Canada's Drug and
Health Technology Agency

CADTH Health Technology Review

Emergency Department Overcrowding: An Environmental Scan of Contributing Factors and an Overview of Reviews of Effectiveness of Interventions — Project Protocol

PROSPERO Registration Number: CRD42023428073

ISSN: 2563-6596

About CADTH: CADTH is an independent, not-for-profit organization responsible for providing Canada's health care decision-makers with objective evidence to help make informed decisions about the optimal use of drugs, medical devices, diagnostics, and procedures in our health care system.

Funding: CADTH receives funding from Canada's federal, provincial, and territorial governments, with the exception of Quebec.

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Abbreviations

AMSTAR	A Measurement Tool to Assess Systematic Reviews
ED	emergency department
PRIOR	Preferred Reporting Items for Overviews of Reviews
SR	systematic review

Introduction and Rationale

Emergency department (ED) overcrowding is a broad term that generally describes a situation in which the demand for ED services exceeds the capacity to deliver those services.[1,2] The ED overcrowding problem exists to varying degrees in many countries that have health care systems similar to Canada's health care system.[3-8] In Canada, ED overcrowding and its related issues (e.g., ED extended wait times, ED closures) is a decades-long concern that affects patients, communities, and health systems across the country.[1,9] Although ED visits declined briefly during the COVID-19 pandemic, utilization data collected by the Canadian Institute for Health Information (CIHI) suggest ED visits are returning to prepandemic levels and continuing an upward trend.[10,11]

The causes and consequences of ED overcrowding are complex and varied and extend beyond the ED.[1,9,12,13] Left unchecked, ED overcrowding poses risks to patients and contributes to a deteriorating standard of care as staff become overworked and burned out.[12] Although ED overcrowding affects everyone involved in receiving and delivering care in the ED, overcrowding has been found to create increased risk of harm for certain patient subgroups, such as older adults and those dealing with mental health, cardiorespiratory, oncology, and hematology issues.[13,14] Outside the ED, the effects of ED overcrowding may also be felt; for example, by increased post-ED care use and increased test ordering for patients in the ED with less severe medical issues.[15]

This report originated as a request from a CADTH customer to update the 2006 CADTH 4-report series on ED overcrowding in Canada.[2,16-18] Through systematic reviews (SRs) of the literature, expert consensus, and surveys, the 2006 reports reviewed relevant indicators of ED overcrowding in Canada,[2] what data were being used to monitor ED overcrowding in Canada,[18] the impact (including frequency and determinants) of ED overcrowding in Canada,[17] and the effectiveness of interventions to reduce ED overcrowding.[16]

The problem of ED overcrowding has persisted since the publication of the original reports; in fact, it has worsened in Canada.[1,19,20] ED overcrowding has also become an issue across health care systems similar to Canada (e.g., in the UK) resulting in a much different body of evidence than was available in 2006.[3-8] In addition, CIHI's collection and reporting of data about ED use in Canada is more comprehensive and standardized than it was in 2006.[11]

These changes have contributed to jurisdictional needs for objective, impartial, and trusted recommendations and/or guidance about which interventions are most effective for alleviating ED overcrowding in Canada. These needs echo a 2022 report from the Canadian Association of Emergency Physicians (CAEP) to address the root causes of ED overcrowding in Canada.[19] Given that the ED overcrowding crisis is not unique to any single Canadian jurisdiction, but rather affects all Canadians, this report will focus on adult and pediatric ED services in urban, rural, and remote health care settings in Canada.

This report makes use of a conceptual model developed by Asplin et al. (2003),[21] which segments the emergency care system into 3 interdependent parts: input, throughput, and output. The input component focuses on factors that influence the need for ED services, the throughput component focuses on factors and processes inside of the ED and hospital, and the output component focuses on elements concerning patient disposition (e.g., to inpatient care or outpatient care).

For clarity and continuity across this Health Technology Assessment (HTA), CADTH has adopted the following definitions:

- Emergency department: a hospital unit intended to provide timely evaluation, diagnosis, and treatment of people with injuries, illnesses, behavioural disorders, and mental health conditions requiring expeditious care for potentially life-threatening conditions (e.g., severe chest pain, stroke, trauma) without a prior appointment.
- Emergency department overcrowding: an imbalance in which the demand for ED services exceeds the capacity of the ED, hospital, or community to provide quality care in a reasonable amount of time.[1,22]

Decision Problem

Given worsening ED overcrowding in jurisdictions across Canada and ED visits returning to pre–COVID-19 pandemic levels, and using the evidence and the expert-informed considerations about the causes and consequences of, and solutions to, ED overcrowding:

- What evidence-informed solutions should be considered to inform decision- and policy-making to effectively alleviate overcrowding of adult and pediatric ED services in urban, rural, and remote health care settings in Canada?

Objectives

The information presented in this report will be used to inform and support policy- and decision-making related to an emerging administrative priority about ED wait times in a health care environment that is seeing ED visitations return to pre–COVID-19 pandemic levels.[10] The objectives of this report are to understand:

- the factors contributing to ED overcrowding in Canada
- which interventions effectively alleviate ED overcrowding.

Deliverables

The following deliverables are planned:

- a report detailing all analyses conducted to achieve the objectives.

This report is part of a series of publications that CADTH will produce on the topic of ED overcrowding in Canada as an update to the 2006 publications. Separate reports not described in this protocol will be published to address additional objectives, including:

- the impact ED overcrowding has on quality of care and patient safety (i.e., the risks of overcrowding)
- the impact ED overcrowding has on health professional learner experience and staff well-being
- how ED overcrowding in Canada has changed since the previous series of reports.

CADTH's Health Technology Expert Review Panel (HTERP) will use the CADTH deliverables as inputs into deliberations that result in a set of recommendations in response to the decision problem.

Research Questions

The following research questions will inform the decision problems and objectives of the HTA. Details on the specific populations, interventions, comparators, and outcomes are included in Table 1 and Table 2.

Environmental Scan of contributing factors:

1. What are the input, throughput, and output factors that contribute to ED overcrowding internationally and in Canada? How does the literature describe the impact of input, throughput, and output factors on ED overcrowding?
2. What are the contextual factors (at the microlevel, mesolevel, and macrolevel) that have an impact on ED overcrowding in Canada? How does the literature describe their impact on ED overcrowding?
3. What are the explanations provided by the literature about how and why the identified input-throughput-output and contextual factors contribute to ED overcrowding in a Canadian context?

Overview of reviews on interventions:

1. For individuals of any age who may need to access ED services, what is the effectiveness and patient safety of interventions to alleviate ED overcrowding?

Equity Considerations

To bring considerations of equity to this HTA, this project drew on the concepts of health equity articulated by Braveman et al. (2017):[23] "Health equity means that everyone has a fair and just opportunity to be as healthy as possible. Achieving this requires removing obstacles to health — such as poverty and discrimination and their consequences, which include powerlessness and lack of access to good jobs with fair pay; quality education, housing, and health care; and safe environments" (p. 4).[23]

EDs play a vital role in providing health care to groups of people who are underserved, which refers to people who experience exclusion based on social identities and who face barriers to social, economic, political, and environmental resources as a result of power imbalances in these spheres.[24] For example, people experiencing social isolation, poverty, and lack of access to safe and secure housing have been shown to use EDs more frequently than others.[25,26] However, these equity-deserving groups are also more likely to report negative ED care experiences compared with those who are not a part of these populations.[27] We will use the Equity Checklist for HTA[28] to iteratively guide our consideration of equity for this project. When developing the protocol, we used the prompts outlined in the Equity Checklist's scoping phase to conceptualize equity in ways that are relevant and meaningful to ED overcrowding. Equity, as it relates to ED overcrowding, is fair and equitable access to EDs and treatment by health care providers.

We will focus equity considerations on 3 domains of ED overcrowding: access, use, and outcomes. One example of considerations around access to ED services might include the lack of a primary care provider, resulting in seeking out ED services that could be provided by a primary care provider. Examples of considerations around use of ED services might include timeliness of care and the differing reasons for unnecessary overuse. An example of considerations around outcomes of ED services might include barriers to outpatient care, resulting in return ED visits. We have decided to focus on these domains due to their approximate alignment with the conceptual model developed by Asplin et al.,[21] which divides ED overcrowding into 3 interdependent parts: input, throughput, and output. In general, access to ED services aligns with input components, use of ED services aligns with throughput components, and outcomes of ED services aligns with output components. However, each of the domains could potentially be associated with any of the input-output-throughput components. The scope of equity considerations for this project is primarily focused on people or services that have contact with, a connection to, or an association with the ED, including interventions targeted at diverting individuals away from the ED and toward other appropriate care. As a result, considerations may not include some emergent situations that do not link to the ED.

Although ED overcrowding can affect all people, some individuals may experience an inequitable burden of its consequences and/or may be inequitably affected by interventions aimed at alleviating ED overcrowding. The acronym PROGRESS-Plus[29] (place of residence; race, ethnicity, culture, and language; occupation; gender and sex; religion; education; socioeconomic status; social capital; and other characteristics ["Plus"] such as sexual orientation, age, and disability) is used to identify characteristics

that stratify health opportunities and outcomes. We will use PROGRESS-Plus[29] to help identify these groups of people. In addition, we will identify specific populations who are at an increased risk of experiencing inequities through the available published and grey literature, and discussions with clinical and content experts. We are aware of the phenomenon in which patients who reside in rural and remote areas are cared for in urban EDs due to a lack of resources. As a result, 1 limitation of using the PROGRESS-Plus[29] tool is the potential inability to distinguish where the patient resides versus where they received care. We will try to extract this information from the literature if possible, and we will also report this as a limitation of the report.

An equity perspective will be integrated across all components of this project. The component-specific application of equity considerations is discussed in the subsequent sections of this protocol. The prompts provided by the Equity Checklist[28] will be used to guide the focused discussion and reflection in the development and conduct of each individual component.

The language surrounding equity will follow the guidelines for inclusive and respectful terminology set out by the *CADTH Style Guide*, 7th Edition.[30] These guidelines strive to promote the use of "language that is inclusive, nonbiased, and respects the preferences of groups and individuals" (p.13). Due to the evolving nature of language related to equity, the terminology used in older literature may not reflect best practices used today. For consistency and clarity, older terminology may be used when referring to the results of older literature; otherwise, we aim to use appropriate and inclusive language.

Methods

To address the objectives of this report, we will conduct an Environmental Scan of contributing factors to ED overcrowding and an overview of reviews of the effectiveness of interventions to alleviate ED overcrowding. A final report will document all the summaries produced and clinical, patient, and community partner engagement activities conducted as part of this project. In addition, a shared discussion section will ensure the integration of the findings from the separate components of this project to inform the decision problem, including reflections on considerations of equity. Although the Environmental Scan of contributing factors and the overview of reviews of interventions will be conducted by 2 separate research teams (i.e., a "factors" team and an "interventions" team) using different methods and inclusion criteria (i.e., we will include all relevant interventions even if there is no corresponding factor found in the literature), both teams will consult each other when assessing the body of evidence found; as part of our reporting of the results, we will use the findings from both to conceptualize how the factors and interventions relate to each other.

To inform the preparation of this protocol, we conducted preliminary scoping searches of a sample of the existing published and unpublished literature, including overviews of reviews, scoping reviews, concept papers, and SRs.

We developed a predefined protocol (as described herein) in adherence to Cochrane methodology (for the overview of reviews)[31] and input from people with extensive personal and/or professional experience with ED care within a Canadian health system.

The protocol for the overview of reviews was prospectively registered in the PROSPERO international prospective register of systematic reviews on May 19, 2023. Any deviations from the protocol, as well as the rationale and timing of these deviations, will be disclosed in the final report, and updates will be made to the PROSPERO record, as appropriate.

We also engaged with 2 content experts who provided guidance during the protocol stage and will continue to support our work throughout the project.

To support HTERP's deliberation and recommendations, CADTH may also identify relevant ethical considerations arising in the identification and implementation of strategies to address ED overcrowding.

Environmental Scan of Contributing Factors

ED overcrowding is a multifactorial and complex issue. As such, investigating factors that contribute to ED overcrowding requires an approach that examines the issue on multiple levels. To help inform the decision problem, we will investigate 2 broad categories of factors that influence ED overcrowding: causal factors and contextual factors. We understand direct casual factors as those that can be targeted by interventions to address ED overcrowding. We will categorize these factors into 3 interdependent components as described by the conceptual model developed by Asplin et al. (2003)[21]: input, throughput, and output. We will also define contextual factors as those that exist outside of the input-throughput-output. We will categorize contextual factors into a macrolevel, mesolevel, or microlevel. We define microlevel contextual factors as those applicable to the ED, mesolevel contextual factors as those applicable to the larger hospital and health system, and macrolevel contextual factors as broader socioeconomic, sociocultural, and institutional factors. These contexts are informed by the Consolidated Framework for Implementation Research constructs.[32]

The following research questions will inform the decision problem and main objective:

1. What are the input, throughput, and output factors that contribute to ED overcrowding internationally and in Canada? How does the literature describe the impact of input, throughput, and output factors on ED overcrowding?
2. What are the contextual factors (at the microlevel, mesolevel, and macrolevel) that have an impact on ED overcrowding in Canada? How does the literature describe their impact on ED overcrowding?
3. What are the explanations provided by the literature about how and why the identified input-throughput-output and contextual factors contribute to ED overcrowding in a Canadian context?

Study Design

We will conduct an Environmental Scan to identify literature about factors contributing to ED overcrowding internationally and in Canada. This study design is suited to the broad, exploratory nature of the research questions and will allow us to investigate the breadth of information available on the topic. The findings of this Environmental Scan will be based on a limited search of the published and grey literature, and ongoing collaboration and communication with the interventions team that will contribute to identifying causal and contextual factors. This review will also draw on the inputs shared and discussed by people with extensive personal and/or professional experience with ED care within the Canadian health system. We will obtain this information from our engagement activities to ensure that our research is relevant and meaningful to health professionals who are providing or supporting care in the ED (e.g., ED physicians, primary care physicians, nurses, social workers) and to people with experience receiving care in the ED (e.g., patients, family members, caregivers).

Input From CADTH

The factors team will engage with and work alongside the interventions team to help ensure that we capture causal and contextual factors relevant to the identified interventions aimed at mitigating ED overcrowding studied in the literature. If the interventions research team identifies novel factors (i.e., factors not identified in the literature for the Environmental Scan), we will run a supplemental search to capture additional information related to these novel factors.

Literature Search Methods

An information specialist will conduct a literature search on key resources including MEDLINE, Embase, and Cumulative Index to Nursing & Allied Health (CINAHL). The search approach will be customized to retrieve a limited set of results, balancing comprehensiveness with relevancy. The search strategy will comprise both controlled vocabulary, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords. Search concepts will be developed based on the elements of the research questions and selection criteria. The main search concepts will be overcrowding, emergency medicine (EDs, emergency medical services, and emergency medicine personnel), and factors contributing to overcrowding. No search filters will be used to limit retrieval by study type. The search will be limited to English- or French-language documents published since January 1, 2013. If required, a second supplemental search on factors contributing to ED overcrowding will be conducted.

In addition, relevant sections of CADTH's Grey Matters: A Practical Tool for Searching Health-Related Grey Literature, which includes the websites of regulatory agencies, HTA agencies, clinical guideline repositories, systematic review repositories, patient-related groups, and professional associations, will be searched to identify grey literature (literature that is not commercially published). Google will be used to search for additional internet-based materials. Refer to Appendix 1 for more information on the grey literature search strategy.

Selection and Eligibility Criteria

Literature that identifies and discusses input-throughput-output and factors contributing to ED overcrowding internationally and in Canada will be included. In addition, literature that describes contextual factors that have an impact on ED overcrowding in Canada will be included. Identified literature will be screened for selection and those that meet the inclusion criteria (Table 1) will be synthesized and summarized within the report.

Table 1: Inclusion Criteria for Informational Screening

Criteria	Description
Population	People of all ages who engage with EDs (e.g., patients, ED staff, pre-ED health care providers, post-ED health care providers, and allied health professionals)
Phenomena of interest	• Input, throughput, and output factors contributing to ED overcrowding • Contextual factors contributing to ED overcrowding
Setting	• EDs in Canada and internationally (including all health system types) • Health care services that do, or could, interface with EDs (e.g., ambulance services, long-term care services)
Types of information	• Information on identified factors contributing to ED overcrowding • Information on how and the extent to which the identified factors contribute to ED overcrowding

ED = emergency department.

Screening and Selecting Studies for Inclusion

One reviewer will screen and select literature for inclusion based on the predetermined inclusion criteria (Table 1). Before screening the full set of literature results, this reviewer will do a pilot test with 50 search results to ensure clarity and definition around concepts for literature selection. This pilot test will also help with familiarization of the literature and concepts. For the published literature, we will first screen titles and abstracts to identify literature of potential interest. Then, reviewer will retrieve full text of all potentially relevant literature for a definitive determination of eligibility. For the grey literature, we will screen the full resource when available. DistillerSR (Evidence Partners, Ottawa, Canada) management software will be used to facilitate literature screening and selection. To achieve a comprehensive understanding of the topic, all study designs will be considered for inclusion in the Environmental Scan. This includes all quantitative, qualitative, and mixed-methods studies. Publication types and information sources (e.g., websites, reports) will also be considered for inclusion. Literature that identifies overcrowding factors that exist both inside and outside of the physical ED will be included. No restrictions will be placed on the population of interest or on the type of ED (e.g., pediatric and adult EDs will be included).

We will exclude literature that describes ED overcrowding related to disaster events (e.g., mass casualty events, natural disasters) and literature that describes interventions to relieve ED overcrowding because it will be included in the overview of reviews.

Equity Considerations

As outlined in the Equity Considerations section, we will follow the domains of access, use, and outcomes of ED services to guide our examination of the literature. When examining factors that contribute to ED overcrowding, we will focus on identifying inequities that exist when trying to access and when using ED services. We will also report the potential impact of overcrowding factors on inequities, such as outcomes. To do so, we will use the PROGRESS-Plus framework[29] to help identify characteristics of people who experience inequities; however, we will also identify and extract details about other equity-related items that fall outside of these characteristics (e.g., newcomer status). We will report details about why these inequities exist if and when it is described in the literature. We will organize findings, such as groups experiencing inequities, by the access, use, and outcome domains.

Literature Data Extraction

One reviewer will collect and extract the data from the included literature. The data will be extracted to a Microsoft Word file or Excel spreadsheet. Before beginning data extraction for all the identified literature, 1 reviewer will pilot test the data extraction form using 2 to 3 included studies to establish possible difficulties in selecting and extracting data and to identify strategies to address these difficulties at an early stage. This pilot test will also help ensure that key data items relevant to our research questions are captured in the data extraction. The type of information that will be extracted includes bibliographic details (i.e., authors, year of publication, and country of origin) of included papers. Other details that will be extracted include:

- causal factor name as described within the text
- contextual factor name
- microlevel, mesolevel, macrolevel classification or contextual factors
- input-throughput-output classification if provided in the text
- setting (e.g., country; jurisdiction; urban, rural, remote location; type of ED)
- population served (e.g., adult, pediatric)
- equity considerations around access, use, and outcomes of ED services (e.g., socioeconomic status, 2SLGBTQ+ identity)
- description of how factors contribute to ED overcrowding.

Due to the exploratory nature of an Environmental Scan, we are not aware of all the factors and their corresponding details relevant to ED overcrowding, and therefore cannot initially list all types of

information that will be extracted. Rather, our goal is to uncover this information as we conduct the scan. As a result, we will take a deductive-inductive approach to data extraction, meaning that we will use both an existing framework to guide data extraction (i.e., the initial categorization of input-throughput-output factors as outlined by Asplin et al.[21]), while also remaining open to and adding new facets as they emerge. As such, if additional relevant details about factors contributing to ED overcrowding are identified from the literature, we will include and report this information. Similarly, we will use a deductive-inductive approach to identifying microlevel, mesolevel, and macrolevel contextual factors and will add categories if needed. We will also extract and provide a description of the literature search results, including the number of relevant publications and grey literature resources and their sources.

Data Analysis and Synthesis

One reviewer will analyze the data from the literature review about factors contributing to ED overcrowding. To respond to the research questions, we will conduct a descriptive analysis and produce a narrative summary that will reflect the findings from the literature search.

To respond to the first research question, we will provide a list of the identified input-throughput-output factors contributing to ED overcrowding as well as a description of these factors. We will provide a narrative summary of the impact that the identified factors play in ED overcrowding. To respond to the second research question, we will provide a list of the identified contextual factors contributing to ED overcrowding as well as a description of these factors. We will provide a narrative summary of the impact that the identified factors play in ED overcrowding. Finally, to respond to the third research question, we will narratively summarize the link between the causal and contextual factors, and ED overcrowding.

When analyzing the data, consideration will be given to the types of populations and settings affected by ED overcrowding. Characteristics of particular interest include the age of patients (e.g., pediatric, adult, and older adults), ED location (e.g., urban, rural, remote), type of ED (e.g., community hospital, major trauma centre), and additional equity-deserving group characteristics (e.g., 2SLGBTQ+ identity, racial and ethnic identity). We will specifically report on findings related to these characteristics. We will capture and report on information related to these populations and settings if available.

For all research questions, when presenting the findings, we will highlight data from Canadian literature. Although the Environmental Scan on contributing factors and the overview of reviews of the effectiveness of interventions to alleviate ED overcrowding will be conducted concurrently and by separate teams, the findings from this Environmental Scan will help inform the presentation and interpretation of findings from the overview of reviews (e.g., both teams will have a discussion about the factors and interventions found in the literature and will work together to present summary results). Similarly, the findings from the overview of reviews will help inform this Environmental Scan because it

may capture interventions that address factors not identified in the scan. These additional factors will be discussed in the findings of the Environmental Scan.

Overview of Reviews on Interventions

The following research question will inform the decision problem and main objective:

1. For individuals of any age in any setting, what is the effectiveness and patient safety of interventions to alleviate ED overcrowding?

Study Design

During our scoping search, we identified several interventions to alleviate ED overcrowding and an overwhelming number of primary studies evaluating the effectiveness of these interventions. For example, a 2021 scoping review[5] found 268 primary studies on interventions or strategies to manage ED overcrowding that involved primary health care professionals. We also identified a growing volume of SRs on interventions to alleviate ED overcrowding. Therefore, we will conduct an overview of reviews to summarize evidence from SRs on the effectiveness of different interventions to address ED overcrowding. Our methodology is guided by the *Cochrane Handbook for Systematic Reviews of Interventions* chapter on "Overview of Reviews"[31] and we will report the conduct of our work in accordance with the Preferred Reporting Items for Overviews of Reviews (PRIOR) guideline.[33]

We are aware of 3 overviews of reviews that have been published on this topic. The 2016 overview of reviews by Van den Heede and Van de Voorde[7] summarized the effectiveness of policy interventions to reduce ED utilization. The 2018 overview of reviews by De Freitas4 summarized evidence on interventions that improved patient flow in the ED. The 2020 overview of reviews by Bittencourt et al.[3] summarized interventions on the throughput component of ED overcrowding. Although these overviews included SRs of specific types of interventions, we are interested in all interventions that aim to the alleviate ED overcrowding to gain a wider view of the issue and include both ED-specific as well as health care system–level interventions.

Information Sources and Search Strategy

An information specialist will develop and conduct a literature search for SRs using a peer-reviewed search strategy according to CADTH's PRESS Peer Review of Electronic Search Strategies checklist.[34] The complete search strategy is presented in Appendix 1.

Published literature will be identified by searching the following bibliographic databases: MEDLINE via Ovid, Embase via Ovid, CINAHL via EBSCO, and the Cochrane Database of Systematic Reviews via CochraneLibrary.com. All Ovid searches will be run simultaneously as a multifile search. Ovid deduplication for multifile searches, followed by manual deduplication in Endnote, will be used to remove duplicate search results. The search strategy will comprise both controlled vocabulary, such as the National Library of Medicine's MeSH, and keywords. Search concepts will be developed based on the elements of the PICOS (population, intervention, comparison, outcomes, and study) framework and research questions. The main search concepts will be overcrowding and emergency medicine (EDs, emergency medical services, and emergency medicine personnel). A supplemental search will be conducted to locate publications related to ED overcrowding from the engineering field.

CADTH-developed search filters will be applied to limit retrieval to health technology assessments, SRs, meta-analyses, overview of reviews, or indirect treatment comparisons. With the aim to capture the most recent, comprehensive, and high-quality SR per comparison outcome, retrieval will be limited to results published since January 1, 2013. It is unlikely that SRs published 10 or more years ago would be considered relevant. Retrieval will also be limited to English- or French-language results, and conference abstracts will be excluded.

An information specialist will perform the initial literature search in spring 2023. Regular alerts will update the database literature searches until the publication of the final report.

Relevant sections of CADTH's Grey Matters: A Practical Tool For Searching Health-Related Grey Literature, which includes the websites of regulatory agencies, HTA agencies, clinical guideline repositories, SR repositories, patient-related groups, and professional associations, will be searched to identify grey literature (literature that is not commercially published). Google will be used to search for additional internet-based materials. These searches will be supplemented by reviewing bibliographies of key papers and through contacts with experts, as appropriate. The grey literature search will be updated before the completion of the stakeholder feedback period. Refer to Appendix 1 for more information on the grey literature search strategy.

Eligibility Criteria and Selection Process

The eligibility criteria for the overview of reviews can be found in Table 2.

Table 2: Eligibility Criteria for the Overview of Reviews of Interventions

Inclusion	Exclusion
Population	

Any population in any setting
 	
Subgroups of interest:
• age groups (pediatric, adults, older adults aged ≥ 65years)
• ED setting (urban, rural, geographically remote, virtual)
• arrival type
  ○ modality (e.g., ambulance, walk-in, private vehicle)
  ○ referral location
• admitted, not admitted, or discharged status
• acuity (e.g., Canadian Triage and Acuity Scale)
• medical complexity
• access to primary care team
 	
Equity-deserving groups:
• health condition (e.g., addictions and/or mental health presentation)
• race
• ethnicity or place of origin
• language
• sex
• gender or gender identity
• place of residence (e.g., fixed address, nonfixed address, unhoused)
• socioeconomic status
• disability (including short term and long term)
• newcomer status
• sexual orientation
	—

Interventions	
Any intervention to alleviate ED overcrowding in any setting, including urban, rural, geographically remote, and virtual	—
Comparators	
Any comparator, including no intervention, usual or standard care, another intervention	No comparator
Outcomes	
• ED length of stay • ED-related wait times (e.g., time before seeing provider, time from triage to care space, time to diagnosis, time from consultation to disposition, ambulance offload time, ED offload delay) • Boarding or access block outcomes (i.e., outcomes related to patients who have been admitted but are waiting for an inpatient bed) • ED occupancy (i.e., ratio of registered ED patients to available care spaces) • Number or proportion of patients in the ED waiting room • Mortality within the ED	—

Inclusion	Exclusion
• Number or proportion of ED visits (including return visits to the ED, recurrent revisits, and return visits to the ED requiring admission) • Number or proportion of patients who left prematurely (e.g., left without being seen, against medical advice) • Patient safety (e.g., harms, adverse events) • Patient satisfaction • Health care provider capacity (e.g., provider burnout, workload, staffing insufficiencies)	
Study designs	
Published and unpublished English-language SRs that include randomized controlled trials, nonrandomized controlled trials, and/or comparative observational studies	• Overviews of reviews • Scoping reviews • Integrative reviews • SRs that only include case series, simulation studies, mathematical modelling approaches, theoretical studies • Clinical practice guidelines • Reviews that do not meet criteria for being SRs • Cost-effectiveness studies • Primary studies • Protocols and trial registers • Editorials, letters, and commentaries • Conference abstracts and presentations • Non-English language
Time frame	
2013 to present	Before 2013

ED = emergency department; SR = systematic review.

The following will be considered when selecting SRs for inclusion:

- All SRs must meet the eligibility criteria outlined in Table 2.
- SRs must include:
  - a research question
  - sources that were searched, with a reproducible search strategy (naming of databases, naming of search platforms or engines, search date, and complete search strategy)
  - inclusion and exclusion criteria
  - selection (screening) methods
  - reporting of the methodological quality and/or risk of bias of the included studies
  - information about data analysis and synthesis that allows the reproducibility of the results.[35]
- If an SR includes both eligible and ineligible primary study designs (e.g., SR with comparative and noncomparative data on interventions for alleviating ED overcrowding), the SR will be eligible for inclusion if it contains results from comparative study designs and those results are reported separately or can be extracted separately. For the purposes of this overview of reviews,

"comparative" includes interventions compared against alternative interventions or standard or usual care.

- We will include SRs of any intervention in which the authors of the SR have clearly stated that the main objective or purpose of the intervention(s) is to alleviate ED overcrowding. We will include SRs that refer to the ED and to crowding, use the terms "crowding," "overcrowding," or other aspects (such as increasing number of visits, increased or increasing patient volumes, ED congestion, ED capacity, increasing ED census, or high demand of ED services) in the title, introduction, or methods sections.
- Interventions can be multifaceted or target multiple components. This is to ensure that we include any information on interventions that affect equity considerations. We will also consider interventions that affect ED overcrowding in different ways, such as demand for the ED (e.g., targeting input factors), care processes within the ED (e.g., targeting throughput factors), or patient follow-up care (e.g., targeting output factors).[21] We will also consider other interventions, such as those at a health system level, interventions related to the social determinants of health that can affect ED use, or interventions outside of the ED that closely affect outcomes within the ED.
- There is currently no consensus among experts about the most appropriate outcome(s) to measure ED overcrowding.[36,37] In addition, different terminology is sometimes used in the literature to refer to the same ED outcome. Therefore, we will be mindful to include eligible SRs that report outcomes that are of interest but may use different wording or units of measurement. Our outcomes of interest include ED length of stay, time from arrival to provider, boarding or access block outcomes (e.g., access block or boarding time, number or proportion of boarders), ED occupancy, number or proportion of patients in the ED waiting room, number or proportion of ED visits (including return visits to the ED), number or proportion of patients who left prematurely (e.g., left without being seen, left before completion of treatment, left against medical advice), patient safety (e.g., adverse events), patient satisfaction (e.g., complaints), and health care provider capacity (e.g., burnout, workload, staffing insufficiencies, adherence to guidelines, medical errors). These outcomes have been validated with our content experts and have also been shown to be important in the literature.
  - ED length of stay measures the time patients spent in the ED.[36] This metric had the strongest association with safety and quality of care in a recent SR.[38] ED length of stay was also associated with 7-day mortality[39] and equity.[38] According to a recent overview of reviews of ED crowding measures,[40] ED length of stay was highly predictive of the degree of crowding in EDs.
  - The time from ED arrival to initial health care provider assessment has been used to define ED wait time.[37] In a comparative evaluation of ED crowding metrics conducted in 3 urban adult EDs in Calgary, Alberta,[37] median ED wait time was the input metric with the strongest association with 72-hour return visits to the ED (compared with ED census, emergency medical services

offload delay, and left without being seen proportion). In addition, ED wait time was found to be a reliable measure of ED crowding across multiple studies.[40]

- Boarding time for admitted patients is the time from admission order (or bed request) to transfer to inpatient unit (or leaving the ED).[37] According to recent literature, inpatient boarding time was the output metric with the strongest association with 72-hour return visits to the ED (compared with emergency inpatient counts and emergency inpatient proportion).[38] Longer boarding time was also strongly associated with worse effectiveness and safety.[38] Delays in hospital inpatient admission were associated with an increase in all-cause 30-day mortality.[38]
- ED occupancy is the ratio of registered ED patients to funded care spaces at the beginning of a shift.[37] ED occupancy was the throughput metric with the strongest association with 72-hour return visits to the ED (compared with clinician care time and ED length of stay).[37] Furthermore, this metric was strongly associated with quality of care,[38,41] patient safety, and employee satisfaction and performance.[40] Number of patients in the ED waiting room was found to be a reliable metric for ED crowding across multiple studies.[40] The number of patients in the waiting room was also linked to ED quality of care[40,41] and mortality.[38]
- Return visits to the ED can include scheduled and unscheduled returns to the ED following an index ED discharge. This measure may reflect poor patient experience, low satisfaction, incomplete care, poor access to outpatient care, or potential diagnostic or treatment errors at the initial ED visit.[37]

- We will include SRs with any definition of above outcomes, as provided by the SR.
- There is no restriction regarding intervention duration or length of follow-up.

The following will be considered exclusion criteria:

- SRs not meeting the eligibility criteria outlined in Table 2
- SRs that do not include any comparative data (e.g., prevalence data)
- duplicate publications
- protocols of SRs
- SRs reported in a language other than English. We will limit our reports to SRs reported in English due to time restrictions and limited resources for translation. However, to supplement this work, we will provide a list of potentially relevant French-language citations in an appendix.

We will use the SR management software DistillerSR (Evidence Partners, Ottawa, Ontario)[42] to facilitate SR selection. Before beginning title and abstract screening, 3 reviewers will do a pilot test to ensure mutual understanding of the selection criteria and usability of the screening form. After screening a random selection of 50 records in triplicate, the reviewers will meet to resolve disagreements, make clarifications to the selection criteria and screening form, and run additional pilot testing rounds if there

are major disagreements or changes to the selection criteria. Once reviewers are satisfied with their understanding of the selection criteria and usability of the screening form, they will independently screen the titles and abstracts of all the retrieved citations for relevance following a liberal-accelerated approach, whereby a single reviewer is required to include a record and 2 reviewers are needed to exclude a record.[43,44]

We will retrieve and independently assess the full texts of titles or abstracts that are judged to be potentially relevant by any reviewer for possible inclusion based on the predetermined selection criteria outlined in Table 2. Three reviewers will conduct pilot testing using a full-text screening form (based on the predetermined selection criteria outlined in Table 2) on a subset (e.g., 10 to 15) of full texts to ensure consistency across reviewers. Any disagreements will be resolved through discussion until consensus is reached. Once reviewers are confident using the screening form, each full text will be reviewed in duplicate. We will present the results of the screening process in a PRIOR flow chart,[33] which will document excluded full-text reports along with the reasons for exclusion. We will also include a list of studies excluded at full-text screening along with the main reason for exclusion.

Selecting Systematic Reviews for Data Synthesis

We expect to identify multiple overlapping SRs (i.e., SRs that address the same [or a similar] question and that include all or some of the same primary studies). Because the inclusion of overlapping SRs can introduce bias if outcome data from the same primary studies are included multiple times, we will aim to select 1 SR for inclusion per comparison outcome.[45] Criteria for the selection of the SR for each comparison outcome will be based on a balance of comprehensiveness, relevance, recency, and methodological quality.[45]

As part of the SR selection, we will use the AMSTAR 2 (A Measurement Tool to Assess Systematic Reviews) tool[46] to assess the methodological quality of SRs that include randomized and nonrandomized studies of health care interventions. Two to 3 reviewers will pilot test the AMSTAR 2 tool on 5 to 10 included SRs to ensure a mutual agreement of the domains and modify the application of the tool, if required.

For each SR, 1 reviewer will chart the population(s), intervention(s), comparator(s), outcome(s), last date of the search, and critical AMSTAR 2 domains. The interventions team will then convene to come to mutual agreement on the most appropriate SR to include per comparison outcome. In some instances, more than 1 SR may be included per comparison outcome (e.g., when each SR focuses on a different population or subgroup). Rationales for including or excluding potentially eligible SRs from the final overview of reviews will be documented and transparently reported; we will include a list of all relevant SRs that were not selected in an appendix. This part of the study selection process will also be presented in the PRIOR flow chart.

Data Extraction of Included SRs

We will extract data using Microsoft Excel. We will pilot test the data extraction form before beginning full data extraction to ensure that it is usable and that it completely and reliably captures populations, interventions, comparators, and outcomes of interest, while avoiding redundancies. During the pilot test, 2 to 3 reviewers will independently extract data from 2 to 3 included SRs and then meet to resolve disagreements through discussion and by referring to the source articles. Additional pilot testing rounds will be run as needed until reviewers are satisfied with the content and usability of the form. We will then perform formal data extraction; each article will be extracted by 1 reviewer and a second reviewer will independently verify the most important data elements (e.g., population, interventions, outcomes, subgroups).

We will extract the following information from each relevant SR:

- Study characteristics, including title, author(s), countries where primary studies were conducted, publication date (of the SR and of the included studies), number of included primary studies, funding sources (of the SR and of the included studies), conflicts of interest of the SR and of the included studies, if reported.
- Study methodology, including aims and objectives, databases and years searched, inclusion and exclusion criteria, methodological quality and/or risk of bias assessment tools used.
- Population information, including population(s), type of settings, sample size of populations within individual primary studies. To address equity considerations, we will consider extracting data using appropriate PROGRESS-Plus items29 if this information is available in the SR and after consultation with content experts. If SR authors have reported or extracted data from primary studies that is unclear or uses terminology not aligned with inclusive language as set out in the CADTH Style Guide,30 we will identify when using older terminology from source documents to accurately report findings from older works of literature as described in the Equity Considerations section.
- Interventions and comparators, including type of intervention(s), duration, how the intervention was implemented, and what factor the intervention aimed to target, if reported. We will note if any interventions target inequities specifically and extract details, if available.
- Results, including number of primary studies included in the SR, study designs included in the SR, outcomes reported at the SR level and for patient subgroups, method of synthesis (e.g., descriptive summary, meta-analysis, subgroup analyses, sensitivity analyses), findings (effect sizes, confidence intervals, measures of heterogeneity if the study data are pooled), author conclusions, and limitations noted by review authors. Because different terminology is sometimes used in the literature to refer to the same ED outcome, we will report outcomes of interest that may use different wording and clarify this in our report. The different patient subgroups will be identified

and validated after consultation with content experts and may include age groups, setting (urban, rural, geographically remote, virtual), ED length of stay by admitted or discharged status, ED occupancy by severity (e.g., by Canadian Triage and Acuity Scale), results by whether patients have a primary care physician, and so on. We will also use findings of the Environmental Scan of contributing factors to identify whether there are important subgroups not identified in this protocol that should be included in the results. We will also extract data from the SRs, if presented, on specific underserved populations identified by our experts as important groups to present (e.g., health condition, race, ethnicity, sex, gender, socioeconomic status).

- Appraisal of evidence, including results of overall methodological quality and/or risk of bias assessments of the studies included in the SRs and outcome-level certainty of evidence assessments (including if study-level methodological quality or risk of bias, whether outcome-level certainty of evidence was not assessed or reported, which tools were used for assessments, limitations of any assessments, reporting bias). We will not do further methodological quality and/or risk of bias appraisals (i.e., we will use the information reported in the article).

Although we will not include overlapping SRs, some of the included SRs may include some (or all) of the same primary studies for a different outcome. Should we identify discrepant data during data extraction within 1 SR, we will consider accessing the primary studies to verify the data, as feasible. If discrepant data are identified across 1 or more SRs, (e.g., findings from the same primary study are reported differently) we will report all data and note the discrepancy transparently.

Methodological Quality of the Included SRs

Because the selection of SRs will have involved only an assessment of AMSTAR 2 critical domains, we will complete our methodological quality of included SRs using the AMSTAR 2[46] on the noncritical domains. For each SR, 1 reviewer will assess the noncritical domains of AMSTAR 2. and assign an overall rating of our confidence in the results of each SR (high, moderate, low, or critically low) based on the evaluation of flaws in critical and noncritical domains, as outlined in the guidance for the tool.[46] We will assign a rating of high confidence for SRs with no critical flaws and a maximum of 1 noncritical weakness; moderate confidence for SRs with no critical flaws and more than 1 noncritical weakness; low confidence for SRs with 1 critical flaw with or without noncritical weaknesses; and critically low confidence for SRs with more than 1 critical flaw with or without noncritical weaknesses. We may assign a rating of critically low confidence for SRs with multiple noncritical weaknesses even without any critical flaws. A second reviewer will check the assessments for accuracy. We will resolve any disagreements through discussion until consensus is reached or involve a third reviewer if necessary. Our assessments will be informed by all documentation for each SR, including the main report, protocol, and registration record, as available. We will include overall assessments, with reasons, in the final report.

Data Synthesis

We will summarize the results of included SRs, narratively and in tables, as they are described in the SRs themselves. We will not reanalyze outcome data presented in the included SRs. As part of our summary, we will report the direction of the effect and effect estimate with the confidence interval, as available. For SRs with meta-analyses, we will report summary measures of treatment effects (e.g., relative risk, odds ratio, mean difference, standardized mean difference), number of participants, confidence intervals, and measures of heterogeneity.

We will develop tables to present the results by comparison outcome and organize them by type of intervention to accompany our narrative summary. If possible, we will also indicate which factors the interventions are targeting based on the Environmental Scan of contributing factors, our reading of included SRs, and consensus among the factor team and the intervention team. Based on consultation with content experts, we will synthesize information on population subgroups and groups experiencing inequities, if appropriate and if evidence is available.

Although we anticipate that the presentation of results for each comparison outcome will be informed by the input-throughput-output conceptual model of ED overcrowding,[21] we will take an iterative approach to collating, summarizing, and reporting the data. We will also draw on the findings of the Environmental Scan of contributing actors while organizing our results and in our interpretation of the findings (e.g., which factors are targeted by which interventions, if applicable). If possible, we will also indicate if there are factors identified in the Environmental Scan of contributing factors that were not targeted by any interventions in the overview of reviews of interventions. This iterative approach will allow us to adapt the level of synthesis and content based on the nature and volume of the evidence and will also help ensure the feasibility and timely completion of this overview of reviews, as well as its scope and comprehensiveness.

We will draw on the certainty of evidence assessments reported in the SRs as well as the methodological quality of the SRs themselves when drawing conclusions for each outcome, per comparison. When outcome-level certainty of evidence appraisals are not reported in the included SRs, we will informally consider aspects that can affect the certainty of evidence (e.g., risk of bias of the included studies, inconsistency in effects across studies, applicability or generalizability of the evidence to the Canadian context, imprecision of effects, publication bias) as they are reported in the SRs, as well as the quality of the SRs themselves, when drawing conclusions.

Clinical, Patient, and Community Engagement

To enhance the quality and relevance of this work, CADTH will engage people with extensive personal and/or professional experience with ED care within a Canadian health system. Specifically, CADTH will engage with health care professionals who provide or support care in the ED (e.g., ED physicians, primary care physicians, nurses, social workers, paramedics, administrators, leadership) and people with experience receiving care in the ED (e.g., patients, family members, caregivers).

Through an open call on CADTH's website, CADTH invited people to complete a statement of interest outlining their connection on the topic of ED overcrowding and how their experiences and views might add to the diversity of the perspectives.

CADTH will select people with the ability to:

- contribute to the diversity of perspectives through awareness of others' experiences and views within the patient or professional community (e.g., experience with a professional or patient association, or as a volunteer, staff member, or board member)
- act with integrity, independent of specific interests
- work constructively as a member of a diverse team.

Engagement opportunities available to support this work, include serving as 1 of the following:

- an expert consultant to ensure relevance and accuracy of the clinical context
- a peer reviewer to provide feedback on appropriate language, scope, and definitions and help ensure relevance to the Canadian context
- a committee member to support deliberations and the development of recommendations on which evidence-informed solutions should be considered to inform decision- and policy-making to effectively alleviate overcrowding of adult and pediatric ED services in urban, rural, and remote health care settings in Canada.

In addition to the engagement opportunities described here, there will be other opportunities to provide input; for example, through a series of consultations to help contextualize literature found for this review and calls for stakeholder feedback.

The final report will include the Guidance for Reporting Involvement of Patients and the Public (GRIPP2) Short Form reporting checklists[47] and include the outcomes, discussion, and reflection items, as suggested by that guidance, to outline the process of engagement and where and how participants' contributions were used in the assessment. A Patient Engagement Officer will keep track of patient engagement activities and interactions in detailed notes and communications.

Protocol Amendments

If amendments are required at any time during the study, the reasons for the changes will be recorded in a study file and subsequently reported within the final study report. If necessary, a rescreening of the previous literature search or an updated literature search will be performed to capture additional data. Any deviations from the protocol, as well as the rationale and timing of these deviations, will be disclosed in the final report, and updates will be made to both the PROSPERO submission for the overview of reviews (registration number: CRD42023428073) and the project protocol on the CADTH website, as appropriate.

References

1. Affleck A, Parks P, Drummond A, Rowe BH, Ovens HJ. Emergency department overcrowding and access block. *CJEM.* 2013;15(6):359-384.
2. Ospina MB, Bond K, Schull M, et al. Measuring overcrowding in emergency departments: a call for standardization. *(CADTH Technology report no. 67.1)*. Ottawa (ON): CADTH; 2006: https://www.cadth.ca/sites/default/files/pdf/320a_overcrowding_tr_e_no-appendices.pdf. Accessed 2023 Mar 28.
3. Bittencourt RJ, Stevanato AM, Braganca CTNM, Gottems LBD, O'Dwyer G. Interventions in overcrowding of emergency departments: an overview of systematic reviews. *Rev Saude Publica.* 2020;54:66.
4. De Freitas L, Goodacre S, O'Hara R, Thokala P, Hariharan S. Interventions to improve patient flow in emergency departments: an umbrella review. *Emerg Med J.* 2018;35(10):626-637.
5. Jeyaraman MM, Copstein L, Al-Yousif N, et al. Interventions and strategies involving primary healthcare professionals to manage emergency department overcrowding: a scoping review. *BMJ Open.* 2021;11(5):e048613.
6. Kirkland SW, Soleimani A, Rowe BH, Newton AS. A systematic review examining the impact of redirecting low-acuity patients seeking emergency department care: is the juice worth the squeeze? *Emerg Med J.* 2019;36(2):97-106.
7. Van den Heede K, Van de Voorde C. Interventions to reduce emergency department utilisation: a review of reviews. *Health Policy.* 2016;120(12):1337-1349.
8. Voaklander B, Gaudet LA, Kirkland SW, Keto-Lambert D, Villa-Roel C, Rowe BH. Interventions to improve consultations in the emergency department: a systematic review. *Acad Emerg Med.* 2022;29(12):1475-1495.
9. Canadian emergency care is being crushed - and why that matters for all of us. Ottawa (ON): Canadian Association of Emergency Physicians (CAEP); 2023: https://caep.ca/wp-content/uploads/2023/01/Letter-Canadian-Emergency-Care-is-Being-Crushed-Jan-2023.pdf. Accessed 2023 Apr 06.
10. COVID-19's impact on emergency departments. Ottawa (ON): Canadian Institute for Health Information; 2021: https://www.cihi.ca/en/covid-19-resources/impact-of-covid-19-on-canadas-health-care-systems/emergency-departments. Accessed 2023 Apr 28.
11. Emergency department wait time for physician initial assessment (90% Spent Less, in Hours) [indicator]. Ottawa (ON): Canadian Institute for Health Information; 2022: https://www.cihi.ca/en/indicators/emergency-department-wait-time-for-physician-initial-assessment-90-spent-less-in-hours. Accessed 2022 Dec 07.
12. Position statement on over-crowded emergency departments. West Melbourne (AU): International Federation for Emergency Medicine (IFEM); 2022: https://assets.nationbuilder.com/ifem/pages/546/attachments/original/1670806966/IFEM_Position_Statement_on_Emergency_Department_Overcrowding_December_2022.pdf?1670806966. Accessed 2023 Apr 06.
13. Javidan AP, Hansen K, Higginson I, et al. Report from the Emergency Department Crowding and Access Block Task Force. West Melbourne (AU): International Federation for Emergency Medicine (IFEM); 2020: https://assets.nationbuilder.com/ifem/pages/270/attachments/original/1650595379/ED-Crowding-and-Access-Block-Report-Final-June-30-2020.pdf?1650595379. Accessed 2023 May 03.
14. Dinh MM, Bein KJ, Alkhouri H, Ni Bhraonain S, Seimon RV. 24 hours - Life in the E.R.: a state-wide data linkage analysis of in-patients with prolonged emergency department length of stay in New South Wales, Australia. *Emerg Med Australas.* 2023.
15. Soltani M, Batt RJ, Bavafa H, Patterson BW. Does what happens in the ED stay in the ED? The effects of emergency department physician workload on post-ED care use. *Manuf Serv Oper Manag.* 2022;24(6):3079-3098.
16. Bond K, Opsina M, Blitz S, et al. Interventions to reduce overcrowding in emergency departments. *(CADTH Technology report no. 67.4)*. Ottawa (ON): CADTH; 2006: https://www.cadth.ca/sites/default/files/pdf/320d_overcrowding_tr_e_no-appendices.pdf. Accessed 2023 Mar 28.

17. Rowe B, Bond K, Opsina M, et al. Frequency, determinants, and impact of overcrowding in emergency departments in Canada: a national survey of emergency department directors. *(CADTH Technology report no. 67.3)*. Ottawa (ON): CADTH; 2006: https://www.cadth.ca/sites/default/files/pdf/320c_Overcrowding_tr_e_no-appendices.pdf. Accessed 2023 Mar 28.

18. Rowe B, Bond K, Opsina M, et al. Data collection on patients in emergency departments in Canada. *(CADTH Technology report no. 67.2)*. Ottawa (ON): CADTH; 2006: https://www.cadth.ca/sites/default/files/pdf/320b_overcrowding_tr_e_no-appendices.pdf. Accessed 2023 Mar 28.

19. Critical conditions in Canadian emergency departments are due to lack of human resources and timely access to hospital beds. Ottawa (ON): Canadian Association of Emergency Physicians (CAEP); 2022: https://caep.ca/wp-content/uploads/2022/07/CriticalCondition-Jul7.pdf. Accessed 2023 Mar 28.

20. Rowe BH, McRae A, Rosychuk RJ. Temporal trends in emergency department volumes and crowding metrics in a western Canadian province: a population-based, administrative data study. *BMC Health Serv Res.* 2020;20(1):356.

21. Asplin BR, Magid DJ, Rhodes KV, Solberg LI, Lurie N, Camargo CA, Jr. A conceptual model of emergency department crowding. *Ann Emerg Med.* 2003;42(2):173-180.

22. Savioli G, Ceresa IF, Gri N, et al. Emergency department overcrowding: understanding the factors to find corresponding solutions. *J Pers Med.* 2022;12(2):279.

23. Braveman P. A new definition of health equity to guide future efforts and measure progress. Washington (DC): HealthAffairs; 2017: https://www.healthaffairs.org/content/forefront/new-definition-health-equity-guide-future-efforts-and-measure-progress. Accessed 2023 Mar 03.

24. National Collaborating Centre for Determinants of Health. Glossary of essential health equity terms. 2023; https://nccdh.ca/glossary. Accessed 2023 Apr 06.

25. Ionescu-Ittu R, McCusker J, Ciampi A, et al. Continuity of primary care and emergency department utilization among elderly people. *CMAJ.* 2007;177(11):1362-1368.

26. Ragin DF, Hwang U, Cydulka RK, et al. Reasons for using the emergency department: results of the EMPATH Study. *Acad Emerg Med.* 2005;12(12):1158-1166.

27. Bartels SA, MacKenzie M, Douglas SL, et al. Emergency department care experiences among members of equity-deserving groups: quantitative results from a cross-sectional mixed methods study. *BMC Emerg Med.* 2023;23(1):21.

28. Benkhalti M, Espinoza M, Cookson R, Welch V, Tugwell P, Dagenais P. Development of a checklist to guide equity considerations in health technology assessment. *Int J Technol Assess Health Care.* 2021;37:e17.

29. O'Neill J, Tabish H, Welch V, et al. Applying an equity lens to interventions: using PROGRESS ensures consideration of socially stratifying factors to illuminate inequities in health. *J Clin Epidemiol.* 2014;67(1):56-64.

30. CADTH style guide, 7th ed. Ottawa (ON): CADTH; 2023: https://www.cadth.ca/sites/default/files/pdf/cadth_style_guide_7th_edition_v1.1.pdf. Accessed 2023 Apr 06.

31. Pollock M, Fernandes RM, Becker LA, Pieper D, Hartling L. Chapter V: overviews of reviews. In: Higgins JPT, Thomas J, Chandler J, et al., eds. *Cochrane handbook for systematic reviews of interventions version 6.3 (updated February 2022)*. London (UK): Cochrane; 2022: www.training.cochrane.org/handbook. Accessed 2023 Mar 28.

32. CFIR. Consolidated Framework for Implementation Research. 2022; https://cfirguide.org/. Accessed 2023 Apr 06.

33. Gates M, Gates A, Pieper D, et al. Reporting guideline for overviews of reviews of healthcare interventions: development of the PRIOR statement. *BMJ.* 2022;378:e070849.

34. McGowan J, Sampson M, Salzwedel DM, Cogo E, Foerster V, Lefebvre C. PRESS Peer Review of Electronic Search Strategies: 2015 guideline statement. *J Clin Epidemiol.* 2016;75:40-46.

35. Krnic Martinic M, Pieper D, Glatt A, Puljak L. Definition of a systematic review used in overviews of systematic reviews, meta-epidemiological studies and textbooks. *BMC Med Res Methodol.* 2019;19(1):203.

36. Badr S, Nyce A, Awan T, Cortes D, Mowdawalla C, Rachoin JS. Measures of emergency department crowding, a systematic review. How to make sense of a long list. *Open Access Emerg Med.* 2022;14:5-14.

37. McRae AD, Rowe BH, Usman I, et al. A comparative evaluation of the strengths of association between different emergency department crowding metrics and repeat visits within 72 hours. *CJEM.* 2022;24(1):27-34.

38. Jones PG, Mountain D, Forero R. Review article: emergency department crowding measures associations with quality of care: a systematic review. *Emerg Med Australas.* 2021;33(4):592-600.

39. McRae A, Usman I, Wang D, et al. LO17: A comparative evaluation of ED crowding metrics and associations with patient mortality. *CJEM.* 2017;19(S1):S33.

40. Pearce S, Marchand T, Shannon T, Ganshorn H, Lang E. Emergency department crowding: an overview of reviews describing measures causes, and harms. *Intern Emerg Med.* 2023:1-22.

41. Stang AS, Crotts J, Johnson DW, Hartling L, Guttmann A. Crowding measures associated with the quality of emergency department care: a systematic review. *Acad Emerg Med.* 2015;22(6):643-656.

42. Evidence Partners. DistillerSR [computer program]. Ottawa (ON): Evidence Partners; 2011.

43. Khangura S, Konnyu K, Cushman R, Grimshaw J, Moher D. Evidence summaries: the evolution of a rapid review approach. *Syst Rev.* 2012;1:10.

44. O'Blenis P. One simple way to speed up your screening process. Ottawa (ON): DistillerSR; 2017: https://blog.evidencepartners.com/one-simple-way-to-speed-up-your-screening-process. Accessed 2023 Jun 06.

45. Pollock M, Fernandes RM, Newton AS, Scott SD, Hartling L. A decision tool to help researchers make decisions about including systematic reviews in overviews of reviews of healthcare interventions. *Syst Rev.* 2019;8(1):29.

46. Shea BJ, Reeves BC, Wells G, et al. AMSTAR 2: a critical appraisal tool for systematic reviews that include randomised or non-randomised studies of healthcare interventions, or both. *BMJ.* 2017;358:j4008.

47. Staniszewska S, Brett J, Simera I, et al. GRIPP2 reporting checklists: tools to improve reporting of patient and public involvement in research. *BMJ.* 2017;358:j3453.

Appendix 1: Literature Search Strategy

Overview of Reviews Literature Search

Interface: Ovid

Databases:

- MEDLINE All (1946 to present)
- Embase (1974 to present)
- Note: Subject headings and search fields have been customized for each database. Duplicates between databases were removed in Ovid.

Date of search: Spring 2023

Alerts: Monthly search updates until project completion

Search filters applied: Systematic reviews; meta-analyses; network meta-analyses; health technology assessments; or overview of reviews

Limits:

- Publication date limit: 2013 to present
- Language limit: English and French language
- Conference abstracts: excluded

Table 3: Syntax Guide

Syntax	Description
/	At the end of a phrase, searches the phrase as a subject heading
MeSH	Medical Subject Heading
exp	Explode a subject heading
*	Before a word, indicates that the marked subject heading is a primary topic; or, after a word, a truncation symbol (wildcard) to retrieve plurals or varying endings
adj#	Requires terms to be adjacent to each other within # number of words (in any order)
.ti	Title
.ab	Abstract
.hw	Heading word; usually includes subject headings and controlled vocabulary
.kf	Keyword heading word
.dq	Candidate term word (Embase)
.pt	Publication type
.mp	Mapped term
.yr	Publication year

Syntax	Description
.ja	Journal abbreviation
.jn	Journal name
.jw	Journal title word (MEDLINE)
.jx	Journal title word (Embase)
medall	Ovid database code: MEDLINE All, 1946 to present, updated daily
oemezd	Ovid database code; Embase, 1974 to present, updated daily

Multidatabase Strategy

1. Crowding/ or "Length of Stay"/
2. Time Factors/ or Patient Admission/
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.
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.
5. (delay* adj5 (service* or "being seen" or treat* or therap* or care or caring or exam* or clearance or consult*)).ti,ab,kf.
6. (volume* adj4 (patient* or case or "use" or usage or center* or centre*)).ti,ab,kf.
7. (staff* adj2 (patient* or bed*) adj2 ratio*).ti,ab,kf.
8. (bed* adj3 (spac* or availab* or utiliz* or utilis* or "use" or usage)).ti,ab,kf.
9. (care* adj3 interval*).ti,ab,kf.
10. (access block* or bed block* or exit block* or access gap*).ti,ab,kf.
11. (throughput* or through-put* or output* or out-put*).ti,ab,kf.
12. (re-enter or reenter or re-entr* or reentr* or readmit* or re-admit* or readmiss* or re-admiss*).ti,ab,kf.
13. without being seen*.ti,ab,kf.
14. ((leav* or left*) adj6 (medical advic* or treat*)).ti,ab,kf.
15. (wait* adj3 time*).ti,ab,kf.
16. ((length* or prolong*) adj5 (stay* or wait*)).ti,ab,kf.
17. (patient* adj2 flow*).ti,ab,kf.
18. exp Health Services Misuse/
19. (overutili* or over-utili* or overus* or over-us*).ti,ab,kf.
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.
21. ((level or low) adj3 (acuit* or complexit*)).ti,ab,kf.
22. or/1-21

23. exp Emergency Medicine/ or Evidence-Based Emergency Medicine/ or exp Emergency Medical Services/ or paramedicine/
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.
25. (trauma* adj3 (unit* or care)).ti,ab,kf.
26. (emergicentre* or emergicenter* or emerg or paramed* or emergetolog*).ti,ab,kf.
27. (accident* adj4 department*).ti,ab,kf.
28. ambulance*.ti,ab,kf.
29. ("Canadian Triage & Acuity Scale" or "Canadian Triage and Acuity Scale" or emergency severity index).ti,ab,kf.
30. Emergency Nursing/ or exp emergency responders/
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.
32. (first adj3 responder*).ti,ab,kf.
33. ("A and E" or "A & E" or "A&E" or CTAS or ESI).ti,ab,kf.
34. Emerg*.ja,jn,jw.
35. or/23-34
36. 22 and 35
37. 36 use medall
38. "crowding (area)"/ or *"length of stay"/
39. Time Factor/ or hospital admission/ or hospital bed utilization/
40. (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.
41. ((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.
42. (delay* adj5 (service* or "being seen" or treat* or therap* or care or caring or exam* or clearance or consult*)).ti,ab,kf,dq.
43. (volume* adj4 (patient* or case or "use" or usage or center* or centre*)).ti,ab,kf,dq.
44. (staff* adj2 (patient* or bed*) adj2 ratio*).ti,ab,kf,dq.
45. (bed* adj3 (spac* or availab* or utiliz* or utilis* or "use" or usage)).ti,ab,kf,dq.
46. (care* adj3 interval*).ti,ab,kf,dq.
47. (access block* or bed block* or exit block* or access gap*).ti,ab,kf,dq.
48. (throughput* or through-put* or output* or out-put*).ti,ab,kf,dq.
49. (re-enter or reenter or re-entr* or reentr* or readmit* or re-admit* or readmiss* or re-admiss*).ti,ab,kf,dq.

50. without being seen*.ti,ab,kf,dq.
51. ((leav* or left*) adj6 (medical advic* or treat*)).ti,ab,kf,dq.
52. (wait* adj3 time*).ti,ab,kf,dq.
53. ((length* or prolong*) adj5 (stay* or wait*)).ti,ab,kf,dq.
54. (patient* adj2 flow*).ti,ab,kf,dq.
55. (overutili* or over-utili* or overus* or over-us*).ti,ab,kf,dq.
56. ((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.
57. ((level or low) adj3 (acuit* or complexit*)).ti,ab,kf,dq.
58. or/38-57
59. 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/
60. (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.
61. (trauma* adj3 (unit* or care)).ti,ab,kf,dq.
62. (emergicentre* or emergicenter* or emerg or paramed* or emergetolog*).ti,ab,kf,dq.
63. (accident* adj4 department*).ti,ab,kf,dq.
64. ambulance*.ti,ab,kf,dq.
65. ("Canadian Triage & Acuity Scale" or "Canadian Triage and Acuity Scale" or emergency severity index).ti,ab,kf,dq.
66. Emergency Nursing/ or emergency nurse practitioner/ or exp "first responder (person)"/ or emergency medical dispatcher/ or emergency physician/ or emergency patient/
67. (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.
68. (first adj3 responder*).ti,ab,kf,dq.
69. ("A and E" or "A & E" or "A&E" or CTAS or ESI).ti,ab,kf,dq.
70. emerg*.ja,jn,jx.
71. or/59-70
72. 58 and 71
73. 72 use oemezd
74. 73 not (conference abstract or conference review).pt.
75. 37 or 74
76. (systematic review or meta-analysis).pt.

77. 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/
78. ((systematic* adj3 (review* or overview*)) or (methodologic* adj3 (review* or overview*))).ti,ab,kf.
79. ((quantitative adj3 (review* or overview* or synthes*)) or (research adj3 (integrati* or overview*))).ti,ab,kf.
80. ((integrative adj3 (review* or overview*)) or (collaborative adj3 (review* or overview*)) or (pool* adj3 analy*)).ti,ab,kf.
81. (data synthes* or data extraction* or data abstraction*).ti,ab,kf.
82. (handsearch* or hand search*).ti,ab,kf.
83. (mantel haenszel or peto or der simonian or dersimonian or fixed effect* or latin square*).ti,ab,kf.
84. (met analy* or metanaly* or technology assessment* or HTA or HTAs or technology overview* or technology appraisal*).ti,ab,kf.
85. (meta regression* or metaregression*).ti,ab,kf.
86. (meta-analy* or metaanaly* or systematic review* or biomedical technology assessment* or bio-medical technology assessment*).mp,hw.
87. (medline or cochrane or pubmed or medlars or embase or cinahl).ti,ab,hw.
88. (cochrane or (health adj2 technology assessment) or evidence report).jw.
89. (comparative adj3 (efficacy or effectiveness)).ti,ab,kf.
90. (outcomes research or relative effectiveness).ti,ab,kf.
91. ((indirect or indirect treatment or mixed-treatment or bayesian) adj3 comparison*).ti,ab,kf.
92. [(meta-analysis or systematic review).md.]
93. (multi* adj3 treatment adj3 comparison*).ti,ab,kf.
94. (mixed adj3 treatment adj3 (meta-analy* or metaanaly*)).ti,ab,kf.
95. umbrella review*.ti,ab,kf.
96. (multi* adj2 paramet* adj2 evidence adj2 synthesis).ti,ab,kf.
97. (multiparamet* adj2 evidence adj2 synthesis).ti,ab,kf.
98. (multi-paramet* adj2 evidence adj2 synthesis).ti,ab,kf.
99. (overview* adj3 review*).ti,ab,kf.
100. ("review of review" or "review of reviews").ti,ab,kf.
101. or/76-100
102. 75 and 101
103. limit 102 to yr=2013-current
104. limit 103 to (english or french)
105. remove duplicates from 104

Other Databases

Cochrane Database of Systematic Reviews

Same MeSH, keywords, and limits used as per MEDLINE search, excluding study types and human restrictions. Syntax adjusted for CochraneLibrary.com platform. The search strategy is available on request.

CINAHL

Same MeSH, keywords, and limits used as per MEDLINE search, excluding study types and human restrictions. Syntax adjusted for EBSCO platform, including the addition of CINAHL headings. The search strategy is available on request.

Grey Literature

Search dates: Spring 2023

Keywords: [Crowding, overcrowding, access blocks, bed blocks, wait times, delays, length of stay, emergency, ambulances]

Limits: Publication years: 2013 to present

Updated: Search updated prior to the completion of stakeholder feedback period

Relevant websites from the following sections of the CADTH grey literature checklist Grey Matters: A Practical Tool for Searching Health-Related Grey Literature were searched:

- Health Technology Assessment Agencies
- Databases (free)
- Internet Search
- Open Access Journal

The complete search archive of sites consulted for this report is available on request.