adults).

- A short-stay, hospital-based, crisis unit for mental health.[48] These included 24-hour and 48-hour behaviour or psychiatric assessment units. This type of intervention demonstrated a neutral effect on the number of people who left prematurely (either left without being seen (LWBS) or against medical advice or authorisation).

- Telephone delivery of post discharge care.[38] Examples of the care varied and included the use of pharmacists conducting medication reconciliation and counselling, referral to dietitians or allied health review, and or telephone assessment by nurses. The population included adults with various conditions (including after orthopaedic surgery, gastrointestinal units, general medicine services, and older adults identified as high risk) discharged from the hospital. This type of intervention demonstrated a neutral effect on the number of ED visits within 30 days of discharge or on patient satisfaction.

- Remote triage, defined as triage from a distance (including telephone, video, web, or short message service).[66] This type of intervention demonstrated a neutral effect on ED use.

- Hospital low-intensity transitional care interventions that involved structured telephone follow-up without home visits.[52] This type of intervention demonstrated a neutral effect on ED visits.

Of these interventions which demonstrated neutral effect, three were categorised as throughput,[48, 64, 65] two were categorised as post-hospital discharge case management,[38, 52] and one as input.[66]

Table 4.3 Interventions found to have a neutral effect on ED overcrowding-related outcomes (adapted from the CDA-AMC summary of systematic reviews)

Category	Authors Year Number of relevant studies	Intervention details Comparator	Population (n)	Findings
ED LOS				
Throughput	Doan et al.[64] 2014 3 randomised controlled trials included in a meta-analysis.	**Intervention:** Rapid viral testing for children with an acute respiratory infection. **Comparator:** Usual care (not using a rapid viral detection test).	Paediatrics with respiratory symptoms.	Pooled results showed no statistically significant reduction of rapid viral testing in paediatrics EDs in mean ED LOS compared to usual care (mean difference: 10.6 minute reduction; 95% Confidence Interval (CI) = -22.47 to 1.25 minutes).
ED-related wait times				
Throughput	Considine et al.[65] 2019 1 randomised controlled trial.	**Intervention:** Nurse-initiated X-rays in ED. **Comparator:** Physician-initiated X-rays in ED (usual care processes).	Adults and children with distal limb injuries.	Nurse-initiated x-rays compared to physician-initiated X-rays in the ED had no significant effect on time from triage to medical assessment (mean difference = -2.4 minutes; 95% CI = - 3.3 to 8.1 minutes; p = 0.410).
ED visits and or use				
Post-hospital discharge case management	Boggan et al.[38] 2025 5 randomised controlled trial included in a meta-analysis and 1 nonrandomised study described narratively.	**Intervention:** Telephone delivery of post discharge care, including the use of pharmacists conducting medication reconciliation and counselling, referral to dietitians or allied health review, and or telephone assessment by nurses. **Comparator:** Usual discharge care.	Adults with various conditions (including after orthopaedic surgery, gastrointestinal units, general medicine services, and older adults identified as high risk) discharged from the hospital.	No effect on number of ED visits within 30 days of discharge with use of a telephone delivery of post-discharge follow-up care (risk difference = 0.00; 95% CI = -0.02 to 0.03).
Input	Rushton et al.[66] 2019	**Intervention:** Remote triage (defined as triage from a distance, including telephone, video, web, or short message service).	Adults.	No effect on ED use with the implementation of remote triage compared to usual care.

Category	Authors Year Number of relevant studies	Intervention details Comparator	Population (n)	Findings
	4 randomised controlled trials and 3 nonrandomised studies synthesised narratively.	**Comparator:** Usual care (discharge education on CHF self-management and usual follow-up with the family physician or cardiologist as required).		
Post-hospital discharge case management	Vedel et al.[52] 2015 3 randomised controlled trials synthesised narratively.	**Intervention:** Hospital low-intensity transitional care intervention that involved structured telephone follow-up (no home visits). **Comparator:** Usual care.	Older adults with congestive heart failure.	In the narrative synthesis, a low-intensity transitional care intervention found no effect on ED visits in older adults with congestive heart failure discharged from hospital inpatient departments to home.
ED return visits				
Throughput	Considine et al.[65] 2019 1 randomised controlled trial.	**Intervention:** Nurse-initiated X-rays in ED. **Comparator:** Physician-initiated X-rays in ED.	Adults with minor distal limb injuries.	Nurse-initiated X-rays in adults with minor injuries compared to physician-initiated X-rays in the ED had no effect on unplanned ED re-attendance within 28 days (2.8% compared to 2.7%, respectively).
People who left prematurely				
Throughput	Anderson et al.[48] 2022 1 nonrandomised study.	**Intervention:** The use of short-stay, hospital based, mental health crisis units, these included 24-hour behavioural or psychiatric assessment units, 48-hour psychiatric assessment units, emergency psychiatric assessment, treatment and healing units, 48-hour crisis assessment linkage and management services and short-term psychiatric decisions units. **Comparator:** Usual care.	Adults experiencing mental health challenges presenting to the ED.	There was no effect on the number of patients leaving the ED without being seen (difference in proportions of −0.3; 95% CI = −1.0 to 0.5) or leaving against medical advice or authorisation (difference in proportions of −0.4; 95% CI = −1.1 to 0.3) after the introduction of a short-stay mental health crisis unit.
Patient Satisfaction				

Category	Authors Year Number of relevant studies	Intervention details Comparator	Population (n)	Findings
Post-hospital discharge case management	Boggan et al.[38] 2025 4 randomised controlled trials included in a meta-analysis.	**Intervention:** Telephone delivery of post discharge care, including the use of pharmacists conduction medication reconciliation and counselling, referral to dietitians or allied health review, and or telephone assessment by nurses. **Comparator:** Usual discharge care.	Adults with various conditions (including after orthopaedic surgery, gastrointestinal units, general medicine services, and older adults identified as high risk) discharged from the hospital.	There was no effect on patient satisfaction with use of a telephone delivery of post-discharge follow-up care compared to usual discharge care.

Key: CI: confidence interval; p = probability value (used in statistical tests).

4.3 Other evidence identified in the current update only

No interventions were identified (in the current update) that could be categorised as output, policy reform, or multicomponent. We also did not find any evidence in the update for the effect of interventions on the following outcomes: boarding and or access block, ED occupancy, number and or proportion of patients in the ED waiting room, and healthcare provider capacity.

There were multiple interventions to which we could not draw any conclusions as to their effectiveness (relative to the comparator). This was either due to how the systematic review was reported (as in low certainty and or low confidence in the methodological quality), or due to low certainty in the primary evidence within the systematic review, or a combination of both. As such, they are not described in detail, but are listed below and included in Appendix 10.

4.3.1 Low confidence in systematic review results

There were 15 interventions comparisons for which the evidence was categorised as favourable (in the current update), but our confidence in the results of the systematic review was low due to methodological limitations:

- fourteen[24-26, 30, 31, 36] throughput interventions comparisons (for example, the effect of accelerated diagnostic protocols on ED LOS,[26] the effect of rapid molecular diagnostic tests on ED LOS,[31] and the effect of point of care testing on waiting time[36])
- one[29] post-hospital discharge case management intervention comparison (the effect of case management interventions for adults with social and material deprivation on the number of ED visits[29]).

There were seven interventions comparisons for which there was evidence of neutral effect, but our confidence in the results of the systematic review was low due to methodological limitations:

- six[25, 35, 36, 39] throughput intervention comparisons (for example, the initiation of ED palliative care services on ED LOS[35] and on ED reattendance[35] and the effect of a triage kiosk on time to triage[36])
- one[39] post-hospital discharge case management intervention comparison (the effect of patient and family-centred care transition interventions on the number of ED visits[39]).

There was one[25] intervention comparison for which there was evidence of unfavourable effect, but our confidence in the results of the systematic review was

low due to methodological limitations. This was a throughput intervention comparison (the effect of hospital at home on ED visits[25]).

4.3.2 Inconclusive due to moderate or high uncertainty

We found evidence on a wide array of interventions comparisons to alleviate ED overcrowding (in the current update), however the evidence on effectiveness was inconclusive due to moderate or high uncertainty in the evidence. These included RCTs in which interventions were compared with usual care, and interrupted time series in which interventions were assessed before and after implementation.

We identified 61 intervention comparisons across 10 systematic reviews[28-30, 32-34, 40-43] for which the evidence was deemed favourable, but inconclusive:

- 23 input intervention comparisons across five systematic reviews[33, 40-43] (for example, the effect of rapid access chest pain clinics on multiple ED outcomes[40] and diversion guidelines on multiple ED outcomes[33])
- 21 throughput intervention comparisons across six systematic reviews[28-30, 32-34] (for example, the effect of telepsychiatry on number of ED visits[29] and the effect of admission to an inpatient psychiatric observation unit on ED LOS[28])
- 14 post-hospital discharge case management intervention comparisons in one review[29] (for example, the effect of care plans on the number of ED visits and the effect of a pain contract on ED visits[29])
- three intervention comparisons categorised as hospital-wide collaboration with the ED, in one systematic review[33] (for example, the effect of process improvement teams on multiple ED outcomes).

We identified 26 intervention comparisons across six systematic reviews[27-30, 32, 34, 37] for which the evidence was deemed neutral, but inconclusive:

- 21 post-hospital discharge case management intervention comparisons across two systematic reviews[29, 37] (for example, the effect of a follow-up telephone call and ED counselling in adults with chronic conditions on number of ED visits[29] and the effect of a medication review programme on number of ED visits[29])
- four throughput intervention comparisons across three systematic reviews[27, 29, 34] (for example, a consult with specialist physician in the ED on number of ED visits[29])
- one input intervention comparison in one systematic review[42] (telephone intervention for patients with colorectal cancer on number of ED visits[42]).

We identified one intervention comparison in one systematic review[29] for which the evidence was deemed unfavourable, but inconclusive. This considered a post-hospital discharge case management intervention comparison (the effect of care transition interventions in adults with social and material deprivation on the number of ED visits).

We identified four intervention comparisons in three systematic reviews[29, 30, 33] for which the evidence was deemed mixed, but inconclusive. This included: one input intervention (full-capacity protocol on ED LOS[33]), one throughput intervention comparison (triage implementation on LWBS[30]) and two post-hospital discharge case management intervention comparisons (for example, care coordination interventions in adults with substance use disorders on ED visits).[29]

5 Discussion

In May 2024, the Minister for Health requested that HIQA conduct a review of urgent and emergency care in the HSE Mid West health region, with the primary objective of ensuring safe quality acute care in the region. As part of this review, the international evidence was reviewed to ensure an evidence-based rationale to inform the potential future configuration of comparable urgent and emergency healthcare services.[1] This report aimed to explore the evidence on the effectiveness and safety of interventions to address ED overcrowding. During scoping for this review, a comprehensive series of reports on ED overcrowding, by the CDA-AMC, were identified.[15-18] These reports included a summary of systematic review evidence around the effectiveness of interventions to alleviate ED overcrowding. To build on this existing evidence base, an update of this summary was undertaken, and 20 relevant systematic reviews were identified that had been published since the CDA-AMC review.[15] When combined with the results of the CDA-AMC review, the totality of evidence included 84 systematic reviews.

5.1 International evidence on interventions for ED overcrowding

It is widely acknowledged in the literature that many factors may contribute to ED overcrowding, both within regions and across regions, and that these factors can be broadly categorised as input, throughput or output factors.[67, 68] At any given time, an input, throughput, or output factor (or combination of factors) may contribute to ED overcrowding. Therefore, it may be likely that a range of measures tackling all the relevant factors may be needed. The majority of systematic reviews identified across the update and CDA-AMC review included interventions which were

categorised as ED throughput. This is similar to what has been reported previously in multiple evidence syntheses.[14, 67, 69] Specifically, Pearce et al.[67] noted that while input and output interventions had the most potential to impact favourably on ED overcrowding-related outcome measures, there was limited or poor-quality evidence for these interventions. The CDA-AMC also noted a mismatch between the systematic reviews identified in their summary (the majority of which were focused on throughput interventions) and the factors highlighted in their environmental scan as contributing to ED overcrowding (the majority of which were output).[15] This may be of concern as ED overcrowding is not just an issue within the ED itself, and exploring interventions related only to within the ED itself is insufficient for understanding and addressing overcrowding.[23] A 2024 guidance document on ED overcrowding, published by the UK's Royal College of Emergency Medicine,[5] highlighted that while improving ED throughput is important, there will be limited effects overall if there is still an issue with ED output.

Furthermore, 76 different types of interventions were identified in the current update, many of which were deemed to have a favourable impact on outcomes related to ED overcrowding, albeit with inconclusive evidence. The broad range of interventions may be reflective of the heterogeneous causes of overcrowding, with Pearce et al.[67] stating that the specific community and national circumstances facing EDs must be considered when proposing solutions to ED overcrowding. Additionally, the outcomes for assessing the effectiveness of an intervention were not specifically evaluating a reduction in ED overcrowding. Instead, they explored related outcomes, such as ED LOS and ED return visits, which act as a proxy for ED overcrowding, as improvements in those outcomes could lead to more efficient use of resources in the ED, and thus in theory reduce overcrowding in the ED. However, it is important to note that improvements in the identified outcomes may not lead directly to a reduction in ED overcrowding.

In this update, only one intervention was found to have a favourable effect on outcomes related to ED overcrowding,[24] and only one intervention was found to have a neutral effect on outcomes related to ED overcrowding.[38] These interventions were focused on telemedicine,[24] and post-hospital discharge case management respectively.[38] When combined with the results of the CDA-AMC review, this resulted in eight types of interventions that demonstrated evidence of a favourable effect on ED overcrowding-related outcomes and six types of interventions that demonstrated evidence of a neutral effect on ED overcrowding-related outcomes. These interventions may provide possible methods of alleviating ED overcrowding, however as stated by Pearse et al.,[67] local issues must be considered prior to implementation. As the eight interventions that demonstrated

evidence of a favourable effect were across multiple categories (input, throughput, policy reform and so on), a multifactorial approach is likely to be required when tackling ED overcrowding. Pearse et al.[67] stated that collaboration across multiple departments and political action are required to alleviate ED overcrowding, and this should be considered during the implementation of any intervention.

While factors related to ED and or overall hospital capacity (such as patient boarding due to a lack of hospital beds) have been found to contribute to ED overcrowding,[70] few interventions included within this update looked specifically at increasing ED capacity directly, with mixed results overall. One systematic review included evidence from two before-and-after studies[71, 72] which investigated the impact of increased ED capacity, and evidence from one before-and-after study[73] which investigated the impact of acute medical unit (AMU) implementation.[33] While both interventions were found to have evidence of a favourable effect, the evidence was deemed as very uncertain due to a high risk of bias. This is similar to that found in the CDA-AMC summary of systematic reviews, where the introduction of an AMU was deemed to have a favourable effect on ED LOS, however with very uncertain evidence.[74] Overall, the evidence identified did not demonstrate conclusive findings to support increasing ED capacity as a solution to address ED overcrowding, whether that be in bed capacity or the introduction of streaming units. Additionally, interventions which focused on increasing inpatient capacity as a means of alleviating ED overcrowding, were not identified in this update, or in the CDA-AMC summary of systematic reviews. Lastly, while a narrative review by Morley et al.[75] outlined that that early physician assessment (which involves a senior physician triaging patients early in their ED arrival), may reduce ED LOS, no evidence on this type of intervention was included in the current update, or the CDA-AMC summary of systematic reviews.

5.2 Applicability of international evidence to the Mid West

It is important to consider the findings from our update, along with the findings of the CDA-AMC summary of systematic reviews, in relation to urgent and emergency care in the Mid West. As previously noted, the only intervention identified in this update with a favourable effect on outcomes related to ED overcrowding was telemedicine.[24] The authors of the systematic review concluded telemedicine offers significant potential for improving triage and patient care in EDs, particularly for non-critical cases.[24] It has been identified in *An analysis of data on urgent and emergency healthcare services in the Health Service Executive Mid West health region* that, compared to the other Model 4 hospitals in Ireland, a lower proportion

of presentations at University Hospital Limerick (UHL) were classified as "standard" and "non-urgent", with a higher proportion classified as "urgent".

Additionally, telemedicine in itself is noted to be a broad construct, and there is a telemedicine initiative in place in UHL, in the form of the National Virtual Ward Programme.[76] The initiative was outlined as a priority in the 2021-2023 Sláintecare Implementation Strategy and Action Plan,[77] the 2024 HSE Urgent and Emergency Care Plan,[78] and the 2024 National Service Plan,[79] and was introduced in UHL and St Vincent's University Hospital in late 2024. A virtual ward supports patients, who would otherwise be in hospital to get home sooner by providing them with care from the hospital team using remote monitoring technology. Prior to leaving hospital, they are provided with a care plan, monitoring kit and planned check-ins. The monitoring kit contains a tablet computer with a virtual ward, a blood pressure monitor, a pulse oximeter and a thermometer.[80] The patient then connects with the Virtual Ward Team from their home, and provides the team with the health information required for monitoring and treatment purposes. While originally for patients with congestive heart failure, low risk chest pain, frailty, and general medical conditions, this was expanded in 2025 to urology, gynaecology, general surgery and orthopaedics. While no formal evaluation of the virtual ward in UHL has been published to date, if the implementation is deemed successful, a potential expansion of the programme could be explored.[38] This is in line with the 2024 Department of Health *Digital for Care: A Digital Health Framework for Ireland 2024-2030* report, which included an aim of using digital technologies to improve access to care for patients, expand capacity, increase efficiency and productivity, and reduce costs.[76, 81]

The CDA-AMC review also outlined that a short-stay crisis unit for mental health has a favourable impact on ED LOS, ED-related wait times, ED boarding, and patient safety.[15] While regional plans in the Mid West have previously proposed the opening of a medical short-stay unit,[82, 83] this has not been specific to mental health. While there is no specific unit, UHL does have dedicated room, a nurse consultation, and a multi-disciplinary consultation available to provide care over a 24-hour period for patients who attend the ED with symptoms of mental distress.[84] The CDA-AMC also outlined a number of other favourable interventions with conclusive evidence, including enhanced paramedic practitioner services; advanced triage protocols; discharge planning and coordination of services in the ED; and time-based strategies. Currently, in the Mid West, as outlined in a *Summary of the key health system and policy recommendations and decisions that impacted urgent and emergency healthcare services in the Health Service Executive Mid West health region (2000 to 2024)*, there are already several similar initiatives in place, such as the Pathfinder Programme and the Alternative Pre-Hospital Pathway Car programme,

Patient Experience Times (which are time-based targets), and ANPs to triage patients presenting to the ED with minor injuries. There are also processes involving bed managers and discharge coordinators to support patient flow and discharge, as well as a dedicated liaison person to support and coordinate discharge for patients with social complexities. Additionally as of January 2025, the ED in the Home (EDITH) frailty response service was operationalised in UHL to provide emergency medical and occupational therapy to adults aged 65 years and older in their own home.[78] While interventions focused on paramedic practitioners services are supporting urgent and emergency care in the Mid West, it was noted by an EAG member that, as of September 2025, Community and or Critical Care Paramedics are not formally registered by the Pre-Hospital Emergency Care Council.[85] It was noted this may be a threat to existing Community Paramedic Practice and act as a barrier to further development.

In 2024, a RCT conducted in the ED at UHL was published.[86] This study aimed to assess the benefits of multidisciplinary comprehensive geriatric assessment in the ED for patients 75 years and older presenting with frailty (assessed on the Identification of Seniors at Risk screening tool). The study demonstrated that multidisciplinary comprehensive geriatric assessment, when compared to usual care with no specifically developed geriatric assessment, led to a significant decrease in median time in the ED. Future interventions could be trialled in the Mid West in a similar manner, enabling the impact of the intervention to be evaluated.

Any additional interventions that may be considered in the Mid West would need to be implemented taking into account other initiatives already in place, with the acknowledgement that there is potential to negatively impact those other initiatives. Additionally, evaluation of numerous simultaneous initiatives would present particular challenges, including the difficulty in isolating the effect of any one intervention within a complex and interconnected healthcare system.

5.3 Limitations

While this update contributes to a comprehensive summary of systematic reviews,[15] there are notable limitations. To ensure consistency with the CDA-AMC review, where possible, the same inclusion criteria (outlined in the PICOS) and search strategy were used. As such, the updated search therefore excluded primary studies, narrative reviews, rapid reviews, systematic reviews that included only non-comparative studies, umbrella reviews, overviews of reviews and summaries of reviews. Additionally, the inclusion criteria were limited to systematic reviews that specifically reported on interventions intended to alleviate ED overcrowding. As a result, some literature may have been excluded from this update that, while they did

not focus specifically on alleviating ED overcrowding, included relevant outcome measures. The research question also aimed to include evidence on the safety of interventions aimed at alleviating ED overcrowding; however, only one systematic review was identified that presented evidence on patient safety measures, with this review assessed as being of low quality. This is similar to the findings from the CDA-AMC review, in which there were few systematic reviews that included relevant outcomes for safety. As such, there are limited results on the safety of the included interventions presented within the findings.

A rigorous approach was applied to appraising the quality of the included systematic reviews and the certainty of the primary evidence (where appropriate). This may have resulted in differences in the assessed evidence of effect (for example, from conclusive in any direction — favourable, neutral or unfavourable to inconclusive evidence) relative to that reported in the published systematic review(s). Additionally, while all of the included systematic reviews reported carrying out a risk of bias assessment on the included primary studies, most lacked a quality assessment or certainty of evidence appraisal for the reported outcomes. In many cases, the risk of bias of primary studies was high or critical, often due to lack of blinding in the intervention group, which can be inherent in these types of interventions.

While a negligible degree of overlap was identified within our update (with one primary study reported in two systematic reviews), a small proportion of overlap (17%) was identified between our included relevant primary studies, and those included in the CDA-AMC summary.[15] Due to resource constraints, we were unable to investigate or assess the impact of these overlapping studies. Lastly, while ED overcrowding is a global issue, and our update included 265 relevant primary studies set internationally, none of these were based in Ireland. Diversity in healthcare systems and structures globally may impact the applicability of favourable interventions to Ireland, while factors affecting implementation must be considered at national, regional and local levels.

6 Conclusion

This report updates the CDA-AMC summary of systematic review evidence on interventions to alleviate ED overcrowding. Twenty systematic reviews were identified and included within this update. When combined with the results of the CDA-AMC summary, a total of 84 systematic reviews were included and the following interventions were found to have a favourable impact on ED overcrowding-related outcomes:

- a short-stay, hospital-based, crisis unit for mental health
- the use of advanced triage protocols
- the use of telemedicine for triage and patient care in the ED
- time-based targets
- enhanced paramedic or emergency care practitioner services
- transitional care interventions
- care coordination strategies
- discharge planning and coordination of services.

Overall, although a large number of interventions have been assessed, there was limited evidence to support any single intervention type that is universally effective at reducing ED overcrowding, and the overall evidence base is generally poor.

From the included evidence, it is likely that a range of measures tackling all the relevant factors may be needed to alleviate ED overcrowding. If consideration is given to the use of any of the interventions outlined as a means to alleviate ED overcrowding in the Mid West, any implementation would need to take account of the specific regional circumstances, including the numerous initiatives already in place. Specifically, a decision to introduce any of these complex interventions, which were found to be effective in one setting, must consider whether they will also be acceptable, implementable, cost effective, scalable and or transferable to the Irish context.

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Appendix 1 — Topic scoping PubMed search strategy

Search query: ("emergency department"[Title/Abstract] OR "emergency medicine"[Title/Abstract] OR "emergency *care"[Title/Abstract] OR "urgent *care"[Title/Abstract]) AND (crowd*[Title/Abstract] OR overcrowd*[Title/Abstract] OR flow[Title/Abstract])

Filters applied: Review, Systematic Review, from 2022/1/1 - 2025/1/16

Total records: 139 results

Appendix 2 — Relevant evidence syntheses identified during topic scoping

Author (year)	Title	Date searches completed
Samadbeik (2024)[14]	Patient flow in emergency departments: a comprehensive umbrella review of solutions and challenges across the health system	3 March 2023
CADTH/CDA-AMC (2023)[15, 17, 18]	Emergency Department Overcrowding: An Environmental Scan of Contributing Factors and a Summary of Systematic Review Evidence on Interventions	Initial search on 27 March 2023
Pearce (2024)[67]	Overcrowding in emergency departments: an overview of reviews describing global solutions and their outcomes	5 October 2022

Key: CADTH = Canadian Agency for Drugs and Technologies in Health; CDA-AMC = Canada's Drug Agency.

Appendix 3 — Notable deviations from Canada's Drug Agency summary of systematic reviews methodology

Section	Focus area	Deviation from CDA-AMC methods
Research question (Section 3.1)	PICOS – Population	The current review does not specify subgroups of interest or equity-deserving groups.
	PICOS – Study design	Narrative reviews included in list of excluded study designs.
	Time frame	Articles published between March 2023 and the search date.
Search strategy (Section 3.2)	-	CADTH-developed search filters were not applied. Ovid searches of MEDLINE and Embase were conducted independently of each other with results reported and combined for data extraction. A supplemental literature search was not conducted in Scopus and PsycINFO, and a focused internet search was not conducted for literature in the engineering, management, and operations fields. A grey literature search was conducted of relevant HTA agencies and databases listed on the CDA Grey Matters search tool. Deviations reflect that the CDA-AMC completed a combined search for both the environmental scan and summary of systematic reviews.
Study selection and data extraction (Section 3.3)	Screening	No pilot testing of title and abstract, and or full text screening was undertaken.

Key: CADTH = Canadian Agency for Drugs and Technologies in Health; CDA-AMC = Canada's Drug Agency.

Appendix 4 — PRIOR Checklist:† Reporting guidelines for overviews of reviews of healthcare interventions

Section Topic	#	Item	Location reported
Title			
Title	1	Identify the report as an overview of reviews.	N/A
Abstract			
Abstract	2	Provide a comprehensive and accurate summary of the purpose, methods, and results of the overview of reviews.	N/A
Introduction			
Rationale	3	Describe the rationale for conducting the overview of reviews in the context of existing knowledge.	pg. 15
Objectives	4	Provide an explicit statement of the objective(s) or question(s) addressed by the overview of reviews.	pg. 17
Methods			
Eligibility criteria	5a	Specify the inclusion and exclusion criteria for the overview of reviews. If supplemental primary studies were included, this should be stated, with a rationale.	pg.17
	5b	Specify the definition of 'systematic review' as used in the inclusion criteria for the overview of reviews.	pg. 19
Information sources	6	Specify all databases, registers, websites, organisations, reference lists, and other sources searched or consulted to identify systematic reviews and supplemental primary studies (if included). Specify the date when each source was last searched or consulted	Appendix 5 and Appendix 6
Search strategy	7	Present the full search strategies for all databases, registers and websites, such that they could be reproduced. Describe any search filters and limits applied.	Appendix 5
Selection process	8a	Describe the methods used to decide whether a systematic review or supplemental primary study (if included) met the inclusion criteria of the overview of reviews.	pg. 19
	8b	Describe how overlap in the populations, interventions, comparators, and/or outcomes of systematic reviews was identified and managed during study selection	-

Section Topic	#	Item	Location reported
Data collection process	9a	Describe the methods used to collect data from reports.	pg. 20
	9b	If applicable, describe the methods used to identify and manage primary study overlap at the level of the comparison and outcome during data collection. For each outcome, specify the method used to illustrate and/or quantify the degree of primary study overlap across systematic reviews.	-
	9c	If applicable, specify the methods used to manage discrepant data across systematic reviews during data collection.	N/A
Data items	10	List and define all variables and outcomes for which data were sought. Describe any assumptions made and/or measures taken to identify and clarify missing or unclear information.	pg. 17 and Appendix 7
Risk of bias assessment	11a	Describe the methods used to assess risk of bias or methodological quality of the included systematic reviews.	pg. 20
	11b	Describe the methods used to collect data on (from the systematic reviews) and/or assess the risk of bias of the primary studies included in the systematic reviews. Provide a justification for instances where flawed, incomplete, or missing assessments are identified but not re-assessed.	Appendix 7
	11c	Describe the methods used to assess the risk of bias of supplemental primary studies (if included)	N/A
Synthesis method	12a	Describe the methods used to summarise or synthesise results and provide a rationale for the choice(s).	pg. 22
	12b	Describe any methods used to explore possible causes of heterogeneity among results.	-
	12c	Describe any sensitivity analyses conducted to assess the robustness of the synthesised results.	-
Reporting bias assessment	13	Describe the methods used to collect data on (from the systematic reviews) and/or assess the risk of bias due to missing results in a summary or synthesis (arising from reporting biases at the levels of the systematic reviews, primary studies, and supplemental primary studies, if included).	-
Certainty assessment	14	Describe the methods used to collect data on (from the systematic reviews) and/or assess certainty (or confidence) in the body of evidence for an outcome.	-
Results			
Systematic review and supplemental primary study selection	15a	Describe the results of the search and selection process, including the number of records screened, assessed for eligibility, and included in the overview of reviews, ideally with a flow diagram.	pg. 23
	15b	Provide a list of studies that might appear to meet the inclusion criteria, but were excluded, with the main reason for exclusion.	Appendix 9

Section Topic	#	Item	Location reported
Characteristics of systematic reviews and supplemental primary studies	16	Cite each included systematic review and supplemental primary study (if included) and present its characteristics.	pg. 25
Primary study overlap	17	Describe the extent of primary study overlap across the included systematic reviews.	pg. 26
Risk of bias in systematic reviews, primary studies, and supplemental primary studies	18a	Present assessments of risk of bias or methodological quality for each included systematic review.	pg. 27
	18b	Present assessments (collected from systematic reviews or assessed anew) of the risk of bias of the primary studies included in the systematic reviews	Appendix 10
	18c	Present assessments of the risk of bias of supplemental primary studies (if included).	N/A
Summary or synthesis of results	19a	For all outcomes, summarise the evidence from the systematic reviews and supplemental primary studies (if included). If meta-analyses were done, present for each the summary estimate and its precision and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	pg. 28
	19b	If meta-analyses were done, present results of all investigations of possible causes of heterogeneity.	N/A
	19c	If meta-analyses were done, present results of all sensitivity analyses conducted to assess the robustness of synthesised results.	N/A
Reporting biases	20	Present assessments (collected from systematic reviews and/or assessed anew) of the risk of bias due to missing primary studies, analyses, or results in a summary or synthesis (arising from reporting biases at the levels of the systematic reviews, primary studies, and supplemental primary studies, if included) for each summary or synthesis assessed.	-
Certainty of evidence	21	Present assessments (collected or assessed anew) of certainty (or confidence) in the body of evidence for each outcome.	Appendix 10
Discussion			
Discussion	22a	Summarise the main findings, including any discrepancies in findings across the included systematic reviews and supplemental primary studies (if included).	pg. 48
	22b	Provide a general interpretation of the results in the context of other evidence.	pg. 48

Section Topic	#	Item	Location reported
	22c	Discuss any limitations of the evidence from systematic reviews, their primary studies, and supplemental primary studies (if included) included in the overview of reviews. Discuss any limitations of the overview of reviews methods used.	pg. 52
	22d	Discuss implications for practice, policy, and future research (both systematic reviews and primary research). Consider the relevance of the findings to the end users of the overview of reviews, e.g., healthcare providers, policymakers, patients, among others	pg. 50 and 53
Other information			
Registration and protocol	23a	Provide registration information for the overview of reviews, including register name and registration number, or state that the overview of reviews was not registered.	-
	23b	Indicate where the overview of reviews protocol can be accessed, or state that a protocol was not prepared.	pg. 18
	23c	Describe and explain any amendments to information provided at registration or in the protocol. Indicate the stage of the overview of reviews at which amendments were made.	N/A
Support	24	Describe sources of financial or non-financial support for the overview of reviews, and the role of the funders or sponsors in the overview of reviews.	-
Competing interests	25	Declare any competing interests of the overview of reviews' authors.	pg.6
Author information	26a	Provide contact information for the corresponding author.	-
	26b	Describe the contributions of individual authors and identify the guarantor of the overview of reviews.	pg. 6
Availability of data and other materials	27	Report which of the following are available, where they can be found, and under which conditions they may be accessed: template data collection forms; data collected from included systematic reviews and supplemental primary studies; analytic code; any other materials used in the overview of reviews.	-

Key: PRIOR = Preferred Reporting Items for Overviews of Reviews
†Gates et al. (2022)[19]

Appendix 5 — Search strategies

Sources searched

Databases	Number of results	Date searched
Medline Complete via Ovid	515	04/02/2025
Embase via Ovid	866	04/02/2025
The Cochrane Library	32	04/02/2025
CINAHL Complete via Ebscohost	223	04/02/2025
Total	1636	
Total after duplicates removed in Endnote and Covidence	**1132**	

Database: Ovid MEDLINE(R) ALL 1946 to January 28, 2025		
#	**Searches**	**Results**
1	Crowding/ or "Length of Stay"/	112366
2	Time Factors/ or Patient Admission/	1268767
3	(crowding or crowded or overcrowd* or gridlock* or boarded or boarding or overload* or over-load* or hallway* or code black* or handover* or hand-over* or offload* or off-load* or occupanc*).ti,ab,kf.	123732
4	((staff* or personnel* or nurs* or physician* or doctor* or resident* or paramedic* or bed* or resourc* or hospital*) adj4 (shortag* or capacit* or strain*)).ti,ab,kf.	31350
5	(delay* adj5 (service* or "being seen" or treat* or therap* or care or caring or exam* or clearance or consult*)).ti,ab,kf.	73286
6	(volume* adj4 (patient* or case or "use" or usage or center* or centre*)).ti,ab,kf.	56171
7	(staff* adj2 (patient* or bed*) adj2 ratio*).ti,ab,kf.	314
8	(bed* adj3 (spac* or availab* or utiliz* or utilis* or "use" or usage)).ti,ab,kf.	7566
9	(care* adj3 interval*).ti,ab,kf.	605

10	(access block* or bed block* or exit block* or access gap*).ti,ab,kf.	1102
11	(throughput* or through-put* or output* or out-put*).ti,ab,kf.	421005
12	(re-enter or reenter or re-entr* or reentr* or readmit* or re-admit* or readmiss* or re- admiss*).ti,ab,kf.	77909
13	without being seen*.ti,ab,kf.	509
14	((leav* or left*) adj6 (medical advic* or treat*)).ti,ab,kf.	32124
15	(wait* adj3 time*).ti,ab,kf.	21068
16	((length* or prolong*) adj5 (stay* or wait*)).ti,ab,kf.	140717
17	(patient* adj2 flow*).ti,ab,kf.	9549
18	exp Health Services Misuse/	20242
19	(overutili* or over-utili* or overus* or over-us*).ti,ab,kf.	22457
20	((nonurgent or non-urgent or semiurgent or semi-urgent or nonacute or non-acute or unnecessary or preventable) adj5 (patient* or visit* or use* or care or problem* or attend* or clinic*)).ti,ab,kf.	23292
21	((level or low) adj3 (acuit* or complexit*)).ti,ab,kf.	12383
22	or/1-21	2275193
23	exp Emergency Medicine/ or Evidence-Based Emergency Medicine/ or exp Emergency Medical Services/ or paramedicine/	190671
24	(emergenc* adj5 (hospital* or department* or room* or service* or care or unit* or ward* or communication system* or dispatch* or call centre* or call center* or transportation* or psychiatr* or prehospital* or pre-hospital* or outpatient* or out-patient*)).ti,ab,kf.	228912
25	(trauma* adj3 (unit* or care)).ti,ab,kf.	14257
26	(emergicentre* or emergicenter* or emerg or paramed* or emergetolog*).ti,ab,kf.	15550
27	(accident* adj4 department*).ti,ab,kf.	3778
28	ambulance*.ti,ab,kf.	14472
29	("Canadian Triage & Acuity Scale" or "Canadian Triage and Acuity Scale" or emergency severity index).ti,ab,kf.	727
30	Emergency Nursing/ or exp emergency responders/	24184
31	(emergenc* adj4 (personnel* or staff* or team* or nurs* or physician* or doctor* or resident* or responder* or medical technician* or patient* or specialist*)).ti,ab,kf.	86962
32	(first adj3 responder*).ti,ab,kf.	4475
33	("A and E" or "A & E" or "A&E" or CTAS or ESI).ti,ab,kf.	115008
34	Emerg*.ja,jn,jw.	148561

35	or/23-34	564325
36	22 and 35	75895
37	(systematic review or meta-analysis).pt.	374219
38	meta-analysis/ or systematic review/ or systematic reviews as topic/ or meta-analysis as topic/ or "meta analysis (topic)"/ or "systematic review (topic)"/ or exp technology assessment, biomedical/ or network meta-analysis/	417958
39	((systematic* adj3 (review* or overview*)) or (methodologic* adj3 (review* or overview*))).ti,ab,kf.	400370
40	((quantitative adj3 (review* or overview* or synthes*)) or (research adj3 (integrati* or overview*))).ti,ab,kf.	19043
41	((integrative adj3 (review* or overview*)) or (collaborative adj3 (review* or overview*)) or (pool* adj3 analy*)).ti,ab,kf.	45375
42	(data synthes* or data extraction* or data abstraction*).ti,ab,kf.	49512
43	(handsearch* or hand search*).ti,ab,kf.	11919
44	(mantel haenszel or peto or der simonian or dersimonian or fixed effect* or latin square*).ti,ab,kf.	40560
45	(met analy* or metanaly* or technology assessment* or HTA or HTAs or technology overview* or technology appraisal*).ti,ab,kf.	13795
46	(meta regression* or metaregression*).ti,ab,kf.	17892
47	(meta-analy* or metaanaly* or systematic review* or biomedical technology assessment* or bio-medical technology assessment*).mp,hw.	559760
48	(medline or cochrane or pubmed or medlars or embase or cinahl).ti,ab,hw.	415118
49	(cochrane or (health adj2 technology assessment) or evidence report).jw.	22349
50	(comparative adj3 (efficacy or effectiveness)).ti,ab,kf.	20464
51	(outcomes research or relative effectiveness).ti,ab,kf.	12162
52	((indirect or indirect treatment or mixed-treatment or bayesian) adj3 comparison*).ti,ab,kf.	4886
53	(multi* adj3 treatment adj3 comparison*).ti,ab,kf.	323
54	(mixed adj3 treatment adj3 (meta-analy* or metaanaly*)).ti,ab,kf.	184
55	umbrella review*.ti,ab,kf.	2526
56	(multi* adj2 paramet* adj2 evidence adj2 synthesis).ti,ab,kf.	15
57	(multiparamet* adj2 evidence adj2 synthesis).ti,ab,kf.	19
58	(multi-paramet* adj2 evidence adj2 synthesis).ti,ab,kf.	13
59	(overview* adj3 review*).ti,ab,kf.	20145
60	("review of review" or "review of reviews").ti,ab,kf.	10660
61	37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60	835540

62	36 and 61	2995
63	limit 62 to dt=20230301-20251231	515

Database: Embase 1974 to 2024 via Ovid		
#	**Searches**	**Results**
1	"crowding (area)"/ or *"length of stay"/	25288
2	Time Factor/ or hospital admission/ or hospital bed utilization/	358194
3	(crowding or crowded or overcrowd* or gridlock* or boarded or boarding or overload* or over-load* or hallway* or code black* or handover* or hand-over* or offload* or off-load* or occupanc*).ti,ab,kf,dq.	161905
4	((staff* or personnel* or nurs* or physician* or doctor* or resident* or paramedic* or bed* or resourc* or hospital*) adj4 (shortag* or capacit* or strain*)).ti,ab,kf,dq.	37987
5	(delay* adj5 (service* or "being seen" or treat* or therap* or care or caring or exam* or clearance or consult*)).ti,ab,kf,dq.	111243
6	(volume* adj4 (patient* or case or "use" or usage or center* or centre*)).ti,ab,kf,dq.	96803
7	(staff* adj2 (patient* or bed*) adj2 ratio*).ti,ab,kf,dq.	413
8	(bed* adj3 (spac* or availab* or utiliz* or utilis* or "use" or usage)).ti,ab,kf,dq.	11685
9	(care* adj3 interval*).ti,ab,kf,dq.	875
10	(access block* or bed block* or exit block* or access gap*).ti,ab,kf,dq.	1796
11	(throughput* or through-put* or output* or out-put*).ti,ab,kf,dq.	497057
12	(re-enter or reenter or re-entr* or reentr* or readmit* or re-admit* or readmiss* or re- admiss*).ti,ab,kf,dq.	131520
13	without being seen*.ti,ab,kf,dq.	868
14	((leav* or left*) adj6 (medical advic* or treat*)).ti,ab,kf,dq.	46746
15	(wait* adj3 time*).ti,ab,kf,dq.	34957
16	((length* or prolong*) adj5 (stay* or wait*)).ti,ab,kf,dq.	247175
17	(patient* adj2 flow*).ti,ab,kf,dq.	15399
18	(overutili* or over-utili* or overus* or over-us*).ti,ab,kf,dq.	31121
19	((nonurgent or non-urgent or semiurgent or semi-urgent or nonacute or non-acute or unnecessary or preventable) adj5 (patient* or visit* or use* or care or problem* or attend* or clinic*)).ti,ab,kf,dq.	36761
20	((level or low) adj3 (acuit* or complexit*)).ti,ab,kf,dq.	15510

21	1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20	1696879
22	exp emergency/ or exp emergency medicine/ or exp emergency health service/ or emergency treatment/ or exp emergency care/ or emergency ward/ or emergency response time/ or emergency call system/ or exp ambulance/ or air medical transport/	516452
23	(emergenc* adj5 (hospital* or department* or room* or service* or care or unit* or ward* or communication system* or dispatch* or call centre* or call center* or transportation* or psychiatr* or prehospital* or pre-hospital* or outpatient* or out-patient*)).ti,ab,kf,dq.	350166
24	(trauma* adj3 (unit* or care)).ti,ab,kf,dq.	18175
25	(emergicentre* or emergicenter* or emerg or paramed* or emergetolog*).ti,ab,kf,dq.	22480
26	(accident* adj4 department*).ti,ab,kf,dq.	4715
27	ambulance*.ti,ab,kf,dq.	21484
28	("Canadian Triage & Acuity Scale" or "Canadian Triage and Acuity Scale" or emergency severity index).ti,ab,kf,dq.	1378
29	Emergency Nursing/ or emergency nurse practitioner/ or exp "first responder (person)"/ or emergency medical dispatcher/ or emergency physician/ or emergency patient/	40072
30	(emergenc* adj4 (personnel* or staff* or team* or nurs* or physician* or doctor* or resident* or responder* or medical technician* or patient* or specialist*)).ti,ab,kf,dq.	130041
31	(first adj3 responder*).ti,ab,kf,dq.	6015
32	("A and E" or "A & E" or "A&E" or CTAS or ESI).ti,ab,kf,dq.	150859
33	emerg*.ja,jn,jx.	177496
34	22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33	881034
35	21 and 34	135874
36	35 not (conference abstract or conference review).pt.	92473
37	(systematic review or meta-analysis).pt.	0
38	meta-analysis/ or systematic review/ or systematic reviews as topic/ or meta-analysis as topic/ or "meta analysis (topic)"/ or "systematic review (topic)"/ or exp technology assessment, biomedical/ or network meta-analysis/	728237
39	((systematic* adj3 (review* or overview*)) or (methodologic* adj3 (review* or overview*))).ti,ab,kf.	474515
40	((quantitative adj3 (review* or overview* or synthes*)) or (research adj3 (integrati* or overview*))).ti,ab,kf.	21456
41	((integrative adj3 (review* or overview*)) or (collaborative adj3 (review* or overview*)) or (pool* adj3 analy*)).ti,ab,kf.	62747
42	(data synthes* or data extraction* or data abstraction*).ti,ab,kf.	58924
43	(handsearch* or hand search*).ti,ab,kf.	14410

44	(mantel haenszel or peto or der simonian or dersimonian or fixed effect* or latin square*).ti,ab,kf.	52856
45	(met analy* or metanaly* or technology assessment* or HTA or HTAs or technology overview* or technology appraisal*).ti,ab,kf.	23553
46	(meta regression* or metaregression*).ti,ab,kf.	21381
47	(meta-analy* or metaanaly* or systematic review* or biomedical technology assessment* or bio-medical technology assessment*).mp,hw.	857937
48	(medline or cochrane or pubmed or medlars or embase or cinahl).ti,ab,hw.	527775
49	(cochrane or (health adj2 technology assessment) or evidence report).jw.	32497
50	(comparative adj3 (efficacy or effectiveness)).ti,ab,kf.	29437
51	(outcomes research or relative effectiveness).ti,ab,kf.	17303
52	((indirect or indirect treatment or mixed-treatment or bayesian) adj3 comparison*).ti,ab,kf.	8545
53	(multi* adj3 treatment adj3 comparison*).ti,ab,kf.	453
54	(mixed adj3 treatment adj3 (meta-analy* or metaanaly*)).ti,ab,kf.	263
55	umbrella review*.ti,ab,kf.	2580
56	(multi* adj2 paramet* adj2 evidence adj2 synthesis).ti,ab,kf.	36
57	(multiparamet* adj2 evidence adj2 synthesis).ti,ab,kf.	22
58	(multi-paramet* adj2 evidence adj2 synthesis).ti,ab,kf.	31
59	(overview* adj3 review*).ti,ab,kf.	20727
60	("review of review" or "review of reviews").ti,ab,kf.	11285
61	37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 or 49 or 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 or 59 or 60	1166019
62	36 and 61	3996
63	limit 62 to yr=2013-current	3352
64	limit 63 to (english or french)	3312
65	Limit 64 to dc=20230301-20251231	866

Database: CINAHL Complete via EBSCOhost

#	Query	Limiters/Expanders	Last Run Via	Results

S36	S22 AND S34 AND S35	Limiters - Publication Date: 20230301- Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	223
S35	(MH "meta analysis" OR MH "systematic review" OR MH "Technology, Medical/EV" OR PT "systematic review" OR PT "meta analysis" OR (((TI systematic* OR AB systematic*) N3 ((TI review* OR AB review*) OR (TI overview* OR AB overview*))) OR ((TI methodologic* OR AB methodologic*) N3 ((TI review* OR AB review*) OR (TI overview* OR AB overview*)))) OR (((TI quantitative OR AB quantitative) N3 ((TI review* OR AB review*) OR (TI overview* OR AB overview*) OR (TI synthes* OR AB synthes*))) OR ((TI research OR AB research) N3 ((TI integrati* OR AB integrati*) OR (TI overview* OR AB overview*)))) OR (((TI integrative OR AB integrative) N3 ((TI review* OR AB review*) OR (TI overview* OR AB overview*))) OR ((TI collaborative OR AB collaborative) N3 ((TI review* OR AB review*) OR (TI overview* OR AB overview*))) OR ((TI pool* OR AB pool*) N3 (TI analy* OR AB analy*))) OR ((TI "data synthes*" OR AB "data synthes*") OR (TI "data extraction*" OR AB "data extraction*") OR (TI "data abstraction*" OR AB "data abstraction*")) OR ((TI handsearch* OR AB handsearch*) OR (TI "hand search*" OR AB "hand search*")) OR ((TI "mantel haenszel" OR AB "mantel haenszel") OR (TI peto OR AB peto) OR (TI "der simonian" OR AB "der simonian") OR (TI dersimonian OR AB dersimonian) OR (TI "fixed effect*" OR AB "fixed effect*") OR (TI "latin square*" OR AB "latin square*")) OR ((TI "met analy*" OR AB "met analy*") OR (TI metanaly* OR AB metanaly*) OR (TI "technology assessment*" OR AB "technology assessment*") OR (TI HTA OR AB HTA) OR (TI HTAs OR AB HTAs) OR (TI "technology overview*" OR AB "technology overview*") OR (TI "technology appraisal*" OR AB	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	339,814

	"technology appraisal*")) OR ((TI "meta regression*" OR AB "meta regression*") OR (TI metaregression* OR AB metaregression*)) OR (MW meta-analy* OR MW metaanaly* OR MW "systematic review*" OR MW "biomedical technology assessment*" OR MW "bio-medical technology assessment*") OR ((TI medline OR AB medline OR MW medline) OR (TI cochrane OR AB cochrane OR MW cochrane) OR (TI pubmed OR AB pubmed OR MW pubmed) OR (TI medlars OR AB medlars OR MW medlars) OR (TI embase OR AB embase OR MW embase) OR (TI cinahl OR AB cinahl OR MW cinahl)) OR (SO Cochrane OR SO health technology assessment OR SO evidence report) OR ((TI comparative OR AB comparative) N3 ((TI efficacy OR AB efficacy) OR (TI effectiveness OR AB effectiveness))) OR ((TI "outcomes research" OR AB "outcomes research") OR (TI "relative effectiveness" OR AB "relative effectiveness")) OR (((TI indirect OR AB indirect) OR (TI "indirect treatment" OR AB "indirect treatment") OR (TI mixed-treatment OR AB mixed-treatment) OR (TI bayesian OR AB bayesian)) N3 (TI comparison* OR AB comparison*)) OR ((TI multi* OR AB multi*) N3 (TI treatment OR AB treatment) N3 (TI comparison* OR AB comparison*)) OR ((TI mixed OR AB mixed) N3 (TI treatment OR AB treatment) N3 ((TI meta-analy* OR AB meta-analy*) OR (TI metaanaly* OR AB metaanaly*))) OR (TI "umbrella review*" OR AB "umbrella review*") OR ((TI multi* OR AB multi*) N2 (TI paramet* OR AB paramet*) N2 (TI evidence OR AB evidence) N2 (TI synthesis OR AB synthesis)) OR ((TI multiparamet* OR AB multiparamet*) N2 (TI evidence OR AB evidence) N2 (TI synthesis OR AB synthesis)) OR ((TI multi-paramet* OR AB multi-paramet*) N2 (TI evidence OR AB evidence) N2 (TI synthesis OR AB synthesis)) OR (TI "overview of reviews" OR AB "overview of reviews" or TI "review of reviews" OR AB "review of reviews" OR TI "overview review" OR AB "overview review")			

S34	S23 OR S24 OR S25 OR S26 OR S27 OR S28 OR S29 OR S30 OR S31 OR S32 OR S33	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	307,903
S33	(TI "A and E") OR (AB "A and E") OR (TI "A & E") OR (AB " A & E") OR (TI "A&E") OR (AB "A&E") OR (TI CTAS) OR (AB CTAS) OR (TI ESI) OR (AB ESI)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	19,038
S32	(TI first OR AB first) N4 (TI responder* OR AB responder*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	2,072
S31	(TI emergenc* OR AB emergenc*) N5 (TI personnel* OR AB personnel* OR TI staff* OR AB staff* OR TI team* OR AB team* OR TI nurs* OR AB nurs* OR TI physician* OR AB physician* OR TI doctor* OR AB doctor* OR TI resident* OR AB resident* OR TI responder* OR AB responder* OR TI "medical technician*" OR AB "medical technician*" OR TI patient* OR AB patient OR TI specialist* OR AB specialist*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	52,173
S30	(TI "Canadian Triage & Acuity Scale") OR (AB "Canadian Triage & Acuity Scale") OR (TI "Canadian Triage and Acuity Scale") OR (AB	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced	423

	"Canadian Triage and Acuity Scale") OR (TI "emergency severity index") OR (AB "emergency severity index")		Search Database - CINAHL Complete	
S29	TI ambulance* OR AB ambulance*	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	7,500
S28	(TI accident* OR AB accident*) N5 (TI department* OR AB department*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	1,800
S27	TI emergicentre* OR AB emergicenter* OR TI emergicenter* OR AB emergicenter* OR TI emerg OR AB emerg OR TI paramed* OR AB paramed* OR TI emergetolog* OR AB emergetolog*	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	9,780
S26	(TI trauma* OR AB trauma*) N4 (TI unit* OR AB unit* OR TI care OR AB care)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	9,912

S25	(TI emergenc* OR AB emergenc*) N6 (TI hospital* OR AB hospital* OR TI department* OR AB department* OR TI room* OR AB room* OR TI service* OR AB service* OR TI care OR AB care OR TI unit* OR AB unit* OR TI ward* OR AB ward* OR TI "communication system*" OR AB "communication system*" OR TI dispatch* OR AB dispatch* OR TI "call centre*" OR AB "call centre*" OR TI "call center*" OR AB "call center*" OR TI transportation* OR AB transportation* OR TI psychiatr* OR AB psychiatr* OR TI prehospital* OR AB prehospital* OR TI pre-hospital* OR AB pre-hospital OR TI outpatient* OR AB outpatient* OR TI out-patient* OR AB out-patient*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	107,803
S24	(SE emerg*) OR (SO emerg*) OR (JT emerg*) OR (JN emerg*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	134,732
S23	(MH "Emergency Medical Services+") OR (MH "Emergency Nurse Practitioners") OR (MH "emergency nursing+") OR (MH "Physicians, emergency") OR (MH "Emergency Medical Technicians") OR (MH "Emergency Patients") OR (MH "Emergency Service Information Systems") OR (MH "Emergencies+")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	153,608
S22	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13 OR S14 OR S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	431,879

S21	TI (((level or low) N3 (acuit* or complexit*))) OR AB (((level or low) N3 (acuit* or complexit*)))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	3,030
S20	TI ((nonurgent or non-urgent or semiurgent or semi-urgent or nonacute or non-acute or unnecessary or preventable) N5 (patient* or visit* or use* or care or problem* or attend* or clinic*)) OR AB ((nonurgent or non-urgent or semiurgent or semi-urgent or nonacute or non-acute or unnecessary or preventable) N5 (patient* or visit* or use* or care or problem* or attend* or clinic*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	9,956
S19	TI ((overutili* or over-utili* or overus* or over-us*)) OR AB ((overutili* or over-utili* or overus* or over-us*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	8,652
S18	(MH "Health Services Misuse+")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	12,438
S17	TI (patient* N2 flow*) OR AB (patient* N2 flow*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search	4,840

			Database - CINAHL Complete	
S16	TI (((length* or prolong*) N5 (stay* or wait*))) OR AB (((length* or prolong*) N5 (stay* or wait*)))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	48,688
S15	AB (wait* N3 time*) OR TI (wait* N3 time*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	8,126
S14	TI (((leav* or left*) N6 (medical advic* or treat*))) OR AB (((leav* or left*) N6 (medical advic* or treat*)))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	6,374
S13	TI without being seen* OR AB without being seen*	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	324

S12	TI (re-enter or reenter or re-entr* or reentr* or readmit* or re-admit* or readmiss* or re- admiss*) OR AB (re-enter or reenter or re-entr* or reentr* or readmit* or re-admit* or readmiss* or re- admiss*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	28,217
S11	TI (throughput* or through-put* or output* or out-put*) OR AB (throughput* or through-put* or output* or out-put*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	34,198
S10	TI (access block* or bed block* or exit block* or access gap*) OR AB (access block* or bed block* or exit block* or access gap*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	511
S9	TI care* N3 interval* OR AB care* N3 interval*	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	625
S8	TI ((bed* N3 (spac* or availab* or utiliz* or utilis* or "use" or usage))) OR AB ((bed* N3 (spac* or availab* or utiliz* or utilis* or "use" or usage)))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search	3,108

			Database - CINAHL Complete	
S7	TI ((staff* N2 (patient* or bed*) N2 ratio*)) OR AB ((staff* N2 (patient* or bed*) N2 ratio*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	298
S6	TI ((volume* N4 (patient* or case or "use" or usage or center* or centre*))) OR AB ((volume* N4 (patient* or case or "use" or usage or center* or centre*)))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	17,810
S5	TI ((delay* N5 (service* or "being seen" or treat* or therap* or care or caring or exam* or clearance or consult*)) OR AB ((delay* N5 (service* or "being seen" or treat* or therap* or care or caring or exam* or clearance or consult*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	20,634
S4	TI ((staff* or personnel* or nurs* or physician* or doctor* or resident* or paramedic* or bed* or resourc* or hospital*) N4 (shortag* or capacit* or strain*)) AND AB ((staff* or personnel* or nurs* or physician* or doctor* or resident* or paramedic* or bed* or resourc* or hospital*) N4 (shortag* or capacit* or strain*))	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	817

S3	TI (crowding or crowded or overcrowd* or gridlock* or boarded or boarding or overload* or over- load* or hallway* or code black* or handover* or hand-over* or offload* or off-load* or occupanc*) OR AB (crowding or crowded or overcrowd* or gridlock* or boarded or boarding or overload* or over- load* or hallway* or code black* or handover* or hand-over* or offload* or off-load* or occupanc*)	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	22,360
S2	(MH "Time Factors") OR (MH "Turnaround time") OR (MH "Patient admission") OR (MH "Treatment delay")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	215,228
S1	(MH "Crowding") OR (MH "Length of Stay")	Expanders - Apply equivalent subjects Search modes - Proximity	Interface - EBSCOhost Research Databases Search Screen - Advanced Search Database - CINAHL Complete	55,438

Database: The Cochrane Library		
#	**Searches**	**Number of results**
#1	MeSH descriptor: [Crowding] this term only	34
#2	MeSH descriptor: [Length of Stay] this term only	9749
#3	MeSH descriptor: [Time Factors] this term only	82498
#4	MeSH descriptor: [Patient Admission] this term only	835
#5	((crowding or crowded or overcrowd* or gridlock* or boarded or boarding or overload* or over-load* or hallway* or code black* or handover* or hand-over* or offload* or off-load* or occupanc*)):ti,ab,kw (Word variations have been searched)	23384
#6	(((staff* or personnel* or nurs* or physician* or doctor* or resident* or paramedic* or bed* or resourc* or hospital*) NEAR/4 (shortag* or capacit* or strain*))):ti,ab,kw (Word variations have been searched)	1776

#7	((delay* NEAR/5 (service* or "being seen" or treat* or therap* or care or caring or exam* or clearance or consult*))):ti,ab,kw (Word variations have been searched)	9497
#8	((volume* NEAR/4 (patient* OR case OR "use" OR usage OR center* OR centre*))):ti,ab,kw (Word variations have been searched)	8426
#9	((staff* NEAR/2 (patient* or bed*) NEAR/2 ratio*)):ti,ab,kw (Word variations have been searched)	25
#10	((bed* NEAR/3 (spac* or availab* or capacit* or utiliz* or utilis* or "use" or usage))):ti,ab,kw (Word variations have been searched)	1775
#11	((care* NEAR/3 interval*)):ti,ab,kw (Word variations have been searched)	323
#12	((throughput* or through-put* or output* or out-put*)):ti,ab,kw (Word variations have been searched)	22215
#13	(("access block" or "access blocks" or "bed block" OR "bed blocks" or "exit block" or "exit blocks" or "access gap" or "access gaps")):ti,ab,kw (Word variations have been searched)	71
#14	((re-enter or reenter or re-entr* or reentr* or readmit* or re-admit* or readmiss* or re-admiss*)):ti,ab,kw (Word variations have been searched)	12316
#15	(("without being seen")):ti,ab,kw (Word variations have been searched)	29
#16	(((leav* or left*) NEAR/6 ("medical advice" or treat*))):ti,ab,kw (Word variations have been searched)	4506
#17	((wait* NEAR/3 time*)):ti,ab,kw (Word variations have been searched)	1820
#18	(((length* or prolong*) NEAR/5 (stay* or wait*))):ti,ab,kw (Word variations have been searched)	37698
#19	((patient* NEAR/2 flow*)):ti,ab,kw (Word variations have been searched)	1530
#20	MeSH descriptor: [Health Services Misuse] explode all trees	791
#21	((overutili* or over-utili* or overus* or over-us*)):ti,ab,kw (Word variations have been searched)	2301
#22	(((nonurgent or non-urgent or semiurgent or semi-urgent or nonacute or non-acute or unnecessary or preventable) NEAR/5 (patient* or visit* or use* or care or problem* or attend* or clinic*))):ti,ab,kw (Word variations have been searched)	57261
#23	(((level or low) NEAR/3 (acuit* or complexit*))):ti,ab,kw (Word variations have been searched)	886
#24	{OR #1-#23)	245929
#25	MeSH descriptor: [Emergency Medicine] explode all trees	387
#26	MeSH descriptor: [Emergency Medical Services] explode all trees	6303
#27	MeSH descriptor: [Paramedicine] explode all trees	2
#28	((emergenc* NEAR/5 (hospital* or department* or room* or service* or care or unit* or ward* or "communication system" or dispatch* or "call centre" or "call center" or transportation* or psychiatr* or prehospital* or pre-hospital* or outpatient* or out-patient*))):ti,ab,kw (Word variations have been searched)	25507

#29	((trauma* NEAR/3 (unit* or care))):ti,ab,kw (Word variations have been searched)	966
#30	((emergicentre* or emergicenter* or emerg or paramed* or emergetolog*)):ti,ab,kw (Word variations have been searched)	80520
#31	((accident* NEAR/4 department*)):ti,ab,kw (Word variations have been searched)	253
#32	((ambulance*)):ti,ab,kw (Word variations have been searched)	1337
#33	(("Canadian Triage & Acuity Scale" or "Canadian Triage and Acuity Scale" or "emergency severity index")):ti,ab,kw (Word variations have been searched)	63
#34	MeSH descriptor: [Emergency Nursing] explode all trees	104
#35	((emergenc* NEAR/4 (personnel* or staff* or team* or nurs* or physician* or doctor* or resident* or responder* or medical technician* or patient* or specialist*))):ti,ab,kw (Word variations have been searched)	12820
#36	((first NEAR/3 responder*)):ti,ab,kw (Word variations have been searched)	427
#37	(("A and E" or "A & E" or "A&E" or CTAS or ESI)):ti,ab,kw (Word variations have been searched)	1767
#38	"Emergency and Critical Care":crg	2733
#39	MeSH descriptor: [Emergency Responders] explode all trees	518
#40	MeSH descriptor: [Evidence-Based Emergency Medicine] explode all trees	6
#41	{OR #25-#40)	86685
#42	#24 AND #41 with Cochrane Library publication date Between Mar 2023 and Dec 2025, in Cochrane Reviews	32

Appendix 6 — Grey literature sources

A search of unpublished (grey) literature was conducted. Resources searched (as adapted from the CDA-AMC grey literature search) from 23 January 2025 to 24 February 2025:

EU/ECCE

- Austria
  - Institute of Technology Assessment (ITA)
- Belgium
  - Kenniscentrum voor de Gezondheidszorg / Le Centre d'expertise des soins de santé (Belgian Health Care Knowledge Centre) (KCE)
- Denmark
  - Sundhedsstyrelsen (Danish Health and Medicines Authority)
- France
  - Comité d'Evaluation de Diffusion des Innovations Technologiques (Committee for the Evaluation and Dissemination of Technological Innovations) (CEDIT)
  - Haute Autorité de Santé (French National Authority for Health) (HAS)
- Germany
  - Deutsches Institut für Medizinische Dokumentation und Information (German Institute for Medical Documentation and Information) (DIMDI)
  - Institute for Quality and Efficiency in Health Care (IQWIQ)
- Ireland
  - Health Service Executive (HSE)
- The Netherlands
  - De Gezondheidsraad (The Health Council) (GR)
- Norway
  - Folkehelseinstituttet (Norwegian Institute of Public Health) (NIPH)
- Sweden
  - Sahlgrenska Universitetssjukhuset (Sahlgrenska University Hospital)

Non-EU

- Australia
  - Monash Health (Centre for Clinical Effectiveness)
  - Sax Institute
  - Australian Government Department of Health - Medical Services Advisory Committee (MSAC)
- Canada

    - Newfoundland and Labrador Centre for Applied Health Research (NLCAHR) - Contextualized Health Research Synthesis Program (CHRSP)
    - Alberta Health
    - Manitoba Centre for Health Policy (MCHP)
    - Health Quality Ontario
    - O'Brien Institute for Public Health
    - The Institut national d'excellence en santé et en services sociaux (The National Institute of Excellence in Health and Social Services) (INESSS)
    - Centre d'expertise et de référence en santé publique (Quebec's National Public Health Insititute) (INSPQ)
    - Ottawa Hospital Research Institute
    - The Hospital for Sick Children (SickKids)
    - McGill University Health Centre (MUHC)
    - University of British Columbia
    - Health Quality Council of Alberta (HQCA)
    - British Columbia Ministry of Health
    - Institute of Health Economics (IHE)
    - Programs for Assessment of Technology in Health (PATH)
    - The Alberta College of Family Physicians (ACFP)
- United Kingdom
    - NIHR Evaluation, Trials and Studies Coordinating Centre
    - University of York
    - UK Department of Health (NHS)
- United States of America
    - Washington State Health Care Authority
    - Institute for Clinical and Economic Review
    - Centers for Medicare & Medicaid Services (CMS)
    - National Center for Biotechnology Information (NCBI)
    - Department of Veterans Affairs (U.S.) (Health Services Research & Development)
    - National Library of Medicine (NLM)
    - U.S. National Library of Medicine & National Institutes of Health (NIH)

EU and International

- World Health Organization Regional Office for Europe
- International Network of Agencies for Health Technology Assessment (INAHTA)
- Joanna Briggs Institute

Latin America

- Latin-American and Caribbean Center on Health Sciences Information (LILACS)

A search of Google (**https://www.google.com/**) was also conducted on 05 February 2025:

Search ("crowding" OR "overcrowding" OR "access blocks" OR "bed blocks" OR "wait times" OR "delays OR "length of stay" OR "emergency ambulances")
AND emergency department.

Sorted by relevance, limited by date: 1 March 2023 to 5 February 2025, and first 5 pages screened (50 results).

Appendix 7 — Sample data extraction template

	Information Extracted
Characteristics of Systematic Review	
Study ID	
Author(s)	
Study Title	
Publication Date	
Conflict of Interest Details (if reported)	
Funding Source(s)	
Systematic Review Methodology	
Aims and or Objectives	
Databases Searched	
Search Dates	
Inclusion Criteria	
Exclusion Criteria	
Outcomes of interest (of the Systematic Review)	
Method of Synthesis	
Methodological Quality and or Risk of Bias Tool(s) Used	
Characteristics of Relevant Primary Studies	
Number of primary studies	
Number of relevant primary studies (reason)	
Publication dates	
Countries where primary studies were conducted	
Included Study Designs	
Conflict of Interest Details (if reported)	
Funding Source(s) (if reported)	
Population Information (from relevant studies)	
Population	
Sample sizes in individual primary studies	

Setting	
Interventions and Comparators (from relevant studies)	
Types of Intervention	
Intervention Duration	
How the Intervention was Implemented	
Comparator Details	
Factor Intervention(s) Aimed to Target *(Within the ED - Input, Throughput, Output;* *Outside the ED - Hospital-wide collaboration, Post-hospital discharge case management, Policy reform, Multicomponent)*	
Results of the SR for relevant studies/outcomes	
Outcomes Reported in the Systematic Review	
Outcomes per Subgroup	
Summary of Key Results and or Findings	
Author Conclusions	
Limitations Noted	
Appraisal of Evidence	
Overall Methodological Quality Assessment of Included Studies	
Overall Risk of Bias Assessment of Included Studies	
Outcome-Level Certainty of Evidence Assessments	

Appendix 8 — Intervention effectiveness (adapted from Canada's Drug Agency summary of systematic reviews†)

Step 1.	Step 2.	Step 3.	Step 4.	
Direction of the effects (intervention versus comparator)	**Certainty of the evidence (intervention versus comparator)**	**Effectiveness category** CDA-AMC definition	**Confidence in the methodological quality of the SR (AMSTAR 2)**	**Overall effectiveness**
Favourable (effect in favour of the intervention)	Systematic review authors reported a high or moderate level of certainty OR We assigned the evidence as certain or some uncertainty	**Favourable** There is certain evidence or evidence with some uncertainty of better effectiveness of the intervention versus a comparator, or the systematic review authors reported a high or moderate level of certainty on other scales, such as GRADE or EPC, of better effectiveness of the intervention versus a comparator.	Moderate to High	**Intervention with evidence of favourable effect**
			Low or critically low	**Favourable, inconclusive[a]**
	Systematic review authors reported a low or very low level of certainty OR We assigned the evidence as very uncertain	**Favourable, inconclusive** There is evidence of better effectiveness of an intervention versus a comparator, yet the systematic review authors reported a low or very low level of certainty or we assigned the evidence as very uncertain.	Moderate to High	**Favourable, inconclusive[b]**
			Low or critically low	**Favourable, inconclusive[c]**
Neutral (neither intervention was favoured)	Systematic review authors reported a high or moderate level of certainty OR We assigned the evidence as certain or some uncertainty	**Neutral** There is certain evidence or evidence with some uncertainty (moderate or high certainty) that neither the intervention nor the comparator was favoured.	Moderate to High	**Intervention with evidence of neutral effect**
			Low or critically low	**Neutral, inconclusive[a]**
	Systematic review authors reported a low or very low level of certainty	**Neutral, inconclusive** There is evidence that neither the intervention nor the comparator was	Moderate to High	**Neutral, inconclusive[b]**

	OR We assigned the evidence as very uncertain	favoured, yet the evidence is very uncertain (low or very low certainty).	Low or critically low	**Neutral, inconclusive[c]**
Mixed (evidence for both directions of effect)	N/A	**Mixed, inconclusive** There are heterogeneous results for effectiveness of an intervention versus a comparator, and the heterogeneity is too serious to draw a conclusion.	N/A	**Mixed, inconclusive**
Unfavourable (effect in favour of the comparator)	Systematic review authors reported a high or moderate level of certainty OR We assigned the evidence as certain or some uncertainty	**Unfavourable** There is certain evidence or evidence with some uncertainty (moderate or high certainty) of worse effectiveness of the intervention versus a comparator.	Moderate to High	**Intervention with evidence of unfavourable effect**
			Low or critically low	**Unfavourable, inconclusive[a]**
	Systematic review authors reported a low or very low level of certainty OR We assigned the evidence as very uncertain	**Unfavourable, inconclusive** There is evidence of worse effectiveness of the intervention versus a comparator, yet the evidence is very uncertain (low or very low certainty).	Moderate to High	**Unfavourable, inconclusive[b]**
			Low or critically low	**Unfavourable, inconclusive[c]**
No evidence	N/A	**No evidence** There is no evidence from primary studies.*	N/A	No overall rating applied

Key: AMSTAR 2 = A MeaSurement Tool to Assess systematic Reviews 2; CDA-AMC = Canada's Drug Agency; EPC = Evidence-based Practice Center program of the Agency of Healthcare Research and Quality; GRADE = Grading of Recommendation, Assessment, Development and Evaluation; N/A = Not available

[a]The evidence of effectiveness is deemed inconclusive due to a low or critically low AMSTAR 2 rating.

[b]The evidence of effectiveness is deemed inconclusive due to a low or very low certainty of evidence (very uncertain).

[c]Overall effectiveness is deemed inconclusive due to a combination of a low or critically low AMSTAR 2 rating and a low or very low certainty of evidence (very uncertain).

*This was assigned only to outcomes reported by the systematic review authors as the primary outcome of interest, or included in the primary objective of the systematic review.

†CDA-AMC summary of systematic reviews.(15)

Appendix 9 — Articles excluded following full-text review (presented alphabetically via author surname)

Article	Exclusion reason
Adibhatla, S.; Lurie, T.; Betz, G.; Palmer, J.; Raffman, A.; Andhavarapu, S.; Harris, A.; Tran, Q. K.; Gingold, D. B. A Systematic Review of Methodologies and Outcome Measures of Mobile Integrated Health-Community Paramedicine Programs. *Prehospital emergency care* 2024; 28(1):168EP - 178	Publication date pre 28 March 2023
Aguilera, C.; Wong, G.; Khan, Z.; Pivazyan, G.; Breton, J. M.; Lynes, J.; Deshmukh, V. R. Patient outcomes after implementation of transitional care protocols. *Neurosurgical Review* 2024; 47(1):362	Not specifically intending to target ED overcrowding
Alhabib, A.; Almutairi, M.; Alqurashi, H. Patient-Centered Care Model's Effectiveness in Reducing Patient Waiting Time in the Emergency Department: A Systematic Literature Review. *Saudi Journal of Health Systems Research* 2024; 4(3):103-113	Not a systematic review
Almass, A.; Aldawood, M. M.; Aldawd, H.M.; AlGhuraybi, S. I.; Al Madhi, A. A.; Alassaf, M.; Alnafia, A.; Alhamar, A. I.; Almutairi, A.; Alsulami, F. A Systematic Review of the Causes, Consequences, and Solutions of Emergency Department Overcrowding in Saudi Arabia. *Cureus* 2023; 15(12):e50669	Not a systematic review
Alruwaili, A.; Alanazy, A.; Alanazi, T. M.; Alobaidi, N.; Almamary, A. S.; Faqihi, B. M.; Al Enazi, F. H.; Siraj, R.; Almukhlifi, Y.; Al Nufaiei, Z. F.; Alsulami, M. Managing High Frequency of Ambulance Calls in Hospitals: A Systematic Review. *Risk Management and Healthcare Policy* 2024; 17():287EP - 296	No comparator
Alsuhebany, N.; Alkhudair, N.; Alzahrani, M.; Alnajjar, F.; Alrajhi, A. M.; Aldoughaim, M.; Alnuhait, M.; Alharbi, A.; Alshamrani, M.; Alshaya, O. Ambulatory care hematology/oncology pharmacy services: A comprehensive review by the Saudi Oncology Pharmacy Assembly. *JACCP Journal of the American College of Clinical Pharmacy* 2024; 7(6):570EP - 580	Not a systematic review

Article	Exclusion reason
Alter, N.; Arif, H.; Wright, D. D.; Martinez, B.; Elkbuli, A. Telehealth Utilization in Trauma Care: The Effects on Emergency Department Length of Stay and Associated Outcomes. *American Surgeon* 2023; 89(11):4826EP - 4834	Not a systematic review
Appelbaum, R. D.; Puzio, T. J.; Bauman, Z.; Asfaw, S.; Spencer, A.; Dumas, R. P.; Kaur, K.; Cunningham, K. W.; Butler, D.; Sawhney, J. S.; Gadomski, S.; Horwood, C. R.; Stuever, M.; Sapp, A.; Gandhi, R.; Freeman, J. Handoffs and transitions of care: A systematic review, meta-analysis, and practice management guideline from the Eastern Association for the Surgery of Trauma. *Journal of Trauma and Acute Care Surgery* 2024;97(2):305EP - 314	Not specifically intending to target ED overcrowding
Aspas Sebastia, N.; Navarro Martinez, O. Telenursing as a tool in emergencies and disasters: A systematic review. *International emergency nursing* 2024; 75():101478	No comparator
Barbosa, M. F.; Canan, A.; Xi, Y.; Litt, H.; Diercks, D. B.; Abbara, S.; Kay, F. U. Comparative Effectiveness of Coronary CT Angiography and Standard of Care for Evaluating Acute Chest Pain: A Living Systematic Review and Meta-Analysis. *Radiology: Cardiothoracic Imaging* 2023; 5(4):e230022	Not specifically intending to target ED overcrowding
Basmaji, J.; Arntfield, R.; Desai, K.; Lau, V. I.; Lewis, K.; Rochwerg, B.; Fiorini, K.; Honarmand, K.; Slessarev, M.; Leligdowicz, A.; Park, B.; Prager, R.; Wong, M. Y. S.; Jones, P. M.; Ball, I. M.; Orozco, N.; Meade, M.; Thabane, L.; Guyatt, G. The Impact of Point-of-Care Ultrasound-Guided Resuscitation on Clinical Outcomes in Patients with Shock: A Systematic Review and Meta-Analysis. *Critical Care Medicine* 2024; 52(11):1661EP – 1673	Not specifically intending to target ED overcrowding
Basso, I.; Gonella, S.; Bassi, E.; Caristia, S.; Campagna, S.; Dal Molin, A. Impact of Quality Improvement Interventions on Hospital Admissions from Nursing Homes: A Systematic Review and Meta-Analysis*. Journal of the American Medical Directors Association* 2024; 25(11):105261	Not specifically intending to target ED overcrowding
Berkovic, D.; Vallance, P.; Harris, I. A.; Naylor, J. M.; Lewis, P. L.; de Steiger, R.; Buchbinder, R.; Ademi, Z.; Soh, S. E.; Ackerman, I. N. A systematic review and meta-analysis of short-stay	Not specifically intending to target ED overcrowding

Article	Exclusion reason
programmes for total hip and knee replacement, focusing on safety and optimal patient selection. *BMC Medicine* 2023;21(1):511	
Braver, J.; Marwick, T. H.; Oldenburg, B.; Issaka, A.; Carrington, M. J. Digital Health Programs to Reduce Readmissions in Coronary Artery Disease: A Systematic Review and Meta-Analysis. *JACC. Advances* 2023;2(8):100591	Not specifically intending to target ED overcrowding
Burns, A; Fitzpatrick, J-M.; Teahan, Á.; Clements, K.; Lee, C.; Lovett, H.; McGrath, N.; Long, J. Safety and effectiveness of remote pre-hospital triage for appropriate emergency department attendances and service use: An evidence review. Health Research Board 2024.	No comparator
Chambers, D.; Cantrell, A.; Preston, L.; Marincowitz, C.; Wright, L.; Conroy, S.; Lee Gordan, A. Reducing unplanned hospital admissions from care homes: a systematic review. *Health and social care delivery research* 2023; 11(18):1-130	Not specifically intending to target ED overcrowding
Daher, M.; Cobvarrubias, O.; Boufadel, P.; Fares, M. Y.; Goltz, D. E.; Khan, A. Z.; Horneff, J. G.; Abboud, J. A. Outpatient versus inpatient total shoulder arthroplasty: A meta-analysis of clinical outcomes and adverse events. *International Orthopaedics* 2025; 49(1):151EP - 165	Not specifically intending to target ED overcrowding
Deng, Z. J.; Gui, L.; Chen, J.; Peng, S. S.; Ding, Y. F.; Wei, A. H. Clinical, economic and humanistic outcomes of medication therapy management services: A systematic review and meta-analysis. *Frontiers in Pharmacology* 2023; 14():1143444	Not specifically intending to target ED overcrowding
Detollenaere J.; Van Ingelghem, I.; Van den Heede, K.; Vlayen, J. Systematic literature review on the effectiveness and safety of paediatric hospital-at-home care as a substitute for hospital care. *Eur J Pediatr* 2023;182(6):2735-2757	Not specifically intending to target ED overcrowding
Dick, S.; Macrae, C.; McFaul, C.; Wilson, P.; Turner, S. W. Interventions in primary and community care to reduce urgent paediatric hospital admissions: Systematic review. *Archives of Disease in Childhood* 2023; 108(6):486EP - 491	Publication date pre 28 March 2023

Article	Exclusion reason
Dmitriew, C.; Houle, D. J.; Filipovic, M.; Chochla, E.; Hemy, A.; Woods, C.; Farhat, N.; Campbell, A.; Liu, L. J. W.; Cragg, J. J.; Crispo, J. A. G. Transitional care clinics for patients discharged from hospital without a primary care provider: A systematic review. *Journal of Hospital Medicine* 2024; 19(8):720EP - 727	Not specifically intending to target ED overcrowding
Eapen, V.; Gerstl, B.; Ahinkorah, B. O.; John, J. R.; Hawker, P.; Nguyen, T. P.; Brice, F.; Winata, T.; Bowden, M. Evidence-based brief interventions targeting acute mental health presentations for children and adolescents: systematic review. *BJPsych Open* 2024; 10(3):e78	Not specifically intending to target ED overcrowding
Ellis, R.; Blough, A.; Clark, M. A systematic review of physical function tests as predictors of key clinical outcomes for adults with blood cancers. *Supportive Care in Cancer* 2023;31(9):555	Not specifically intending to target ED overcrowding
Farzandipour, M.; Nabovati, E.; Sharif, R. The effectiveness of tele-triage during the COVID-19 pandemic: A systematic review and narrative synthesis. *Journal of telemedicine and telecare* 2024; 30(9):1367EP - 1375	Publication date pre 28 March 2023
Feliciano, D. R.; Reis-Pina, P. Enhancing End-of-Life Care With Home-Based Palliative Interventions: A Systematic Review. *Journal of Pain and Symptom Management* 2024	Not specifically intending to target ED overcrowding
Ferguson, C.; Shaikh, F.; Allida, S. M.; Hendriks, J.; Gallagher, C.; Bajorek, B. V.; Donkor, A.; Inglis, S. C. Clinical service organisation for adults with atrial fibrillation. *Cochrane Database of Systematic Reviews* 2024; 2024(7):CD013408	Not specifically intending to target ED overcrowding
Flanagan, P.; Waller, R.; Lin, I.; Richards, K.; Truter, P.; Machado, G. C.; Cavalheri, V. Interventions to improve the quality of low back pain care in emergency departments: a systematic review and meta-analysis. *Internal and emergency medicine* 2024	Not specifically intending to target ED overcrowding
Fried, S.; Bar-Shai, A.; Frydman, S.; Freund, O. Transition of care interventions to manage severe COVID-19 in the ambulatory setting: a systematic review. *Internal and emergency medicine* 2024; 19(3):765EP - 775	Not specifically intending to target ED overcrowding

Article	Exclusion reason
Grygorian, A.; Montano, D.; Shojaa, M.; Ferencak, M.; Schmitz, N. Digital Health Interventions and Patient Safety in Abdominal Surgery: A Systematic Review and Meta-Analysis. *JAMA Network Open* 2024; 7(4):E248555	Not specifically intending to target ED overcrowding
Harji, D. P.; Griffiths, B.; Stocken, D.; Pearse, R.; Blazeby, J.; Brown, J. M. Protocolized care pathways in emergency general surgery: a systematic review and meta-analysis. *British Journal of Surgery* 2024; 111(3):znae057	Not specifically intending to target ED overcrowding
Hasan, M. K.; Nasrullah, S. M.; Quattrocchi, A.; Arcos Gonzalez, P.; Castro-Delgado, R. Hospital surge capacity preparedness in disasters and emergencies: a systematic review. *Public Health* 2023; 225():12EP - 21	Not specifically intending to target ED overcrowding
Howitt, L.; Jacob, G.; Zucal, G.; Smith, J.; Crocker Ellacott, R.; Sharkey, S. Navigation Support during Transitions in Care for Persons with Complex Care Needs: A Systematic Review. *Healthcare* (Basel, Switzerland) 2024;12(18)	Not specifically intending to target ED overcrowding
Huang, Z.; Liu, T.; Gao, R.; Chair, S. Y. Effects of nurse-led self-care interventions on health outcomes among people with heart failure: A systematic review and meta-analysis. *Journal of clinical nursing* 2024; 33(4):1282EP - 1294	Not specifically intending to target ED overcrowding
Jansen, A-J. S.; Peters, G. M.; Kooij, L.; Doggen, C. J.M.; van Harten, W. H. Device based monitoring in digital care and its impact on hospital service use. *NPJ Digital Medicine* 2025; 8(1):1-12	No appropriate risk of bias assessment
Jasinska-Stroschein, M.; Waszyk-Nowaczyk, M. Multidimensional Interventions on Supporting Disease Management for Hospitalized Patients with Heart Failure: The Role of Clinical and Community Pharmacists. *Journal of Clinical Medicine* 2023; 12(8):3037	Not specifically intending to target ED overcrowding
Johnson, R.; Chang, T.; Moineddin, R.; Upshaw, T.; Crampton, N.; Wallace, E.; Pinto, A. D. Using Primary Health Care Electronic Medical Records to Predict Hospitalizations, Emergency Department Visits, and Mortality: A Systematic Review. *Journal of the American Board of Family Medicine* 2024; 37(4):583EP - 606	Not specifically intending to target ED overcrowding

Article	Exclusion reason
Keller, M. S.; Qureshi, N.; Mays, A. M.; Sarkisian, C. A.; Pevnick, J. M. Cumulative Update of a Systematic Overview Evaluating Interventions Addressing Polypharmacy. *JAMA Network Open* 2024; 7(1):E2350963	Not a systematic review
Louras, N.; Reading Turchioe, M.; Shafran Topaz, L.; Ellison, M.; Abudu-Solo, J.; Blutinger, E.; Munjal, K. G.; Daniels, B.; Masterson Creber, R. M. Mobile Integrated Health Interventions for Older Adults: A Systematic Review. *Innovation in aging* 2023; 7(3):igad017	Publication date pre 28 March 2023
Manning, L.; Islam, M. S. A systematic review to identify the challenges to achieving effective patient flow in public hospitals. *The International journal of health planning and management* 2023; 38(3):805EP - 828	Publication date pre 28 March 2023
Mitra, A.; Veerakone, R.; Li, K.; Nix, T.; Hashikawa, A.; Mahajan, P. Telemedicine in paediatric emergency care: A systematic review. *Journal of telemedicine and telecare* 2023; 29(8):579EP - 590	Publication date pre 28 March 2023
Ohta, R.; Yawata, M.; Sano, C. Effectiveness of Doctor Clerks Supporting Physicians' Work in Japan: A Systematic Review. *Cureus* 2024; 16(2):e53407	Not specifically intending to target ED overcrowding
Omuya, H.; Nickel, C.; Wilson, P.; Chewning, B. A systematic review of randomised-controlled trials on deprescribing outcomes in older adults with polypharmacy. *The International Journal of Pharmacy Practice* 2023; 31(4):349-368	Not specifically intending to target ED overcrowding
Otis, M.; Barber, S.; Amet, M.; Nicholls, D. Models of integrated care for young people experiencing medical emergencies related to mental illness: a realist systematic review. *European Child & Adolescent Psychiatry* 2023;32(12):2439-2452	Publication date pre 28 March 2023
Pang, P. S.; Collins, S. P.; Cox, Z. L.; Roumpf, S. K.; Strachan, C. C.; Swigart, W.; Ramirez, M.; Hunter, B. R. Clinical and utilization outcomes with short-stay units vs hospital admission for lower risk decompensated heart failure: a systematic review and meta-analysis. *Heart Failure Reviews* 2024	Not specifically intending to target ED overcrowding

Article	Exclusion reason
Park, Y.; Kim, J.; Kim, S.; Moon, D.; Jo, H. Effects of Transitional Care after Hospital Discharge in Patients with Chronic Obstructive Pulmonary Disease: An Updated Systematic Review and Meta-Analysis. *International Journal of Environmental Research and Public Health* 2023; 20(11):6053	Not specifically intending to target ED overcrowding
Putrik, P.; Grobler, L.; Lalor, A.; Ramsay, H.; Gorelik, A.; Karnon, J.; Parker, D.; Morgan, M.; Buchbinder, R.; O'Connor, D. Models for delivery and co-ordination of primary or secondary health care (or both) to older adults living in aged care facilities. *Cochrane Database of Systematic Reviews* 2024; 2024(3):CD013880	Not specifically intending to target ED overcrowding
Reay, G.; Norris, J. M.; Nowell, L.; Hayden, K. A.; Yokom, K.; Lang, E. S.; Lazarenko, G. C.; Abraham, J. Transition in Care from EMS Providers to Emergency Department Nurses: A Systematic Review. *Prehospital emergency care* 2020; 24(3):421EP - 433	Publication date pre 28 March 2023
Rodrigues, R. C.; Gomes, G. K. A.; Sodre, B. M. C.; Lima, R. F.; Barros, D. S. L.; Figueiredo, A. C. M. G.; Stefani, C. M.; da Silva, D. L. M. Lists of potentially inappropriate medications for older people in primary care: a systematic review of health outcomes. *Cadernos de Saude Publica* 2024; 40(5):e00016423	Not specifically intending to target ED overcrowding
Ruiz-Grao, M. C.; Alvarez-Bueno, C.; Garrido-Miguel, M.; Berlanga-Macias, C.; Gonzalez-Molinero, M.; Rodriguez-Martin, B. Multidisciplinary home-based interventions in adverse events and quality of life among frail older people: A systematic review and meta-analysis. *Heliyon* 2024; 10(21):e40015	Not specifically intending to target ED overcrowding
Schober, T.; Wong, K.; Delisle, G.; Caya, C.; Brendish, N. J.; Clark, T. W.; Dendukuri, N.; Doan, Q.; Fontela, P. S.; Gore, G. C.; Li, P.; McGeer, A. J.; Noel, K. C.; Robinson, J. L.; Suarthana, E.; Papenburg, J. Clinical Outcomes of Rapid Respiratory Virus Testing in Emergency Departments: A Systematic Review and Meta-Analysis. *JAMA Internal Medicine* 2024; 184(5):528EP - 536	Not specifically intending to target ED overcrowding
Schwab, C.; Clementz, A.; Dechartres, A.; Fernandez, C.; Hindlet, P. Are Lists of Potentially Inappropriate Medications Associated with Hospital Readmissions? A Systematic Review. *Drugs and Aging* 2024; 41(3):209EP - 218	Not specifically intending to target ED overcrowding

Article	Exclusion reason
Severijns, P.; Goossens, N.; Dankaerts, W.; Pitance, L.; Roussel, N.; Denis, C.; Fourre, A.; Verschueren, P.; Timmermans, A.; Janssens, L. Physiotherapy-led care versus physician-led care for persons with low back pain: A systematic review. *Clinical rehabilitation* 2024; 38(12):1571EP - 1589	Not specifically intending to target ED overcrowding
Shaw, V.; Yu, A.; Parsons, M.; Olsen, T.; Walker, C. Acute assessment services for patient flow assistance in hospital emergency departments. Cochrane Database of Systematic Reviews 2023; 2023(7):CD014553	No information found
Soh, Y. Y.; Zhang, H.; Toh, J. J. Y.; Li, X.; Wu, X. V. The effectiveness of tele-transitions of care interventions in high-risk older adults: A systematic review and meta-analysis. *International Journal of Nursing Studies* 2023;139():N.PAG-N.PAG	Publication date pre 28 March 2023
Tang, M. Y.; Graham, F.; O'Donnell, A.; Beyer, F.; Richmond, C.; Dhami, R.; Sniehotta, F. F.; Kaner, E. F. S. Effectiveness of shared medical appointments delivered in primary care for improving health outcomes in patients with long-term conditions: a systematic review of randomised controlled trials. *BMJ Open* 2024; 14(3):e067252	Not specifically intending to target ED overcrowding
Tian, Y.; Wang, S.; Zhang, Y.; Meng, L.; Li, X. Effectiveness of information and communication technology-based integrated care for older adults: a systematic review and meta-analysis. *Frontiers in public health* 2023; 11():1276574	Not specifically intending to target ED overcrowding
Tyagi, M.; Vashundhara; Rajkumar. Systematic Approaches to Orthopaedic Trauma Management in Rural Settings: Challenges, Innovations, and Evidence-Based Solutions - A Systematic Review. *International Journal of Pharmaceutical and Clinical Research* 2024; 16(12):1049EP - 1053	Not a systematic review
Tyler, N.; Hodkinson, A.; Planner, C.; Angelakis, I.; Keyworth, C.; Hall, A.; Jones, P. P.; Wright, O. G.; Keers, R.; Blakeman, T.; Panagioti, M. Transitional Care Interventions from Hospital to Community to Reduce Health Care Use and Improve Patient Outcomes: A Systematic Review and Network Meta-Analysis. *JAMA Network Open* 2023; 6(11):E2344825	Not specifically intending to target ED overcrowding

Article	Exclusion reason
Waite, E.; Ahmed, Z. How safe and effective are paediatric virtual fracture clinics? A systematic review. *Frontiers in Digital Health* 2023; 5():1261035	Not specifically intending to target ED overcrowding
Wang, C.; Ba, Y.; Ni, J.; Huang, R.; Du, X. Role of Telemedicine Intervention in the Treatment of Patients with Chronic Heart Failure: A Systematic Review and Meta-analysis. *Anatolian Journal of Cardiology* 2024; 28(4):177EP - 187	Not specifically intending to target ED overcrowding
Weeda, E.; Gilbert, R. E.; Kolo, S. J.; Haney, J. S.; Hazard, L. T.; Taber, D. J.; Axon, R. N. Impact of Pharmacist-Driven Transitions of Care Interventions on Post-hospital Outcomes Among Patients With Coronary Artery Disease: A Systematic Review. *Journal of Pharmacy Practice* 2023; 36(3):668EP - 678	Not specifically intending to target ED overcrowding
Zhou, D.; Chen, Z.; Tian, F. Deprescribing Interventions for Older Patients: A Systematic Review and Meta-Analysis. *Journal of the American Medical Directors Association* 2023; 24(11):1718-1725	Not specifically intending to target ED overcrowding
Zylla, M. M.; Imberti, J. F.; Leyva, F.; Casado-Arroyo, R.; Braunschweig, F.; Purerfellner, H.; Merino, J. L.; Boriani, G. Same-day discharge vs. overnight stay following catheter ablation for atrial fibrillation: a comprehensive review and meta-analysis by the European Heart Rhythm Association Health Economics Committee. *Society of Cardiology* 2024; 26(8)	Not specifically intending to target ED overcrowding

Appendix 10 — Detailed findings tables (listed by category)

Summary of findings for input interventions

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Black et al.[40] (2024) Descriptive statistics Up to March 2024	Effectiveness of rapid access chest pain clinics (RACPC) on patient outcomes and resource utilisation	Not reported (NR) NR	1 RCT 2 prospective cohort study Face-to-face or telehealth RACPC clinics versus routine care	Adults Patients with chest pain referred from ED or primary care	Emergency department (ED) reattendance	Findings were consistent with RACPCs being associated with favourable clinical outcomes, reduced emergency department reattendance, cost effectiveness and high patient satisfaction… Others found that RACPC could facilitate early ED discharge without a concomitant increase in hospital admission rates. High levels of satisfaction are consistently reported by both patients and referring doctors.	Very uncertain[a]	Favourable, inconclusive	Moderate	Favourable, inconclusive
			1 prospective cohort study RACPC versus routine care		ED referrals		Very uncertain[a]	Favourable, inconclusive		Favourable, inconclusive
			1 retrospective cohort study RACPC versus routine care		Early ED discharge		Very uncertain[a]	Favourable, inconclusive		Favourable, inconclusive
			1 pre and post study 1 RCT 1 prospective cohort study RACPC versus routine care		Patient satisfaction		Very uncertain[a]	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Burrell et al.[41] (2023) Framework analysis and narrative synthesis January 1990 to August 2022	General Practitioner (GP) roles in emergency medical services (EMS)	UK, Sweden, Norway NR	4 prospective studies 1 retrospective study GP use in non-critical emergency medical services versus direct conveyance to ED/no GP use	NR Non-critical (low-acuity) patients of EMS	ED non-conveyance	GPs in EMS does seem to offer some clinical benefit, although the reduction in ED conveyance and hospital admission in interventional studies may be owing to low-acuity case selection rather than the impact of GPs themselves. Once referred, there is minimal evidence that specific patient groups benefit more from GP involvement than others.	Some uncertainty[b]	Favourable, inconclusive	Critically low	Favourable, inconclusive
Kim et al.[42] (2023) Descriptive statistics and meta-analysis Until June 2021	Effectiveness of telenursing interventions on patient outcomes for colorectal cancer (CRC) patients	Australia, UK NR	2 RCTs Telephone based intervention versus face-to-face interventions	Adults Patients with colorectal cancer	ED visits	Our findings showed that the effect of telenursing intervention did not differ from that of usual care, thus indicating that telenursing may be an alternative way to provide nursing care for patients with CRC and for those who reside in remote areas.	Very uncertain[c]	Neutral, inconclusive	Critically low	Neutral, inconclusive
			2 RCTs Telephone based intervention versus face-to-face interventions		Patient satisfaction		Very uncertain[c]	Favourable, inconclusive	Critically low	Favourable, inconclusive
Shahabian et al.[33] (2024) Descriptive statistics Up to November 2020	Strategies for the management of ambulance diversion (AD) and ED overcrowding	USA, Canada NR	4 prospective before-after studies 2 retrospective before-after studies Diversion guidelines versus pre diversion guidelines	NR NR	Ambulance diversion time	In summary, increasing bed capacity, AD ban and diversion policy, the formation of improvement teams, the cooperation between regional hospitals and emergency medical services organizations, and determination of optimal patient destination by a destination-control	Very uncertain[c]	Favourable, inconclusive	Critically low	Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			2 retrospective before-after studies Diversion guidelines versus no pre diversion guidelines		ED length of stay (LOS)	physician are the main strategies for decreasing ambulance deviation in order to reduce ED overcrowding.	Very uncertain[c]	Favourable, inconclusive		Favourable, inconclusive
			2 prospective before-after studies Determination of optimal patient destination by a destination control physician versus pre destination control physician		Ambulance diversion time		Very uncertain[c]	Favourable, inconclusive		Favourable, inconclusive
			1 prospective before-after studies Determination of optimal patient destination by a destination control physician versus pre destination control physician		ED LOS		Very uncertain[c]	Favourable, inconclusive		Favourable, inconclusive
			1 prospective before-after study		Ambulance diversion time		Very uncertain[c]	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			Formal collaboration of EMS agencies and local hospitals versus pre collaboration							
			2 retrospective before-after studies Full capacity protocol versus pre protocol		Ambulance diversion time		Very uncertain[c]	Favourable, inconclusive		Favourable, inconclusive
			2 retrospective before-after studies Full capacity protocol versus pre protocol		ED LOS		Very uncertain[c]	Mixed, inconclusive		Mixed, inconclusive
			2 retrospective before-after studies Full capacity protocol versus pre protocol		Left without being seen		Very uncertain[c]	Favourable, inconclusive		Favourable, inconclusive
Tian et al.[43] (2024) Descriptive statistics 2010 to September 2023	Effectiveness and stakeholder views of community-based allied health (AH) on acute care utilisation	USA, Canada, Netherlands, Norway, Australia, Denmark, Finland, UK, Sweden, Hong Kong	1 retrospective cohort 3 RCTs 1 quasi-experimental 1 pre/post study Multidisciplinary allied health professional (AHP)-led versus usual care, other	Adults and paediatrics Diverse conditions	ED visits	Overall, the findings suggest that community-based AH services may positively impact acute care utilizations, highlighting their potential to alleviate the pressure on acute care. While patients and their families are supportive of these services, the certainty of evidence for patient-	Very low overall rating (GRADE)	Favourable, inconclusive	Low	Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
		Community	intervention, or no intervention			important outcomes is 'very low', emphasizing cautious interpretation.				
			2 RCTs Multidisciplinary AHP-led versus usual care, other intervention, or no intervention		Patient satisfaction		Very low overall rating (GRADE)	Favourable, inconclusive		Favourable, inconclusive
			6 RCTs 1 prospective cohort study 1 retrospective cohort study 1 quasi-experimental study 1 secondary analysis of RCT Physiotherapy-led versus usual care, other intervention, or no intervention		ED visits		Very low overall rating (GRADE)	Favourable, inconclusive		Favourable, inconclusive
			3 RCTs Physiotherapy-led versus usual care, other intervention, or no intervention		Patient satisfaction		Very low overall rating (GRADE)	Favourable, inconclusive		Favourable, inconclusive
			1 cluster RCT 1 quasi-experimental study 2 retrospective cohort studies Social work-led versus usual care,		ED visits		Very low overall rating (GRADE)	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			other intervention, or no intervention							
			1 RCT Social work-led versus usual care, other intervention, or no intervention		Patient satisfaction		Very low overall rating (GRADE)	Favourable, inconclusive		Favourable, inconclusive
			1 RCT 1 controlled interrupted time series 2 pre/post studies 1 prospective cohort study Nutrition and dietetics-led versus usual care, other intervention, or no intervention		ED visits		Very low overall rating (GRADE)	Favourable, inconclusive		Favourable, inconclusive
			1 RCT Nutrition and dietetics-led versus usual care, other intervention, or no intervention		Patient satisfaction		Very low overall rating (GRADE)	Favourable, inconclusive		Favourable, inconclusive
			1 secondary analysis of cluster RCT 2 RCTs Occupational therapy-led versus usual care, other intervention, or no intervention		ED visits		Very low overall rating (GRADE)	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			1 RCT Psychology-led versus usual care, other intervention, or no intervention		Adverse events		Very low overall rating (GRADE)	Favourable, inconclusive		Favourable, inconclusive

Key: AD = ambulance diversion; AH = allied health; CRC = colorectal cancer; EMS = emergency medical services; GP = general practitioner; GRADE = Grading of Recommendations, Assessment, Development and Evaluations system; LOS = length of stay; NR = not reported; RACPC = rapid access chest pain clinics; RCT = randomised controlled trial.

[a]Overall low quality and high RoB (Cochrane RoB tool, Newcastle-Ottawa Quality Assessment Scale, Consolidated Criteria for Reporting Qualitative Studies checklist).

[b]Satisfactory and key (CASP checklist then ratings from Dixon-Woods et al.).

[c]High RoB overall (Cochrane RoB tool).

Summary of findings for throughput interventions

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Ahmed et al.[24] (2024) Descriptive statistics Up to November 2024	Role of telemedicine in emergency department (ED) triage and patient care	Brazil, USA, Germany, Tunisia In the ED	2 randomised controlled trials (RCTs) Telemedicine versus conventional face-to-face with physician in the ED	Adults Patients presenting to the ED for various medical conditions (i.e. acute respiratory tract infections, non-emergency complaints, and dermatological emergencies).	ED length of stay (LOS)	Telemedicine offers significant potential for improving triage and patient care in EDs, particularly for non-critical cases. The results of this review suggest that telemedicine can enhance diagnostic accuracy, reduce re-consultation rates, improve treatment adherence, and streamline ED workflows, ultimately leading to better patient outcomes. However, further research is needed to evaluate its effectiveness in high-acuity emergency settings and to address the technological and logistical challenges associated with its implementation	Some uncertainty[a]	Favourable, conclusive	Moderate	Favourable
			1 RCT Telemedicine versus conventional face-to-face with physician in the ED		Treatment time		Some uncertainty[a]	Favourable, conclusive		Favourable
			1 RCT Telemedicine versus conventional face-to-face with physician in the ED		Patient satisfaction	Improvements in patient satisfaction and reduced throughput times were particularly notable in non-emergency scenarios	Some uncertainty [a]	Favourable, conclusive		Favourable

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Dick et al.[25] (2024) Descriptive statistics 2000 to February 2024	Interventions to reduce hospital and ED stay in paediatric populations	Australia Discharged from hospital or ED	1 RCT 1 non-randomised trial Outpatient parenteral antibiotic therapy (OPAT) versus intravenous antibiotics administered exclusively during inpatient hospital admission	Paediatrics Various conditions (i.e. cellulitis and urinary tract infections)	ED LOS	Compared with usual care, when care was provided outside of the hospital or ED, healthcare costs were reduced in eight studies reporting on cost-effectiveness, and LOS in ED or hospital decreased in some studies, whilst the total duration of treatment or care increased in some, but not all, studies.	Some uncertainty[b]	Favourable, conclusive	Low	Favourable, inconclusive
			1 RCT OPAT versus intravenous antibiotics administered exclusively during inpatient hospital admission		ED visits		Some uncertainty[b]	Neutral, conclusive		Neutral, inconclusive
			1 RCT Hospital at home versus standard discharge		ED visits		Some uncertainty[b]	Unfavourable, conclusive		Unfavourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Hill et al.[26] (2024) Descriptive statistics and meta-analysis Up to October 2023	Effectiveness of accelerated diagnostic protocols (ADPs) for reducing ED length of stay in patients presenting with chest pain	Australia, USA, Canada, Sweden, Thailand, UK, Switzerland, New Zealand, Belgium In the ED	5 RCTs 32 observational studies ADPs used in the ED versus no use of ADP	Adults Presenting to the ED with chest Pain	ED LOS	Our findings showed that implementing an ADP may significantly reduce ED LOS and should be considered by hospitals or healthcare entities searching for strategies to improve operational efficiency. This decrease in LOS was even seen in the absence of any change in the type of Troponin assay. Moreover, this decrease in LOS was associated with meaningful reductions in hospital admissions, without an increase in subsequent adverse events (such as major adverse cardiac events). The observed benefits also translated across multiple countries and health regions.	Some uncertainty[c]	Favourable, conclusive	Low	Favourable, inconclusive
Huber et al.[27] (2023) Descriptive statistics Up to September 2022	Effectiveness of brief non-pharmacological interventions in ED and psychiatric inpatient units for people in crisis	Not reported (NR) In the ED	1 quasi-experimental study Brochure about panic versus brochure about panic plus ED consultation with educator specialising in panic versus usual care	Adults Patients presenting to the ED with panic symptoms	ED visits	Brochure for panic in ED is ineffective in reducing ED presentations, though face-to-face contact may demonstrate efficacy in larger sample size	Very uncertain[d]	Neutral, inconclusive	Low	Neutral, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Magarey et al.[28] (2023) Descriptive statistics 1990 onwards	Impact of psychiatric observation units on emergency department boarding	USA, Australia Urban hospitals with academic affiliations	4 pre/post retrospective studies 1 mixed prospective and retrospective case control study 1 retrospective case control 1 retrospective case series Admission to an inpatient psychiatric observation unit versus pre-introduction of the psychiatric observation unit	Adults Patients presenting to the ED with a psychiatric illness	ED LOS	We found that there appears to be some benefit following the introduction of such units in ED LOS. Seven of the 14 studies reported ED LOS, a key ED metric, and the majority (6 of 7) showed some reduction in ED LOS. However, the majority of the studies were retrospective and of relatively poor quality due to risk of bias.	Very uncertain[e]	Favourable, inconclusive	Low	Favourable, inconclusive
Memedovich et al.[29] (2023) Descriptive statistics 2013 to January 2023	Effective approaches to address the care needs of patients who often seek care at the ED	USA, Canada, UK, Australia, Sweden, Taiwan, Spain, Belgium, Denmark, Portugal, the Netherlands, Singapore, Switzerland	1 RCT Early assessment and intervention versus usual care	Adults Older adults	ED visits	Care coordination with additional support and early assessment and intervention were the only two interventions that consistently reported improved outcomes for patients, though both studies had relatively small populations. There were no significant improvements in ED revisits for follow-up telephone calls, care transition interventions, early assessment and intervention, and multi-faceted interventions.	Very uncertain[f]	Favourable, inconclusive	Critically low	Favourable, inconclusive
			1 RCT Early assessment and intervention versus usual care		ED LOS		Very uncertain[f]	Favourable, inconclusive		Favourable, inconclusive
			2 observational studies 1 RCT Geriatric assessment versus pre implementation or usual care		ED visits		Very uncertain[f]	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			1 observational study 1 RCT Geriatric assessment versus pre implementation or usual care		ED LOS	One intervention, a geriatric-specific ED with a clinical pharmacy specialist, reported significant increases in ED revisits in intervention patients compared to control patients. No other study, however, reported worse outcomes for patients. It therefore appears that, while patients' needs may not be being met by these interventions, the majority of patients are not being negatively impacted.	Very uncertain[f]	Favourable, inconclusive		Favourable, inconclusive
			2 observational studies 1 RCT Pharmacist or physical therapy consultation versus pre implementation or usual care		ED visits		Very uncertain[f]	Neutral, inconclusive		Neutral, inconclusive
			1 observational study Consult with specialist physician in the ED versus pre implementation	Adults Chronic conditions	ED visits	Overall, several different interventions were utilized for patients with chronic conditions, several of which reported decreases in ED revisits. Many different interventions and combinations of interventions have been utilized across many different chronic conditions. Most controlled trials, however, reported no significant changes in any outcome, and most larger studies reported no significant changes in outcomes. No study reported worse	Very uncertain[f]	Neutral, inconclusive		Neutral, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
						outcomes for patients. The success of interventions was largely dependent on the patients' condition and what patient needs were addressed by the intervention. The successful interventions included care plans for patients with chronic pain to encourage non-opioid methods to pain management, education for patients with heart failure to better manage their condition, a pain contract for frequent users with chronic pain, and a referral to a diabetes management clinic for patients with diabetes. Other interventions for patients with the same conditions were not always successful.				
			1 RCT Telepsychiatry versus usual care	Adults Individuals with mental health conditions	ED visits	One large study assessing telepsychiatry reported a significant decrease in ED revisits, but no other significant changes were reported. No studies reported on patient or staff perspectives, costs, or wait times, and only one reported on outpatient utilization and time spent in the ED.	Very uncertain[f]	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Mitchell et al.[30] (2023) Descriptive statistics 1990 to February 2023	Impact of triage implementation on clinical outcomes and process measures in low- and middle income country EDs	South Africa, China, Egypt, Iran, Uganda, Botswana, India, Mozambique LMIC, LIC, UMIC	2 pre/post studies Triage implementation versus pre-implementation	Adult and paediatrics NR	ED LOS	The direction of effect was positive for most indicators, including mortality, ED LOS, patient satisfaction, time to antibiotics, over-triage, and waiting time. There were conflicting data, or no evidence of association, in relation to inpatient LOS and the rates of hospital and intensive care unit admission, LWBS, and under-triage.	Low (GRADE)	Favourable, inconclusive	Low	Favourable, inconclusive
			6 pre/post studies Triage implementation versus pre-implementation		Waiting time		Moderate (GRADE)	Favourable, conclusive		Favourable, inconclusive
			1 pre/post study Triage implementation versus pre-implementation		Time to antibiotics		Low (GRADE)	Favourable, inconclusive		Favourable, inconclusive
			2 pre/post studies Triage implementation versus pre-implementation		Left without being seen (LWBS)		Very Low (GRADE)	Mixed, inconclusive		Mixed, inconclusive
			3 pre/post studies Triage implementation versus pre-implementation		Patient satisfaction		Very Low (GRADE)	Favourable, inconclusive		Favourable, inconclusive
			3 pre/post studies Triage implementation versus pre-implementation		ED mortality		Low (GRADE)	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Mojebi et al.[31] (2024) Descriptive statistics 2019 to 2023	Clinical impact of rapid molecular diagnostic tests in patients presenting with viral respiratory symptoms	UK, France, Sweden, USA, Australia, Canada, Netherlands Acute Medical Unit (AMU), ED, or other acute areas	6 retrospective studies 3 retrospective pre/post implementation studies 2 non-randomised trials 1 prospective implementation study 1 RCT Rapid molecular diagnostic test (RMDT) versus Standard molecular test or rapid antigen diagnostic test	Adults Patients presenting to the ED with symptoms of respiratory viral illness	ED LOS	Findings from this study suggest that RMDTs optimize patient flow and improve patient bed management by accelerating the patient characterization process and having a positive impact on patient treatment and discharge decisions, thereby increasing isolation room availability and expediting access to hospital procedures, resulting in more timely clinical decision-making.	Some uncertainty[9]	Favourable, conclusive	Critically low	Favourable, inconclusive
Rolving et al.[32] (2024) Descriptive statistics Up to September 2024	Effect of involving physiotherapists in the management of low back pain (LBP) at ED	UK, Australia, Malta, China In the ED	2 retrospective cohort studies Involvement of physiotherapy versus usual care	Adults Presenting to the ED with low back pain	ED LOS	This review revealed a potentially beneficial effect of ED physiotherapy interventions in comparison with usual care on patients consulting an ED due to LBP with regards to length of stay, referral for imaging and patient satisfaction, while effects on prescription medication and other	Very low (GRADE)	Favourable, inconclusive	Moderate	Favourable, inconclusive
			3 retrospective cohort studies Involvement of physiotherapy versus usual care		ED reattendance		Very low (GRADE)	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			1 retrospective cohort study Involvement of physiotherapy versus usual care		Waiting time	healthcare use, self-reported pain, disability and health-related quality of life were inconclusive. Waiting time at the ED was reported …and was significantly in favour of physiotherapist-led care. Similarly, admission following ED visit was only reported … with significantly fewer admissions among patients receiving physiotherapist-led care	Very low (GRADE)	Favourable, inconclusive		Favourable, inconclusive
			1 prospective cohort study 1 RCT Involvement of physiotherapy versus usual care		Patient satisfaction		Very low (GRADE)	Favourable, inconclusive		Favourable, inconclusive
Shahabian et al.[33] (2024) Descriptive statistics Up to November 2020	Strategies for the management of ambulance diversion (AD) and ED overcrowding	USA, Canada	2 retrospective before-after studies Increase in ED bed capacity versus pre increase	NR NR	Ambulance diversion time	In summary, increasing bed capacity, AD ban and diversion policy, the formation of improvement teams, the cooperation between regional hospitals and emergency medical services organizations, and determination of optimal patient destination by a destination-control physician are the main strategies for decreasing ambulance deviation in order to reduce ED overcrowding. Based on the obtained evidence, the provision of solutions to back-end	Very uncertain[h]	Favourable, inconclusive	Critically low	Favourable, inconclusive
			2 retrospective before-after studies Increase in ED bed capacity versus pre increase		ED LOS		Very uncertain[h]	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			1 retrospective before-after study Development of AMU versus pre development		Ambulance diversion time	problems would bring about the best outcomes. Some studies strived to develop an AMU as a new form of controlling patient flow at the back-end of ED, while other studies tried to control ED overcrowding by increasing bed capacity. An ED-managed acute care unit can have an impact on ED overcrowding and ambulance diversion. Active bed management and quality improvement initiative leads to a significant decrease in ambulance diversion.	Very uncertain[h]	Favourable, inconclusive		Favourable, inconclusive
			1 retrospective before-after study Development of AMU versus pre development		LWBS		Very uncertain[h]	Favourable, inconclusive		Favourable, inconclusive
			1 prospective before-after study Active bed management initiative versus pre initiative		Ambulance diversion time		Very uncertain[h]	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Vella et al.[34] (2024) Descriptive statistics and meta-analysis Up to March 2023	Nurse practitioners and allied health practitioners managing musculoskeletal conditions in ED	UK, Australia, Canada In the ED	1 RCT Primary-contact physiotherapy or nurse practitioner management versus usual care provided by ED physician	Adults Patients presenting to the ED with peripheral soft tissue injury (with no associated bone fracture, ongoing prior injury or systemic disease/disorder)	Patient flow	One trial provided very-low certainty of evidence that no model of care (as in, physiotherapy versus nursing versus emergency physician models of care) was superior than another with regard to patient-flow. The authors suggested that nurse practitioners were cost effective and had a positive impact on waiting times and patient satisfaction, however the impact of nursing models of care on ED services (e.g. ED re-presentation rates) remains unclear.	Very-low (GRADE)	Neutral, inconclusive	Low	Neutral, inconclusive
			2 RCTs Primary-contact physiotherapy or nurse practitioner management versus usual care provided by ED physician		ED reattendance		Very-low (GRADE)	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			2 RCTs Primary-contact physiotherapy or nurse practitioner management versus usual care provided by ED physician		Patient satisfaction		Low (GRADE)	Favourable, inconclusive		Favourable, inconclusive
Wong and Teoh[35] (2024) Descriptive statistics 2018 onwards	Effectiveness of palliative care initiation in the ED in reducing healthcare utilisation among adults with life-limiting disease	NR In the ED	1 cross sectional study 1 retrospective observational study Initiation of palliative care services in the ED versus standard practice without initiation of palliative care intervention in the ED	Adults Patients presenting to the ED with life-limiting disease	ED LOS	The effectiveness of palliative care initiation in the ED in reducing ED LOS remains inconclusive. The study found no notable distinctions in ED LOS or 10-day repeat ED visit rates	Some uncertainty[i]	Neutral, conclusive	Low	Neutral, inconclusive
			1 cross sectional study Initiation of palliative care services in the ED versus standard practice without initiation of palliative care		ED reattendance		Some uncertainty[i]	Neutral, conclusive		Neutral, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			intervention in the ED							
Youssef et al.[36] (2024) Descriptive statistics and meta-analysis NR	Interventions to improve ED throughput and care delivery indicators	Australia, Canada, France, Turkey, South Africa, Spain, Thailand, UK, USA All ED settings (community, teaching, rural, urban)	7 RCTs POC testing vs central laboratory	Adults/Paediatric All age groups presenting to the ED	ED LOS	Overall, our systematic review and meta-analyses showed that ED interventions identified in our search (point-of-care testing, triage liaison physician, expedited upfront workup, etc.) were all successful in improving ED flow. Most of these interventions that are generally designed to mitigate ED crowding resulted in reduction of at least one of the ED flow metrics (ED LOS, waiting time, and LWBS). Automatic notification to residents: However, there was no significant disparity in ED length of stay between the control and intervention groups. Similarly, no significant statistical difference was observed in the turnaround time for discharged patients.	Moderate (GRADE)	Favourable, conclusive	Low	Favourable, inconclusive
			4 RCTs POC testing vs central laboratory		Waiting time		Moderate (GRADE)	Favourable, conclusive		Favourable, inconclusive
			4 RCTs Triage liaison physician versus routine triage		ED LOS		Moderate (GRADE)	Favourable, conclusive		Favourable, inconclusive
			2 RCTs Triage liaison physician versus routine triage		Waiting time		Moderate (GRADE)	Favourable, conclusive		Favourable, inconclusive
			3 RCTs Triage liaison physician versus routine triage		LWBS		Moderate (GRADE)	Favourable, conclusive		Favourable, inconclusive
			3 RCTs Expedited upfront workup versus routine care		ED LOS		Moderate (GRADE)	Favourable, conclusive		Favourable, inconclusive
			1 RCT Triage kiosk versus regular check-in		Waiting time		Moderate (GRADE)	Favourable, conclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			1 RCT Triage kiosk versus regular check-in		Time to triage		Moderate (GRADE)	Neutral, conclusive		Neutral, inconclusive
			1 RCT Automatic notifications to ED residents to review their patient list versus routine care		ED LOS		Moderate (GRADE)	Neutral, conclusive		Neutral, inconclusive
			1 RCT Automatic notifications to ED residents to review their patient list versus routine care		Turnaround time		Moderate (GRADE)	Neutral, conclusive		Neutral, inconclusive
			1 RCT Messaging consultants with a secure messaging app versus notifying consults verbally via telephone		ED LOS		Moderate (GRADE)	Favourable, conclusive		Favourable, inconclusive
			1 RCT Use of scribes in the ED versus no scribes		ED LOS		Moderate (GRADE)	Favourable, conclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			1 RCT Announcing Level 2 cases to medical staff by microphone versus announcing by telephone or announcing by computer		Waiting time		Moderate (GRADE)	Favourable, conclusive		Favourable, inconclusive

Key: AD = ambulance diversion; ADP: accelerated diagnostic protocol; AMU = Acute Medical Unit; ED = emergency department; GRADE = Grading of Recommendations, Assessment, Development and Evaluations system; LBP = lower back pain; LOS = length of stay; LWBS = left without being seen; NR = not reported; OPAT = outpatient parenteral antibiotic therapy; RCT = randomised controlled trial; RMDT = rapid molecular diagnostic test.

[a]Fair to good (Downs and Black scale). Includes 'fair' quality studies, small number of studies, small study sizes (publication bias) and limited generalisability (per SR authors), though there was consistency in reported outcomes across studies.

[b]High and medium overall rating (CASP checklist). Heterogeneity in outcomes between studies and small sample sizes.

[c]Low overall RoB (Cochrane RoB tool and Newcastle-Ottawa Scale) but significant heterogeneity of results, including across most subgroups, and authors state 'results should be interpreted cautiously'.

[d]Moderate on JBI, but also includes one study with very small sample size.

[e]All NRS and moderate to serious overall RoB (ROBINS-I tool).

[f]Overall, study quality was moderate to low; RCT: low to high RoB; Observational: Moderate to Critical RoB.

[g]Overall low (ROBINS-I tool) and overall low (Cochrane RoB tool).

[h]High RoB overall (Cochrane RoB tool).

[i]High quality (JBI cross-sectional checklist), however some small samples.

Summary of findings for hospital-wide collaboration with ED interventions

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Shahabian et al.[33] (2024) Descriptive statistics Up to November 2020	Strategies for the management of ambulance diversion (AD) and emergency department (ED) overcrowding	USA, Canada	1 retrospective before-after studies 1 prospective before-after studies Process improvement teams versus pre-process improvement team	Not reported (NR) NR	Ambulance diversion time	In summary, increasing bed capacity, AD ban and diversion policy, the formation of improvement teams, the cooperation between regional hospitals and emergency medical services organizations, and determination of optimal patient destination by a destination-control physician are the main strategies for decreasing ambulance deviation in order to reduce ED overcrowding. Based on the obtained evidence, the provision of solutions to back-end problems would bring about the best outcomes. Some studies strived to develop an ACU as a new form of controlling patient flow at the back-end of ED, while other studies tried to control ED overcrowding by increasing bed capacity.	Very uncertain[a]	Favourable, inconclusive	Critically low	Favourable, inconclusive
			1 prospective before-after study Process improvement teams versus pre-process improvement team	NR NR	ED length of stay		Very uncertain[a]	Favourable, inconclusive		Favourable, inconclusive
			1 retrospective before-after studies	NR NR	Left without being seen		Very uncertain[a]	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			Process improvement teams versus pre-process improvement team							

Key: AD = ambulance diversion; ED = emergency department; NR = not reported.

[a]High overall RoB.

Summary of findings for post-hospital discharge case management interventions

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Ahmed et al.[24] (2024) Descriptive statistics Up to November 2024	Role of telemedicine in ED triage and patient care	Tunisia In the ED	1 RCT Telemedicine follow-up with four telephone calls versus follow-up call on one day only	Adults Patients presenting to the ED for various medical conditions (as in acute respiratory tract infections, non-emergency complaints, and dermatological emergencies)	Patient satisfaction	Improvements in patient satisfaction and reduced throughput times were particularly notable in non-emergency scenarios.	Some uncertainty[a]	Favourable, conclusive	Moderate	Favourable
Bai et al.[37] (2025) Descriptive statistics and meta-analysis Up to April 2023	Associations between early physician follow-up and post-discharge outcomes	Canada, USA Post-hospital discharge	7 cohort studies 2 uncontrolled before and after studies 3 RCTs Physician follow-up visit within 30 days of hospital discharge versus no follow-up with physician within 30 days of hospital discharge	Adults Hospitalised for a medical condition or to a medical service	ED visits	It is uncertain whether early physician follow-up reduces the risks of hospital readmission, emergency department visit, or death.	Very low (GRADE)	Neutral, inconclusive	Moderate	Neutral, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
Boggan et al.[38] (2025) Descriptive statistics and meta-analysis 2012 to May 2023	Effectiveness of synchronous post discharge contacts on health care use and patient satisfaction	USA, New Zealand, Canada, Denmark, Switzerland, Italy Post discharge from hospital	5 RCTs 1 interrupted time series Telephone delivery of post discharge contacts versus usual discharge care	Adults Various conditions	Emergency department (ED) visits	Our review found little supporting evidence that brief post discharge follow-up calls, often comprising a single telephone call, affect the key health care outcomes of hospital readmissions and ED use at 30 days and patient satisfaction with care.	Moderate (GRADE, RCTs) and very low (GRADE, observational study)	Neutral, conclusive	Moderate	Neutral
			4 RCTs Telephone delivery of post discharge contacts versus usual discharge care		Patient satisfaction		Moderate (GRADE)	Neutral, conclusive		Neutral
Chartrand et al.[39] (2023) Descriptive statistics and meta-analysis Up to March 2021	Patient- and family-centred care transition interventions for adults	USA, Oman, Denmark, Australia, Canada, China, Taiwan Post-discharge from general medicine, general surgery, geriatric, neurosurgery, orthopaedi	16 RCTs Patient- and family-centred care transition interventions provided during or after a hospitalisation versus usual care, simplified intervention, or no other intervention	Adults At least one active chronic condition or who were admitted to a general medicine, general surgery, geriatric, neurosurgery, orthopaedic, or urology unit	ED visits	Patient- and family-centred care transition interventions appear to significantly decrease the risk of unplanned hospital readmissions rates compared to usual care. However, these interventions seem to have minimal impact on the risk of ED visits rates compared to the usual care group, regardless of time after discharge.	Some uncertainty	Neutral, conclusive	Critically low	Neutral, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
		c, or urology unit								
Memedovich et al.[29] (2023) Descriptive statistics 2013 to January 2023	Effective approaches to address the care needs of patients who often seek care at the ED	USA, Canada, UK, Australia, Sweden, Taiwan, Spain, Belgium, Denmark, Portugal, the Netherlands, Singapore, Switzerland	2 observational studies Care coordination versus pre implementation	Adults Frequent users of the ED	ED visits	Care plans and care coordination may be successful at reducing ED revisits, either as a standalone intervention or when paired with some other intervention, whereas case management is unlikely to be successful. Very few studies assessed time spent in the ED, hospital LOS, outpatient utilization, and patient perspectives and no interventions assessed wait times or staff perspectives.	Very uncertain[b]	Favourable, inconclusive	Critically low	Favourable, inconclusive
			1 observational study Care coordination versus pre implementation	Adults Frequent users of the ED	ED length of stay (LOS)		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 observational study Care coordination and home visits versus pre implementation	Adults Frequent users of the ED	ED visits		Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive
			1 RCT Care coordination and referral versus usual care	Adults Frequent users of the ED	ED visits		Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive
			3 observational studies 1 RCT Care plan versus pre	Adults Frequent users of the ED	ED visits		Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			implementation or usual care							
			1 RCT Care plan versus usual care	Adults Frequent users of the ED	ED LOS		Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive
			4 observational studies 1 RCT Case management versus pre implementation or usual care	Adults Frequent users of the ED	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 observational study Care coordination and support versus pre implementation	Adults Older adults	ED visits	Care coordination with additional support and early assessment and intervention were the only two interventions that consistently reported improved outcomes for patients, though both studies had relatively small populations. There were no significant improvements in ED revisits for follow-up	Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive
			1 observational study Care plan, education, and referral versus pre implementation	Adults Older adults	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			1 RCT Care transition intervention versus usual care	Adults Older adults	ED visits	telephone calls, care transition interventions, early assessment and intervention, and multi-faceted interventions. One intervention, a geriatric-specific ED with a clinical pharmacy specialist, reported significant increases in ED revisits in intervention patients compared to control patients.	Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 RCT Education, follow up, telephone call and referral versus usual care	Adults Older adults	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			2 RCTs Follow up, telephone call and referral versus usual care	Adults Older adults	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 RCT Medication review programme versus or usual care	Adults Older adults	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 observational study Care coordination versus pre implementation	Adults Chronic conditions	ED visits	Overall, several different interventions were utilized for patients with chronic conditions, several of which reported	Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			1 observational study Care plan versus pre implementation	Adults Chronic conditions	ED visits	decreases in ED revisits. Many different interventions and combinations of interventions have been utilized across many different chronic conditions. Most controlled trials, however, reported no significant changes in any outcome, and most larger studies reported no significant changes in outcomes. No study reported worse outcomes for patients. The success of interventions was largely dependent on the patients' condition and what patient needs were addressed by the intervention. The successful interventions included care plans for patients with chronic pain to encourage non-opioid methods to pain management,	Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive
			1 RCT Education versus usual care	Adults Chronic conditions	ED visits		Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive
			1 RCT Education versus usual care	Adults Chronic conditions	ED LOS		Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive
			1 observational study Education and referral versus pre implementation	Adults Chronic conditions	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 RCT Flag EMR and referral versus usual care	Adults Chronic conditions	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 RCT Follow up, telephone call, ED counselling versus usual care	Adults Chronic conditions	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 observational study	Adults Chronic conditions	ED visits		Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			Pain contract versus pre implementation			education for patients with heart failure to better manage their condition, a pain contract for frequent users with chronic pain, and a referral to a diabetes management clinic for patients with diabetes. Other interventions for patients with the same conditions were not always successful.				
			1 RCT Pharmacist intervention usual care	Adults Chronic conditions	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			3 observational studies Referral versus pre implementation	Adults Chronic conditions	ED visits		Very uncertain[b]	Mixed, inconclusive		Mixed, inconclusive
			1 observational study Referral versus pre implementation	Adults Substance use disorders	ED visits	Overall, several small studies reported success in reducing ED revisits, including referrals, care plans, and care coordination. However, only five different interventions were tried in this population, many of which had similarities. There may be other interventions that would be useful for patients with a SUD that were not	Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive
			1 observational study Care plan versus pre implementation	Adults Substance use disorders (SUD)	ED visits		Very uncertain[b]	Favourable, inconclusive		Favourable, inconclusive
			1 observational study Flagged EMR and referral versus pre implementation	Adults Substance use disorders	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			1 observational study Flagged EMR and referral versus pre implementation	Adults Substance use disorders	ED LOS	explored in this literature.	Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 observational study 1 RCT Care coordination versus pre implementation or usual care	Adults Substance use disorders	ED visits		Very uncertain[b]	Mixed, inconclusive		Mixed, inconclusive
			1 observational study Screening and brief intervention and referral versus pre implementation	Adults Substance use disorders	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 RCT Referral versus pre implementation	Adults Social and material deprivation	ED visits	Both controlled trials reported significant decreases in ED revisits, but the observational study reported a significant increase in ED revisits.	Some uncertainty[b,c]	Favourable, inconclusive		Favourable, inconclusive
			1 RCT Case management versus pre implementation	Adults Social and material deprivation	ED visits		Some uncertainty[b,c]	Favourable, conclusive		Favourable, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			1 observational study Care transition intervention versus pre implementation	Adults Social and material deprivation	ED visits		Very uncertain[b]	Unfavourable, inconclusive		Unfavourable, inconclusive
			1 observational study Care plan telephone follow up versus pre intervention	Adults Individuals with mental health conditions	ED visits	One large study assessing telepsychiatry reported a significant decrease in ED revisits, but no other significant changes were reported. No studies reported on patient or staff perspectives, costs, or wait times, and only one reported on outpatient utilization and time spent in the ED.	Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 RCT Care plan telephone follow up versus usual care	Adults Individuals with mental health conditions	ED LOS		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 RCT Case management versus usual care	Adults Individuals with mental health conditions	ED visits		Very uncertain[b]	Neutral, inconclusive		Neutral, inconclusive
			1 observational study Referral versus pre implementation	Adults People with disability	ED visits	There were no significant decreases in ED revisits, hospitalization, or time spent in the ED, but there were significant decreases in medical expenditure.	Very uncertain[d]	Neutral, inconclusive		Neutral, inconclusive
			1 observational study	Adults People with disability	ED LOS		Very uncertain[d]	Neutral, inconclusive		Neutral, inconclusive

First author (Year) Synthesis Search Dates	Focus	Country Setting	Types of studies Intervention-comparison	Population Condition	Outcome	Conclusions by authors	Certainty	Effectiveness category	AMSTAR-2	Overall effectiveness rating
			Referral versus pre implementation							
			1 observational study Referral versus pre implementation	Adults People experiencing homelessness	ED visits	There was a significant decrease in ED visits, but no other significant changes.	Very uncertain[d]	Favourable, inconclusive		Favourable, inconclusive

Key: ADP = accelerated diagnostic protocol; AMU = Acute Medical Units; ED = emergency department; EMS = emergency medical services; GP = general practioner, GRADE = Grading of Recommendations Assessment, Development and Evaluation; LIC = low-income country; LMIC = low-middle income country; LOS = length of stay; LWBS = left without being seen; NR = not reported; OECD = Organisation for Economic Co-operation and Development; POC = point-of-care, RACPC = rapid access chest pain clinic; RCT = randomised controlled trial; RoB = risk of bias; SUD = substance abuse disorder; UK = United Kingdom; UMIC = upper-middle income country; USA = United States of America.

[a]Fair to good (Downs and Black scale). Includes 'fair' quality studies, small number of studies, small study sizes (publication bias) and limited generalisability (per SR authors), though there was consistency in reported outcomes across studies.

[b]Overall, study quality was low; RCT: some concerns to high RoB; Observational: Moderate to serious RoB.

[c]RCT only and large sample size.

[d]Observational: Serious RoB.

Appendix 11 — Overlap table

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Total # of studies in systematic review	4	12	6	8	5	16	3	37	1	4	7	58	12	13	5	18	31	4	2	20	266
# of unique studies	4	11	6	8	5	15	3	37	1	4	7	58	12	13	5	18	31	4	2	20	265
# of overlapping studies	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Primary studies																					**Frequency**
Aboumatar (2019)						Y															1
Accorsi (2022)	Y																				1
Al Marashi (2020)								Y													1
Alburaih (2018)												Y									1
Al-Hashar (2018)						Y															1
Allen (2018)								Y													1
Anand (2021)								Y													1
Angus (2020)															Y						1
Arendts (2006)																				Y	1
Arendts (2018)*												Y									1
Asamoah (2008)																Y					1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Asha (2014)*																				Y	1
Asthana (2018)												Y									1
Auger (2018)							Y														1
Au Yeung (2021)														Y							1
Balaban (2015)						Y															1
Barnes (2021)								Y													1
Beaver (2012)										Y											1
Bean (2019)																	Y				1
Begaz (2017)*																				Y	1
Bell (2016)*				Y																	1
Berkowitz (2018)																	Y				1
Berwa (2022)														Y							1
Bevins (2022)								Y													1
Bibby (2022)														Y							1
Biese (2014)*												Y									1
Biese (2017)												Y									1
Black (2013)																	Y				1
Black (2019)			Y																		1
Black (2023)			Y																		1
Blair (2018)												Y									1
Blind (2022)												Y									1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Blodgett (2017)					Y																1
Blodgett (2020)					Y																1
Bodenmann (2017)												Y									1
Boockvar (2022)																	Y				1
Braitberg (2018)*											Y										1
Brendish (2020)														Y							1
Brennan (1999)	Y																				1
Browne (2011)*											Y										1
Bruijns (2008)													Y								1
Burke (2013)																Y					1
Burns (2014)*						Y															1
Buttinger (2019)								Y													1
Cai (2020)													Y								1
Cancella (2023)														Y							1
Capp (2017)*												Y									1
Carlton (2020)								Y													1
Cassarino (2021)												Y									1
Castillo (2011)																Y					1
Chaisirin (2020)																				Y	1
Cheng (2013)*																				Y	1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Chew (2019)								Y													1
Cho (2023)																	Y				1
Chu (2017)																	Y				1
Clari (2015)				Y																	1
Clemson (2016)																	Y				1
Collinsworth (2018)						Y															1
Corace (2020)												Y									1
Cossette (2015)*												Y									1
Coultas (2016)																	Y				1
Courtney (2009)*						Y															1
Coyle (2019)																				Y	1
Crowder (2015)								Y													1
Davies (2022)															Y						1
Dekker-Boersema (2017)													Y								1
Dev (2021)		Y																			1
Dhalla (2014)		Y																			1
Douma (2016)*																				Y	1
Dyckman (1999)									Y												1
Edgren (2016)												Y									1
Elbaih (2022)													Y								1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Elston (2022)												Y									1
Farag (2016)																	Y				1
Farris (2014)				Y																	1
Fidahussein (2014)*		Y																			1
Fiesseler (2015)												Y									1
Flowers (2019)												Y									1
Foo (2014)*												Y									1
Ford (2021)								Y													1
Friedman (2011)																Y					1
Furmaga (2021)								Y													1
Gagnon (2021)																		Y			1
Ganguli (2021)								Y													1
Gao (2022)												Y									1
Gerdtz (2019)												Y									1
Gerlier (2021)														Y							1
Gitlin (2017)																	Y				1
Goldberg (2020)												Y									1
Goldstein (2018)																				Y	1
Goncalves (2022)												Y									1
Granata (2020)																				Y	1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Greenslade (2020)								Y													1
Griffin (2021)		Y																			1
Grover (2016)												Y									1
Grover (2018)												Y									1
Gulacti (2017)*																				Y	1
Gurvey (2013)																	Y				1
Haag (2016)				Y																	1
Hansoti (2016)													Y								1
Hansoti (2017)													Y								1
Harrison (2002)*						Y															1
Harrison (2011)										Y											1
Hausfater (2020)																				Y	1
Heeren (2019)*												Y									1
Henschen (2022)						Y															1
Hill (2011)																	Y				1
Hill (2023)								Y													1
Holroyd (2007)*																				Y	1
Howell (2008)*																Y					1
Hsiao (2007)																				Y	1
Hsu (2022)												Y									1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Hu (2020)						Y															1
Huber (2021)											Y										1
Hughes (2023)								Y													1
Hussein (2022)		Y																			1
Ibrahim (2019)							Y														1
Jang (2013)*																				Y	1
Jefford (2016)										Y											1
Jesudason (2012)																		Y			1
Jimenez-Barragan (2021)																				Y	1
Juanes (2022)												Y									1
Kahler (2017)												Y									1
Karlson (1998)			Y																		1
Karvelas (2017)																	Y				1
Kashef (2018)			Y																		1
Kelen (2001)*																Y					1
Kelley (2020)*												Y									1
Kendall (1998)*																				Y	1
Khankeh (2013)													Y								1
Kim (2022)											Y										1
Knott (2013)																	Y				1
Kraal (2017)																	Y				1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Krickus (2023)		Y																			1
Kuluski (2016)		Y																			1
Lambrakis (2021)								Y													1
Lankelma (2019)														Y							1
Larsson (2017)					Y																1
Lau (2008)*															Y						1
Lee (2017)*																Y					1
Lee (2020)													Y								1
Leith (2020)																			Y		1
Lesser (2018)												Y									1
Li (2011)*																				Y	1
Liang (2021)						Y															1
Liberman (2020)												Y									1
Lin (2016)													Y								1
Lin (2017)*												Y									1
Lin (2021)												Y									1
Lindpaintner (2013)				Y																	1
Lisby (2019)						Y															1
Livingstone (2022)														Y							1
Ljung (2019)								Y													1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Lundby (2020)				Y																	1
Maeng (2020)												Y									1
Magny-Normilus (2021)						Y															1
Mahler (2018)								Y													1
Martinot (2019)														Y							1
McCarty (2015)												Y									1
McClellan (2012)*																		Y			1
McConnel (2005)																Y					1
McLeod (2010)																Y					1
Menon (2020)																	Y				1
Miller (2022)								Y													1
Mitchell (2014)																	Y				1
Mitchell (2020)											Y										1
Mohmed (2021)								Y													1
Moreno (2021)																	Y				1
Mortazavi (2022)														Y							1
Mountain (2016)								Y													1
Mullan (2014)													Y								1
Mumma (2020)								Y													1
Mungani (2020)								Y													1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Murphy (2014)*												Y									1
Murphy (2017)												Y									1
Murray (1999)*																				Y	1
Naar (2018)																	Y				1
Naylor (1999)						Y															1
Naylor (2004)						Y															1
Neven (2016)*												Y									1
Ng (2015)												Y									1
Nguyen (2016)																	Y				1
Nossel (2016)												Y									1
Ola (2021)								Y													1
Parsonage (2017)								Y													1
Parwani (2018)*											Y										1
Patel (2006)																Y					1
Patel (2012)*																Y					1
Patel (2021)		Y																			1
Peaper (2021)														Y							1
Pedersen (2016)												Y									1
Phillips (2023)								Y													1
Price (2005)			Y																		1
Pringle (2018)												Y									1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Randolph (2018)								Y													1
Rash (2018)												Y									1
Reinius (2013)												Y									1
Reuter (2018)																			Y		1
Richardson (2005)																		Y			1
Richardson (2010)																	Y				1
Ridsdale (2013)												Y									1
Ringwalt (2015)*												Y									1
Rogers (2019)																Y					1
Rowe (2016)																	Y				1
Rowe (2023)								Y													1
Ruangsomboon (2018)								Y													1
Salisbury (2013)																	Y				1
Santolaya-Perrin (2019)												Y									1
Sayer (2018)															Y						1
Scanlan (2019)							Y														1
Schulz (2016)															Y						1
Schumacher (2021)												Y									1
Seaberg (2017)*												Y									1
Shah (2006)																Y					1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Shankar (2022)												Y									1
Sharma (2010)		Y																			1
Shaw (2016)												Y									1
Shrapnel (2019)												Y									1
Siddle (2018)																	Y				1
Singh (2022)													Y								1
Smith (2020a)																	Y				1
Smith (2020b)												Y									1
Sommers (2011)		Y																			1
Soltane (2024)	Y																				1
Soong (2014)				Y																	1
Stamy (2021)*											Y										1
Stanley (2015)												Y									1
Stergiopoulos (2017)*												Y									1
Stevens-Lapsley (2023)																	Y				1
Subash (2004)*																				Y	1
Suh (2022)								Y													1
Suikkanen (2021)																	Y				1
Swart (2018)													Y								1
Tabit (2017)												Y									1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Taylor (2023)																	Y				1
Than (2018)								Y													1
Than (2021)								Y													1
Tistad (2018)																	Y				1
Toh (2023)			Y																		1
Trent (2022)								Y													1
Tu (2020)						Y															1
Twerenbold (2016)								Y													1
Tyner (2023)								Y													1
Van Assche (2023)								Y													1
van Loon-van Gaalen (2021)																Y					1
Van Spall (2019)		Y				Y															2
Vigen (2020)								Y													1
Vilke (2004a)																Y					1
Vilke (2004b)																Y					1
Villa (2020)	Y																				1
Villareal (2017)					Y																1
Wabe (2019)														Y							1
Walker (2019)*																				Y	1
Watase (2012)																Y					1

Systematic review	Ahmed et al.[24]	Bai et al.[37]	Black et al.[40]	Boggan et al.[38]	Burrell et al.[41]	Chartrand et al.[39]	Dick et al.[25]	Hill et al.[26]	Huber et al.[27]	Kim et al.[42]	Magarey et al.[28]	Memedovich et al.[29]	Mitchell et al.[30]	Mojebi et al.[31]	Rolving et al.[32]	Shahabian et al.[33]	Tian et al.[43]	Vella et al.[34]	Wong and Teoh[35]	Youssef et al.[36]	Total
Weerahandi (2015)																	Y				1
Weinberger (1996)		Y																			1
Wesolowksi (2023)														Y							1
Wexler (2015)*												Y									1
Willard (2017)*																Y					1
Yancer (2006)																Y					1
Yiadom (2020)				Y																	1
Young (2013)*										Y											1
Zafar (2020)												Y									1
Zakariassen (2010)					Y																1
Zanaboni (2023)																	Y				1

Key: *Included in CDA-AMC summary of reviews.

Appendix 12 — Detailed information for Ahmed et al. systematic review

A systematic review by Ahmed et al.[24] presented a narrative synthesis, which included four relevant RCTs[45-47] that measured the effectiveness of telemedicine in an adult population on a range of outcomes (ED LOS, treatment time, and patient satisfaction), in a variety of ED settings (see Table A1). Briefly,

- ED LOS:
    - One RCT[46] investigated the effect of telemedicine as a 'virtual ED' in the hospital, compared to standard face-to-face evaluation, in adults who presented to the ED with acute respiratory tract infections, during the COVID-19 pandemic. The average ED LOS was similar in both groups, indicating telemedicine as an effective alternative for managing low-risk patients.
    - One RCT[47] investigated the effects of remote treatment via telemedicine, in adults attending a suburban ED with non-emergency complaints. Remote treatment was provided by an emergency physician located in a rural hospital. Compared to those who received in-person treatment (in the suburban ED), the telemedicine group had a shorter average throughput time.
- Treatment time:
    - One RCT[45] investigated the effects of telemedicine for remote evaluation of skin lesions, compared to face-to-face consultation, in adults presenting with dermatological emergencies to the ED. Treatment time was significantly shorter for the telemedicine group compared to those who received face-to-face evaluation and diagnosis.
- Patient satisfaction:
    - The same RCT which investigated the effects of remote treatment by an emergency physician located at a rural hospital also reported that telemedicine patients were slightly more satisfied with the care received, compared to those who had in-person treatment.[47]
    - One RCT[87] investigated the effects of telemedicine (telephone calls on days two, seven, 15 and 30) on adults who were discharged from the ED with non-emergency conditions. Significantly more patients in the telemedicine group were satisfied with their care, compared to those

who received standard care (and who received a follow-up phone call on day 30).

Overall, Ahmed et al.[24] concluded in their systematic review that telemedicine offers significant potential for improving triage and patient care in EDs, particularly for non-critical cases.

Comparison with the findings of the CDA-AMC summary of reviews

In relation to telemedicine, the CDA-AMC summary of reviews[15] found that moderate to high-intensity transitional care interventions (TCI) were effective in reducing ED visits. These TCI consisted of telephone follow-up combined with home visits, clinic follow-up and or video visits, with older patients who had congestive heart failure who had been discharged home following an inpatient admission.[52] Those who underwent the moderate to high-intensity TCI had fewer ED visits, compared to those who received usual care. The low-intensity TCI, which consisted solely of telephone follow-up, had no effect on ED visits.[52]

The implementation of remote triage (triage from a distance, including telephone, video, web or short message service) was found to have no effect on ED visits.[66]

A number of other telemedicine interventions were outlined by the CDA-AMC to have favourable or neutral effect, but had inconclusive evidence, including:

- telemedicine triage on ED LOS,[88] ED visits,[89] and patient satisfaction[90]
- lean healthcare interventions supported by digital technologies on ED LOS, ED-related wait times, patients leaving without being seen and patient satisfaction[91]
- post-discharge telemedicine on ED visits[92, 93] and patient satisfaction.[93]

Table A1. Study characteristics of relevant RCTs from Ahmed et al.[†] with conclusive evidence of favourable effect

Category	Authors Year Country	Intervention details Comparator	Population (n) Condition(s)	Findings	Overall systematic review conclusion
ED LOS					"Telemedicine offers significant potential for improving triage and patient care in EDs, particularly for non-critical cases. The results of this review suggest that telemedicine can enhance diagnostic accuracy, reduce re-consultation rates, improve treatment adherence, and streamline ED workflows, ultimately leading to better patient outcomes. However, further research is needed to evaluate its effectiveness in high-acuity emergency settings and to address the technological and logistical challenges associated with its implementation."
Throughput	Accorsi et al.[46] 2022 Brazil	**Intervention:** Patients attending the ED received a brief telemedicine consultation in a 'virtual ED' in the hospital, before a face-to-face evaluation. The diagnosis was based on the patient's history and institutional protocols, and telemedicine physicians could consult a decision support system integrated into the electronic medical records. *Telemedicine type:* Direct-to-consumer telemedicine. *Technology:* Licensed HIPAA-compliant platform (InTouch Health), connected to institutional wireless network, using Cerner Millennium electronic records system. *Delivery:* Digital tablet (Apple iPad). **Comparator:** Face-to-face evaluation at the ED.	Adults (Intervention: n = 48; Comparator: n = 50) Acute respiratory tract infections during COVID-19 pandemic.	The average ED LOS was similar in both groups (80.8 minutes for telemedicine versus 97.9 minutes for face-to-face, p = 0.167), indicating telemedicine as an effective alternative for managing low-risk patients.	
Throughput	Brennan et al.[47] 1999 USA	**Intervention:** Patients attending an ED in a suburban hospital were evaluated by a nurse in-person, and treated by a remote emergency physician located at a rural hospital using a telemedicine link. *Telemedicine type:* Real-time telemedicine. *Technology:* "Friendly Roll-about Engineered for Doctors" with peripherals such as digital stethoscope, otoscope, dermascope. *Delivery:* Video workstations. **Comparator:** In-person treatment by an emergency physician at the suburban hospital.	Adults (Intervention: n = 54; Comparator: n = 50) Non-emergency complaints (for example, abrasions, allergic reactions, and eye conditions).	Telemedicine group had a shorter average throughput time (106 minutes) compared to the control group (117 minutes).	
Patient Satisfaction					

Category	Authors Year Country	Intervention details Comparator	Population (n) Condition(s)	Findings	Overall systematic review conclusion
Throughput	Brennan et al.[47] 1999 USA	See ED LOS outcome.	See ED LOS outcome.	Patient satisfaction was high in both groups, with telemedicine patients slightly more satisfied with the care received.	
Post-hospital discharge case management	Soltane et al.[47, 87] 2024 Tunisia	**Intervention:** The telemedicine group received follow-up at home via structured telephone calls on days 2, 7, 15, and 30 after ED discharge. Interventions included adjusting treatment, changing dosage, stopping treatment, or referring patients to specialists. *Telemedicine type:* Telephone follow-up. *Technology:* No specific telemedicine platform used. *Delivery:* Standard hospital telephone. **Comparator:** Standard care with a follow-up phone call only on day 30 after ED discharge.	Adults (Intervention: n = 200; Comparator: n = 200) Non-emergency conditions such as benign infectious diseases, trauma, mild decompensation of chronic conditions and suspected COVID-19 cases.	Significantly more patients in the telemedicine group were satisfied with their care, compared to the control group (90% versus 37.5%, $p < 0.05$).	
Treatment Time					
Throughput	Villa et al.[45] 2020 Germany	**Intervention:** An emergency physician in the ED took images of skin lesions and sent them to a remote dermatologist for evaluation. Suspected diagnosis was made based on the transmitted images and clinical data. **Telemedicine type:** Store-and-forward teledermatology. **Technology:** Photographic acquisition and transmission of skin lesions for tele-evaluation. **Delivery:** Tablet PC (Pokini TAB A8, EXTRA Computer GmbH). **Comparator:** Face-to-face evaluation and diagnosis by a dermatologist in the ED.	Adults (Intervention: n = 50; Comparator: n = 50) Dermatological emergencies.	Treatment time was significantly shorter in the telemedicine group (43 ± 38 minutes) compared to the conventional group (151 ± 71 minutes, $p < 0.001$).	

Key: COPD = chronic obstructive pulmonary disease; COVID-19 = coronavirus disease 2019; ED = emergency department; HIPAA = Health Insurance Portability and Accountability Act; p = probability value (used in statistical tests); PC = personal computer.

[†]Ahmed et al.[(24)]

Appendix 13 — Detailed information for Boggan et al. systematic review

A systematic review by Boggan et al.[38] presented a meta-analysis of eight relevant RCTs that measured the impact of various post-hospital discharge case management programmes on ED visits (five RCTs[55-59]) and patient satisfaction (four RCTs[59-62]) (see Table A2). An interrupted time series study which provided data for ED visits was also described narratively.[63] Briefly, for:

- ED visits:
    - One RCT[55] investigated the effect of pharmacists providing services such as medication reconciliation, counselling and education to patients hospitalised for acute coronary syndrome and or acute decompensated heart failure. Services were provided both pre and post-hospital discharge. Usual and routine discharge consisted of nurses, pharmacists, and physicians involved in the patients' care performing medication reconciliation and counselling, with no routinely performed post-discharge follow-up calls. When compared with usual care and routine discharge, the intervention was found to have no effect on time to first unplanned ED visit.
    - One RCT[56] investigated the effects of (i) a minimal intervention by a pharmacist case manager (which included medication review and reconciliation, and patient education) and (ii) an enhanced intervention which included the minimal intervention, as well as a post-hospital discharge care plan and follow-up call. Standard care involved medication reconciliation at admission according to hospital policy, nurse discharge counselling and a discharge medication list for patients. When compared with standard care, neither intervention had an effect on the number of ED visits, at 30 or 90 days post hospital discharge.
    - One RCT[57] investigated the effects of a pharmacist-led medication therapy management consultation (post-hospital discharge), compared with a nurse medication review. A similar number of ED visits at 30-days post-hospital discharge was observed for both the pharmacist-led and nurse-led reviews.
    - One interrupted time series study[63] investigated the effect of a post-discharge telephone assessment, education, and support by a team of experienced community nurses on the first and third days after

discharge, in older adults with an acute medical admission who were identified as high-risk. There were also pre-discharge components, which included nutrition screening and possible referral to a dietitian, allied health review, and discharge medication reconciliation and patient education. This was compared with the period before the intervention was implemented. No significant difference in ED visits at 30 days was found between pre and post implementation.

- One RCT[58] investigated the effects of a post-hospital discharge phone call by patient navigators (that is, a non-clinician who facilitates appointment scheduling and acts as a resource for the medical team, patient, and families) providing general health and discharge information, compared with usual care (no post-hospital discharge phone call) in adults. Similar results for ED visits at 30 days were observed in both the intervention and the control groups.

- One RCT[59] investigated a nurse using a script along with a 'teach back' technique, to assess patient knowledge of discharge diagnosis and plan, and to identify and address gaps in knowledge or planned care transition supports. This was compared with usual care, which included reviewing documentation noting their new medication regimen, follow-up appointment scheduling planning, education on new diagnoses and symptoms for which to seek care, with no follow-up call. A similar number of ED revisits was observed between the intervention and the control groups.

- Patient satisfaction:

  - One RCT[60] investigated the effects of a telephone call follow-up, by a nurse, 24–96 hours after discharge. Overall patient health, and if an educational intervention or reinforcement technique was undertaken, was noted. No significant difference was observed, for either overall experience of hospitalisation or clarity of information received, between patients who received the intervention and those who received usual care which involved patients receiving routine instructions for discharge, without a telephone call.

  - One RCT[61] investigated a nurse care manager carrying out pre- and post-discharge activities. The nurse care manager phoned patients within 24 hours of discharge, to evaluate self-efficacy (which is an individual's belief in their ability to execute behaviours to achieve an outcome) and reinforce self-management strategies; was available by pager 24 hours a day for five days; and ended the intervention with a home visit. Significantly higher satisfaction was reported in the

intervention group, compared with the control group (who received routine care, which was no care or contact from the nurse care manager).

- One RCT[62] investigated the effects of a pharmaconomist (similar to a pharmacist without the legal authority to own a pharmacy) providing pre- and post-discharge care, including discharge counselling, medication review and a telephone call three days after discharge. A similar numbers of patients in the intervention group and the control group (who received standard care, which consisted of medication reconciliation as well as usual discharge procedures within the surgical department) reported overall satisfaction 'to a great extent' or 'to a very great extent'.
- The same RCT[59] that investigated using a nurse to make a post-discharge phone call with a 'teach back' method also assessed patient satisfaction. There was no significant difference, for 'overall experience' or 'likelihood to recommend', between groups.

Overall, Boggan et al.*(38)* reported no evidence of effect of post-hospital discharge telemedicine case management on ED visits or patient satisfaction.[2]

Comparison with the findings of the CDA-AMC summary of reviews

The CDA-AMC summary of systematic reviews[15] found two post-hospital discharge case management interventions[52, 53] with conclusive evidence of a favourable effect on ED visits. One of these, moderate to high-intensity transitional care interventions which involved telemedicine as part of a comprehensive support package,[52] is described in Section 4.2.1.

The second type of intervention was broadly described by the systematic review authors as a care coordination strategy. This involves one or more healthcare practitioners organising care in consultation with the patient, to address the patient's healthcare needs.[53] Care coordination may involve case management, team changes, promotion of self-management, decision support and or use of a clinical information system. Specific interventions also included other quality improvement strategies such as patient navigators, outreach activities, patient education or

[2] The overall systematic review conclusions included interpretation of evidence from four additional primary studies that did not assess outcomes relevant to the current update.

appointment reminders, and clinician reminders. A reduction in all ED visits was observed in patients that received a care coordination strategy intervention, compared to routine care.

Table A2. Study characteristics of relevant evidence from Boggan et al.[†] with conclusive evidence of neutral effect, in the post-hospital discharge case management category

Authors Year Country	Intervention details Comparator	Population (n) Condition(s)	Findings	Overall systematic review conclusion
ED Visits				"Our review found little supporting evidence that brief post-discharge follow-up calls, often comprising a single telephone call, affect the key health care outcomes of hospital readmissions and ED use at 30 days and patient satisfaction with care."
Bell et al.[(55)] 2016 USA	**Intervention:** Pharmacists provided patients with services including medication reconciliation; counselling –- including educating patients on medication regimens, and troubleshooting barriers to adherence; and educational materials pre- and post-hospital discharge. Patients were contacted within four days of discharge and medication-related issues were referred to pharmacists. **Comparator:** Usual care, routine discharge which consisted of nurses, pharmacists, and physicians involved in the patients' care performing reconciliation and counselling, with no routinely performed post-discharge follow-up calls.	Adults (Intervention: n = 430; Comparator: n = 432) Patients hospitalised for acute coronary syndrome and or acute decompensated heart failure (HF).	No significant difference in time to first unplanned ED visit was observed between the intervention group and the control group (aHR = 1.04, 95 % CI 0.78-1.39). A reduction in early ED visits was observed for patients in the intervention group that had inadequate health literacy (n = 87) (aHR = 0.29, 95 % CI 0.11-0.78, p = 0.01).	
Farris et al.[(56)] 2014 USA	Two intervention groups: minimal and enhanced. **Minimal intervention:** A pharmacist case manager (PCM) carried out medication review and reconciliation at admission, recommendations to medical team and patient education pre-discharge. No telephone call. **Enhanced intervention:** Minimal intervention plus a discharge care plan prepared by the PCM, faxed to the community physician and pharmacy. The PCM phoned the patient 3-5 days after discharge to evaluate adherence and	Adults (Minimal intervention: n = 314; Enhanced intervention: n = 315; Usual care: n = 316) Hypertension, hyperlipidaemia, HF, coronary artery disease, myocardial infarction, stroke, transient ischaemic attack, asthma, or COPD or receiving oral anticoagulation.	A similar percentage of patients in the enhanced (E) (13.5%) and minimal (M) (16.5%) intervention groups had an ED visit within 30 days, when compared to the control (C) group (17.8%) (no significant difference). Similar results were observed for the 90-day ED visit outcome (E (14.6%), M (13.6%), C (15.7%)) (no significant difference).	

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	new side effects, and answer questions. The report was faxed to the community physician and pharmacist if a problem was noted. **Comparator:** Standard care involved medication reconciliation at admission according to hospital policy, nurse discharge counselling and a discharge medication list for patients.			
Haag et al.[57] 2016 USA	**Intervention:** Pharmacist-led medication therapy management consultation 3-7 business days after hospital discharge. Pharmacists reviewed the electronic medical record to complete a comprehensive review of all prescriptions, non-prescriptions, and herbal medications. **Comparator:** A nurse practitioner home visit up to three days after discharge to review medication.	Older adults (Intervention: n = 13; Comparator: n = 12) Hospital inpatients aged 60 and over who were predicted to be at high risk for an ED visit or hospital readmission, and were previously living independently, and enrolled in a care transition program were among the study participation criteria.	No significant difference in 30-day ED visits observed between the intervention and the control group (p > 0.99).	
Robinson et al.[63] 2015 New Zealand	**Intervention group:** Pre-discharge components included nutrition screening and possible referral to a dietitian, allied health review, and discharge medication reconciliation and patient education by a pharmacist. The post-discharge component was a telephone assessment, education, and support by a team of experienced community nurses on the first and third days after discharge. **During intervention group**: As above but where the intervention was being trialled in a small number of patients.	Older adults (Intervention: n = 5,172; During intervention development group: n = 1,525; Pre intervention group: n = 13,985) Patients aged ≥65 years with an acute medical admission who were identified as being 'high-risk' patients.	The interrupted time-series trial did not show a significant difference in 30-day ED use with of pre-discharge components interventions.	

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	Pre-intervention group: No identification of 'high-risk' patients, with routine discharge at the time (not specified).			
Soong et al.[58] 2014 Canada	**Intervention:** Patients received a discharge summary and patient-specific instructions, along with an in-person review by a patient navigator (a non-clinician who facilitates appointment scheduling and acts as a resource for the medical team, patient, and families). The patient navigator called patients or caregivers up to three days post-discharge. A telephone script was delivered soliciting information on general health status, checking comprehension of discharge instructions, and reinforcing discharge instructions using a teach-back method. **Comparator:** Usual care, which was no post-hospital discharge phone call.	Adults (Intervention: n = 169; Comparator: n = 165) General medical patients discharged home after hospitalisation.	Similar results between the two groups for 30-day ED visits (21% of patients in the intervention group, compared to 18% in the control group (p = 0.60; odds ratio = 1.20, 95% CI 0.61–2.37)).	
Yiadom et al.[59] 2020 USA	**Intervention:** A nurse telephoned patients with a script to assess knowledge of discharge diagnosis and plan, with attention to medication changes, follow-up appointments, and anticipated discharge support services. Patients were asked to 'teach back' their discharge plan. Gaps in knowledge or planned care transition supports were identified and addressed. **Comparator:** Usual care, which included reviewing documentation noting their new medication regimen, follow-up appointment scheduling planning, education on new	Adults (Intervention: n = 1,534; Comparator: n = 1,520) All inpatients discharged from a general medicine service.	No significant difference in 30-day ED revisits (attendance at ED within 30 days of hospital discharge) between the intervention and the control groups (6.1% vs. 5.4%; difference 0.7% (95% CI, -1.0 to 2.3); P=0.43).	

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	diagnoses and symptoms for which to seek care, with no follow-up call.			
Patient Satisfaction				
Clari et al.[60] 2015 Italy	**Intervention:** Routine care and discharge instructions were provided. A follow-up telephone call by a nurse occurred 24–96 hours after discharge and was designed to give the nurse the opportunity to assess the overall health of the patient. During this call, the nurse recorded whether or not an educational intervention or reinforcement technique was carried out. **Comparator:** Usual care which involved the patients receiving routine instructions for discharge, with no telephone call.	Adults (Intervention: n = 110; Comparator: n = 109) Patients hospitalised for 'low- or medium-intensity orthopaedic surgery' (ASA score less than three).	No significant difference between the intervention group and control group regarding the overall experience of hospitalisation (p = 0.07) or the clarity of the information received during hospitalisation (p = 0.08). However, patients who received the phone call said that the information they received was more useful (p = 0.004).	
Lindpaintner et al.[61] 2013 Switzerland	**Intervention:** Pre-discharge assessment of symptom burden, prior medication adherence, family caregiving and functional status by the	Adults (Intervention: n = 30; Control: n = 30)	Using a four-point Likert scale±, patients in the intervention group reported significantly higher satisfaction with	

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	nurse care manager. The nurse care manager was involved in discharge planning and team rounds and called patients with a structured assessment within 24 hours of discharge, evaluating self-efficacy and giving reminders about self-management strategies and follow-up appointments; was available by pager 24/7 for five days after discharge; and ended the intervention with a home visit and a letter to the primary care physician. **Comparator:** Usual care/routine discharge, involved no care or contact from the nurse care manager.	Patients at 'high risk' for adverse events after discharge and with oral anticoagulation, newly ordered insulin, polypharmacy∞ or new diagnosis requiring four or more long-term medicines; patients also lived alone, received home nursing care before admission, or required complex wound care.	discharge processes on day five after discharge (p = 0.027), while family caregivers in the intervention group also reported higher satisfaction on day 30 (p = 0.008).	
Lundby et al.*(62)* 2020 Denmark	**Intervention:** A pharmaconomist prepared patient information and performed discharge counselling, medication review, discussion with physician, medication report to primary care physician, and telephone follow-up to the patient three days after discharge. The discharge counselling included an updated medication list and a written summary of the counselling for the patient to take home. **Comparator:** Usual care, which consisted of medication reconciliation as well as usual discharge procedures within the surgical department.	Adults (Intervention: n = 32; Control: n = 32) Patients discharged from the gastrointestinal (GI) unit with GI diseases (inflammatory bowel disease, cancer in the GI system, or complex fistulas).	Patients were asked six questions regarding their discharge experience, with no significant difference observed for any question between the intervention group and the control group. No significant difference was observed regarding the 'overall satisfaction' question, where 75% of patients in the intervention group reported 'to a great extent' or 'to a very great extent', and 91% of those in the control group responded likewise (p = 0.10).	
Yiadom et al.*(59)* 2020 USA	See ED visits outcome.	See ED visits outcome.	No significant difference observed for the overall experience rating of the intervention group compared to the control group (-0.2% (95% CI:-0.4-0.1),	

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			p = 0.68)*. Similar results were obtained for the 'likelihood to recommend' question.	

Key: aHR = adjusted hazard ratio; ASA = American Society of Anesthesiologists; C = control group; COPD = chronic obstructive pulmonary disease; CI = confidence interval; E = enhanced intervention group; ED = emergency department; GI = gastrointestinal; HF = heart failure; M = minimal intervention group; PCM = pharmacist case manager; PI = prediction interval.

†Boggan et al.(38)

∞Defined as at least eight regularly-used medicines at the time of admission.

±Likert scale ranged from one to four (one = very satisfied, two = somewhat satisfied, three = somewhat dissatisfied, four = very dissatisfied).

*Using Press Ganey Hospital Consumer Assessment of Healthcare Providers and Systems patient experience scores.

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