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Technologies to Address Wait Times in the Emergency Department

Key Messages

What Is the Issue?

- Emergency departments (EDs) across Canada are currently under strain, resulting in patients experiencing long wait times and delays in receiving care.
- Across the country, long wait times have had devasting effects on patients and staff alike. Finding solutions to improve patient flow and efficiency is paramount to improving the quality of care for patients and well-being for those that work in the ED.
- This report aims to provide an overview of emerging technologies, such as artificial intelligence (AI) and vital sign monitors, which may reduce wait times in the ED or manage patient safety.

What Are the Technologies?

- AI triage and clinical decision support models use machine-learning algorithms to analyze patient data and recommend acuity levels for patients as well as suggestions for next steps.
- Portable or wearable vital sign monitors continuously monitor vital signs such as blood pressure or oxygen levels for patients in the waiting area. Alerts are sent when any irregularities are detected.
- Digital information tools provide real-time updates to patients or clinicians working in the ED about average wait times, patient volumes, and available resources.
- Telemedicine connects patients via synchronous video calls to remote providers who assess patients and initiate care by ordering tests or imaging.

What Is the Potential Impact?

- AI triage systems and digital information tools could improve patient flow by streamlining triage or redirecting patients with low-acuity care needs to choose alternative ED sites. These systems may also allow for better resource utilization.
- Vital sign monitors and staff-facing digital information tools could improve patient safety for patients waiting for care or at risk of extended waiting periods by allowing prompt treatment escalation.
- Telemedicine may allow for faster consultations for patients with low-acuity care needs.

Key Messages

What Else Do We Need to Know?

- Before widespread adoption, more robust studies with larger sample sizes need to be conducted in Canada to examine how well these technologies can work compared to standard care and in real-life situations. Further evaluations could assist clinicians in gaining a better understanding of these technologies and how they may alleviate ED overcrowding, as well as facilitate their implementation, if appropriate.
- AI-powered solutions show potential in enhancing patient flow, although regulatory frameworks, guidelines, and policies are needed to address accountability, errors, algorithm biases, and data privacy concerns.
- Technological advancements, no matter how promising, cannot replace human care and intuition. Proposed models may have the greatest impact when used in tandem with human experience and empathy.

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Purpose and Approach

This Horizon Scan provides health care decision-makers in Canada an overview of emerging technologies, such as artificial intelligence (AI) or vital sign monitors, which may address wait times and/or manage patient safety in emergency departments (EDs). This report describes the technologies, availability, clinical evidence, and some considerations related to implementation in Canada.

To inform this Horizon Scan, we searched key resources including journal citation databases, and we conducted a focused internet search for relevant evidence published since 2020. This report is not a systematic review and does not involve critical appraisal. It is not intended to provide recommendations for or against the use of technology.

What Is the Issue?

EDs across Canada are currently under strain. Consequently, patients are experiencing long wait times and delays in receiving care. Factors that contribute to ED overcrowding include lack of access to primary care, increased patient volumes in the ED, staff shortages, decreased bed capacity, and insufficient access to continuing care.[1,2]

Across the country, long wait times have had devasting effects on patients and staff alike. There have been reported cases in which patients died or their conditions worsened due to reduced throughput.[3] These situations can have ripple effects on patient care and morale of ED staff. Finding ways to improve patient flow and efficiency is paramount to improving the quality of care for patients and the experiences of those who work in the ED. In this increasingly digital and rapidly evolving era, technological advancements are being developed or used to address health care challenges and their effects. In the ED, a range of innovative tools are being used to improve patient flow, enhance triage processes, support decision-making, and manage patient safety.

What Are the Technologies and How Do They Work?

Several technologies have been deployed or proposed as solutions to improve patient flow in the ED. They can be classified into 4 categories.

AI Triage and Clinical Decision Support Tools

These tools are proposed machine-learning algorithms that act as clinical decision support aids for ED clinicians.[4-8] Algorithms analyze data collected from demographics, vital signs, chief complaints, medical history, and traditional triage scales such as the Emergency Severity Index or the Canadian Triage and Acuity Scale.

After analysis, AI tools recommend an acuity level on a scale of 1 to 5 (with 1 representing patients who are severely ill, and 5 representing patients requiring nonurgent care), stratifying patients according to their need for care. Some systems can get subjective information from patients with prompts and patient-facing features, such as video and voice.[5] Therefore, patients can describe their presenting conditions to be incorporated into the AI analysis. Upon completion of triage, the AI models can produce a summary report with the patient's condition and suggestions for further investigation or referrals.

Vital Sign Monitoring

Vital sign monitors are portable or wearable devices that use biosensors to continuously monitor vital signs such as heart rate, blood pressure, oxygen levels, breathing rate, and temperature.[9-11] ED nurses can assign these monitors to patients who are triaged as urgent to semiurgent and who are at risk of prolonged waiting periods. The devices continuously monitor patients and can provide real-time information to clinical staff via monitors, dashboards, or mobile apps. If irregularities are detected, the systems trigger automatic alerts to allow the timely escalation of care.

Digital Information Tools

Digital information tools visualize ED activity and status by providing real-time updates on the state of the ED.[12-16] They provide information on the current wait times, patient volume, resource availability, predictive trends, surge thresholds, and management options to address surges. Information tools can be designed for ED clinical staff to view live updates on a monitor, such as the Command Centre at Humber River Hospital,[14] or for patients with low-acuity care needs to decide when or where to seek care, such as wait-time websites.[15]

Telemedicine

Telemedicine connects patients to remote providers via synchronous video calls.[17,18] Upon arrival at the ED, patients describe the reason for their visit and have their vital signs checked. After check-in, patients are assigned to a remote telemedicine provider who conducts a consultation and initiates care by ordering any necessary tests or imaging. An in-person physician then completes an assessment using notes left by the telemedicine provider.

Examples of technologies identified in each category can be found in Table 1.

Who Might Benefit?

Current triage systems rely on clinical judgment and subjectivity, which can vary across individuals, circumstances, and settings. AI triage systems offer a solution by acting as clinical decision support tools or aids for ED clinicians.[7,8] With implementation, AI-driven triage has the potential to prioritize patients more accurately and faster.[6] As a result, the cognitive load and administrative impact ED clinicians experience can be lifted, allowing for better resource allocation and utilization. Working in tandem with AI-powered systems can also increase the confidence of ED clinicians, especially during busy periods.[5,7,8] Furthermore, systems such as the Diagnostic AI System for Robot-Assisted ED Triage (DAISY) can operate in different languages, circumventing the need for interpreters when documenting patient information. This has the advantage of more accurate symptom documentation for speakers of languages other than English, as well as better resource utilization.[5]

Table 1: Examples of Technologies to Address Wait Times and Safety in the ED

Class of technology	Examples	Purpose of technology
AI triage tools	Smart Triage, DAISY,[a] TriageGO, KATE, Triage-Bot[a]	AI models that serve as clinical decision support tools to streamline triage process
Vital signs and patient monitors	Portable wearable biosensor, portable pulse oximeter	Monitor vital signs or wait times for people in the waiting area; usually send an alert when irregularities are detected
Digital information tools	AI-powered Command Centre, Hero AI, SurgeCon, wait-time tracker	Provide information to patients or ED clinicians regarding average wait times, patient volume, or real-time ED activity
Telemedicine	Telepsychiatry and teleintake	Live video calls that involve patient assessment upon arrival to ED

AI = artificial intelligence; DAISY = Diagnostic AI System for Robot-Assisted ED Triage; ED = emergency department.

Note: KATE is a system created by Mednition Inc.

[a]Proposed models in development and/or public evidence on performance and effectiveness of systems are not available.

In periods when EDs are over capacity, with many patients with high-acuity care needs and limited bed capacity for resuscitation, patients with low-acuity care needs are at risk of waiting for prolonged periods of time. During this time, ED clinical staff are working at capacity with fewer opportunities to monitor patients' vital signs as they wait for care.[3] This can impact patient safety and reduce morale among ED staff. Portable or wearable continuous vital sign monitoring devices can help mitigate this problem. These sensors trigger automatic alerts to ED staff when irregularities are detected or if patients have been waiting for extended periods of time.[19] This allows for timely escalation and reprioritization of patients, which can prevent the worsening of symptoms.

Likewise, digital information tools can provide real-time updates about the status of the ED to ED clinicians.[12,13] As a result, EDs may have more information to manage crowding and expedite care for patients waiting for long periods of time. For patients with low-acuity needs, wait-time website trackers allow them to consider accessing care at sites with shorter times, and avoid sites working at capacity.[15] At a system level, these tools may allow for transparency and better coordination between health services.

Availability and Use in Canada

A summary of technologies being used or in development in Canada is provided in Table 2. Examples include AI-driven triage, vital sign monitors, and digital information tools being deployed across Canadian EDs. Due to the evolving nature of research and development in this field, other examples may exist that were not identified.

Additional examples of technologies in use or development outside Canada are provided in the Table 3 in Appendix 2.

Table 2: Technologies Used or in Development in Canada

Technology, jurisdiction	Development group or site used	Stage of development	Description of technology
AI triage			
Triage-Bot[8] **Ontario**	Canada (Queens University and Ontario Tech University) and UK (Bradford University)	In development	A machine-learning model system based on the CTAS. This uses voice and video with preset and open-ended questions to allow patients to describe concerns. The system also measures vital signs.
Vital sign monitor			
Portable pulse oximeter[10] **Nova Scotia**	Used at Dartmouth General Hospital, Nova Scotia	In use	Device attached to a patient's fingers or wrists to continuously monitor vital signs such as pulse rate and oxygen levels. It is wirelessly connected to a monitor that tracks vital signs. The system detects abnormalities or changes in breathing rate.
Digital information tools			
Hamilton emergency wait-time tracker[15] **Ontario**	Hamilton Health Sciences	In use	A website that tracks the wait times at EDs and UCCs across Hamilton. Patients use the website to compare wait times across sites and consider their options for care.
Hero AI[12,13] **Ontario**	Hero AI group	In use	AI-powered dashboard that monitors the ED waiting room in real time to reduce wait times for patients at risk of clinical deterioration, who are usually triaged as urgent or semiurgent. This supports faster identification and prioritization of care for this patient group. Uses medical history, vital signs, demographics, and free text clinical notes to identify patients at risk of clinical deterioration. Alerts are sent to a mobile app, Beacon, which sends notifications to ED staff when patients at risk of clinical deterioration are identified to allow care coordination between ED clinicians.
SurgeCon[16] **Newfoundland and Labrador**	Research team at Carbonear General Hospital and MOBIA Technology Innovations	In use	Digital platform that supports real-time ED surge management. ED staff update the platform with patient volumes and resource availability. The platform categorizes the ED based on preset thresholds and suggests appropriate action to address the surges.

Technology, jurisdiction	Development group or site used	Stage of development	Description of technology
The Command Centre[13,14] **Ontario**	Humber River Hospital	In use	AI-powered centralized operating system that shows ED staff how long patients have been waiting in the ED. Nurses referred to as "clinical expediters" monitor screens and intervene if patients have been waiting longer than the targeted time for their suspected condition.

AI = artificial intelligence; CTAS = Canadian Triage and Acuity Scale; ED = emergency department; UCC = urgent care centre.

Cost

No information was identified regarding Canadian prices for any of these technologies; however, their implementation would require resources for launch, integration, and comprehensive training of staff and users. For AI triage systems, for example, comprehensive training of how data algorithms are set up and their ability to enhance care has been reported to increase ED clinicians' trust, which could facilitate implementation.[5] In addition, the adoption of technologies would include costs associated with device maintenance and software updates.

Evidence

Evidence suggests that some technologies have the potential to enhance patient care by shortening wait times, reducing the time patients spend in the ED, or managing patient safety while monitoring patients who are waiting, or are at risk of waiting, for extended periods of time. Identified studies were small (conducted at a single site or with small sample sizes), funded by the manufacturer,[6] or focused on short-term ED outcomes (i.e., time intervals from patient arrival to treatment wait times over a short study period),[6,9] and therefore must be interpreted with caution. Although there are machine-learning models being developed or piloted in Canada,[7,8] the evidence identified on the feasibility of the systems was conducted outside of Canada. Therefore, results may not be generalizable to Canadian EDs. For vital sign monitors and digital information tools, news releases have highlighted their pilot implementation across Canadian EDs; however, more robust studies are needed to understand their effects on ED workflow to have a lasting impact on Canadian health care systems.

Additional details regarding study characteristics and findings of included studies can be found in Table 4 in Appendix 3.

AI Triage

TriageGO

A multisite quality improvement study that implemented an AI clinical decision support tool across 3 EDs in Connecticut found that AI triage was linked to patients receiving care more quickly and leaving the ED sooner compared to before implementation of the tool. The AI triage tool had site-specific machine-learning algorithms applied at the 3 study sites — a free-standing community ED, an urban-academic ED, and an urban ED — that routinely collected data at triage.[6]

There were reductions in time from:

- arrival to initial care area, by a median of 4 minutes
- arrival to ED disposition, by a median of 8 minutes
- arrival to ED departure, by a median of 19 minutes.

TriageGO was also implemented at the John Hopkins University hospital ED, with promising results on streamlining the triage process. Reports suggest that implementation has resulted in improved efficiency in patient flow. At the time of the news release, the rollout was expanded to other EDs in the area and hospitals in other states.[20]

Smart Triage

In a qualitative study on the perspectives of health workers who used Smart Triage in Uganda, Novakowski and colleagues reported that the digital triaging platform had a positive impact on reducing the time to treatment for pediatric emergency cases. The predictive model was reported to accurately identify and categorize critically ill children in low-resource settings.[4,21]

Vital Sign Monitoring

Evidence from a before-and-after study in the US, in which wearable biosensors were placed on patients triaged as urgent to nonurgent (Emergency Severity Index levels 3 to 5), suggests that this could be an alternative method for monitoring vital signs of patients waiting for prolonged periods of time in a busy ED setting.[9]

A portable pulse oximeter was deployed in an ED in Nova Scotia for patients with chest pain, abnormal lab results, or difficulty breathing, to continuously monitor their vital signs. Preliminary results indicate that the device captured changes in heart rhythm and breathing. As a result, the clinical team could reprioritize care for patients at risk of their conditions deteriorating.[10]

Digital Information Tools

Command Centre

Use of the AI-powered Command Centre at Humber River Hospital in Toronto was reported to shorten wait times in the ED. Nurses identified patients waiting for extended periods of time and expedited their care if wait times were longer than the targeted period for their health complaint.[13]

SurgeCon

A proof-of-concept study conducted at a hospital in Carbonear reported that the use of the digital SurgeCon platform shortened average wait times from 104 minutes to 42 minutes, despite a 25% increase in patient volume, during the study period between 2013 and 2017. Deployment of SurgeCon was also associated with shortened time between arrival to admittance or discharge, from 199 minutes to 134 minutes.[16] Results from the larger study once the app was developed were not identified.

Wait Times Tracker

Upon launching a website in 2019 that displays individual wait times for EDs and urgent care centres in Hamilton, researchers found patient wait times at EDs were reduced for patients who require low-acuity care.[15]

Telemedicine

Two retrospective cohort studies examined the effects of telepsychiatry for patients in the ED, and found that wait times were significantly lower with telepsychiatry evaluation compared to in-person evaluation. However, the results also showed that the overall ED length of stay was longer with telepsychiatry.[17]

A before-and-after study conducted in a community hospital in the US found that the door-to-provider time decreased with the implementation of teleintake at triage, although the door-to-admit time slightly increased compared to before implementation of teleintake. Teleintake physicians reported that teleintake was as good as in-person triage.[18]

Issues to Consider

Trust

Although studies report that ED practitioners are open to having AI triage tools play an assistive role in streamlining triage, there is some skepticism of AI-powered systems.[5] Trust is paramount for the adoption of technologies to have lasting effects on the health care system. Lack of trust has the potential to act as an implementation barrier. The development and sharing of more robust evidence that demonstrates the effectiveness and reliability of AI models, including feasibility and effectiveness in real-world settings and during different ED activity levels, may help increase trust among ED clinicians. Comprehensive training of ED staff may also develop trust in AI systems, as this would contribute to a deeper understanding of how algorithms work, how to troubleshoot, and strategies to harness the tools.[5,22]

Issues With Machine-Learning Development

Proposed machine-learning models appear to have the ability to allow for the assessment of large volumes of patients efficiently. However, they have the potential to perpetuate existing health disparities if AI models are not trained with datasets that represent the diversity of patient demographics present across Canadian health care systems,.[22,2324] Ideally, predictive machine-learning models would be informed by datasets that can make reliable predictions for all demographic and ethnic groups represented in the population.[24]

"Medicine Is Art"

AI triage comes with the promise of the ability to document subjective information from patients via video and audio integrated in their systems. This enables the system to create a comprehensive summary of the patient, including both subjective and objective information. However, some patients may be unwilling or unable to articulate their conditions effectively to nonhuman agents. To ensure equitable implementation, proposed AI models would ideally have the ability to work with diversity at the ED site to ensure accurate information for each patient is documented, allowing for accurate triage.

Medicine may be viewed as a combination of art and science. Intuition and nonverbal cues are driving forces that ED staff take pride in when delivering high-quality care.[5] Some medical practitioners have noted concerns that AI triage models may have challenges interpreting subtleties and visual cues that are sometimes associated with certain conditions, such as abuse.[5] In situations where human care and connection is needed, it is unclear how AI will perform.[5,8]

Data Safety

Data privacy and confidentiality were concerns noted by ED medical practitioners.[5,22] There is concern that deployment of AI-powered digital tools puts sensitive patient information at risk of breach. Before implementation, software must be deemed secure to ensure patient data are not at higher risk of compromise.

Need for Guidelines

Regulatory frameworks, quality standards, guidelines, or policies can govern the use of AI in health care. Before widespread adoption of AI in triage, continuous monitoring, and ED activity trackers, such frameworks should be established. Having these in place could help health systems anticipate and navigate problems when there are AI-driven errors, system malfunctions, adverse events, deaths, or data breaches. Guidelines may also support accountability and algorithm bias.[5,22]

With the promising effects of AI automated decision-making, there is a risk of automation bias.[8] Automation bias is the tendency of humans to defer to automated decisions. This can have negative effects if models are not properly validated. Having policies in the ED that mandate human input before care is delivered may help prevent this issue.[22]

Vital Sign Monitors

As the field of digital vital sign monitors evolves, usability remains an important consideration, so that ED staff with diverse technological competencies can easily use the device.[19]

There is evidence that there are biases in pulse oximetry among racialized patient groups. For patients who have pigmented skin, evidence suggests that measurements are not always accurate. For example, in 1 study, pulse oximeters were found to overestimate oxygen levels in patients with darker skin tones.[25] Regulatory bodies such as Health Canada and hospitals have a role to ensure that accurate oxygen measurements are possible for all patients with diverse skin pigmentation.[26] Without this, widespread deployment of vital sign monitors may not be able to alert irregularities in racialized groups.

With the use of wireless vital sign monitoring devices, vital signs are able to be monitored when ED staff are working at capacity for patients who are at risk of waiting for extended periods of time. However, for certain patient groups, such as children, certain devices may be more difficult to attach to measure vital signs.[21] Consequently, ED staff may spend more time troubleshooting to ensure accurate, complete vital signs are captured. This may end up lengthening triage times, disrupting efficiency and flow in the ED.

Related Developments

AI Models

Several AI models are in development, with the aim of serving as clinical decision support aids or managing patient flow in the ED.

- A collaboration between the National Health Service (NHS) and the University of York in the UK has proposed the DAISY system, with the aim of reducing ED wait times. The system directs patients through triage by capturing both subjective and objective data. Patients can input subjective information about their condition, and have vital signs captured and recorded. The system will then create a summary report with suggestions.[5]
- Two machine-learning models — Triage-Bot,[8] proposed by researchers from Canada and the UK, and KATE,[7] by researchers in the US — work as clinical decision support aids for ED nurses during triage.
- A tool is being developed at Humber River Hospital that simulates patients flow and assigns time slots for patients to visit the ED. The system will harness AI to assign patient time slots based on urgency of condition, resource availability, and real-time ED activity.[27]

Monitoring in Prehospital Settings

There are ongoing studies being conducted in Denmark and the US that aim to investigate whether continuous vital sign monitoring of critically ill patients during ambulance transport to the hospital may impact coordination of care, time to treatment, and ED length of stay.[28,29]

Future Clinical Studies

Several future or ongoing clinical trials were identified that aim to evaluate the effectiveness, performance, and safety of technologies to address wait times or manage safety in ED. Trials in Canada, the US, the UK, and Europe were identified. Topics of study include:

- AI-powered triage that acts as a virtual assistant or clinical decision support aid for ED clinicians
- safety and effectiveness of validated AI models in real-world settings
- performance and safety of wearable vital sign monitors; camera-based, contact-free, or remote physiologic monitoring devices; or patient deterioration warning systems
- performance and safety of hand-held devices that facilitate the triage of pediatric patients.

Additional details about trial designs and settings can be found in Table 5 in Appendix 3.

Looking Ahead

There are promising results and technological solutions to shorten ED wait times and improve patient safety during extended wait times. With the impact of ED overcrowding costing the health care system and patients, there is demand for innovative solutions that streamline ED processes to enhance patient flow. In Canada, pilot studies and proof-of-concept studies are promising, but further work is required to examine the feasibility of widespread implementation and long-term results on patient flow. Regulatory and ethical frameworks would support broader adoption of promising technologies. Further, robust testing and well controlled trials would also help to establish trust and overcome any skepticism in AI-powered systems in the ED.

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Appendix 1: Methods

Please note that this appendix has not been copy-edited.

Literature Search Strategy

An information specialist conducted a literature search on key resources including MEDLINE, the Cochrane Database of Systematic Reviews, the International HTA Database, the websites of health technology assessment agencies in Canada and major international HTA agencies, as well as a focused internet search. The search approach was customized to retrieve a limited set of results, balancing comprehensiveness with relevance. The search strategy comprised both controlled vocabulary, such as the National Library of Medicine's MeSH (Medical Subject Headings), and keywords. Search concepts were developed based on the elements of the research questions and selection criteria. The main search concepts were emergency departments, wearable devices, vital sign monitoring, patient flow, overcrowding, technologies, and artificial intelligence. The search was completed on May 13, 2025, and limited to English-language documents published since January 1, 2020.

Selection Criteria

One author screened the literature search results and reviewed the full texts of all potentially relevant studies. Studies were considered for inclusion if the intervention was a technological model or device that is in use or development to address wait times and improve safety of patients waiting in the ED. Conference abstracts and grey literature were included when they provided additional information to that available in the published studies.

Appendix 2: Technologies Outside Canada

Please note that this appendix has not been copy-edited.

Table 3: Technologies to Address Wait Times and Safety Outside Canada

Technology	Development group or site used	Stage of development or use	Description of technology
AI triage and clinical decision support			
KATE[7] **US**	Mednition	In development	Machine-learning software that acts as a clinical decision support aid. It works alongside EHR and uses patient information, current presentation, medical history and ESI to create an acuity decision. If acuity decision does not match the nurse's recommendation, nurses can override decision.
Smart Triage[4,30] **Canada, Kenya, and Uganda**	BC Children's Hospital Research Institute, BC Children's Hospital and BC Women's Hospital and Health Centre, Kenya Medical Research Institute, and Walimu (Uganda)	In use mainly in low-resource settings	Digital triaging platform that uses predictive algorithm to identify and stratify patients according to acuity level and has a platform to monitor pulse oximetry. The mobile application is linked to an interactive dashboard that provides clinicians real-time data on risk category, demographics, and location, treatment times. It also has a Bluetooth tracking system.
Triage GO[6,20] **(Beckman Coulter)** **US**	John Hopkins University and Beckman Coulter	Currently in use in sites in the US (Maryland, Florida, Connecticut, and Missouri)	A clinical decision support system that uses machine learning to estimate the patient's risk of critical care using data collected on arrival including demographics, chief complaint, and vital signs. Patients are then given a severity level between 1 and 5 (1 refers to high acuity; 5 refers to low acuity), which is added to the EHR workflow for nurses to access.
Vital sign monitoring			
Armband vital sign monitor[11] **Australia**	Propell Health and Biofourmis	In use	An armband with a blood pressure cuff and oximeter that allows vital signs monitoring in the waiting area. After a patient is triaged, the triage nurse decides to monitor a patient's vital signs. The patient is monitored by the Health in a Virtual Environment service that alerts the hospital if there are any irregularities.
Portable wearable biosensor[9] **US**	NR	In use	Biosensor that captures HR, BP, RR, oxygen saturation, and temperature. Patients triaged with ESI with score greater than 3 (urgent to nonurgent) as well as chief complaints of dyspnea, syncope, suspected infection, or at triage nurse or physician discretion and an expected ED waiting period > 2 hours.

Technology	Development group or site used	Stage of development or use	Description of technology
			A technician was placed at a patient monitoring patients in ED triage to track patients until they were admitted or discharged.
Telemedicine			
Tele-intake[18] **US**	NA	In use	Teleintake physicians used to triage patients from 11 a.m. to 6 p.m., 7 days a week. Synchronous video calls for physical examination and physician documents findings and initiates care by placing orders.
Telepsychiatry[17] **US**	NA	NA	Live video meeting and assessments of patients upon arrival to psychiatric ED.

BC = British Columbia; BP = blood pressure; ED = emergency department; EHR = electronic health record; ESI = Emergency Severity Index; HR = heart rate; NA = not applicable; NR = not reported; RR = respiratory rate.

Appendix 3: Characteristics of Included Studies

Please note that this appendix has not been copy-edited.

Table 4: Studies of Technologies to Address Wait Times and Safety in Emergency Departments

Author, year, country, technology	Topic area, study design	Population, comparator, outcomes	Main findings
Taylor et al. (2025)[6] **US** **TriageGO**	Implementation of AI-driven clinical decision support intervention. Multisite quality improvement pre-post intervention study (at 3 ED)	P: Patients visiting the ED I: AI-driven clinical decision support tool C: Preimplementation ESI-based triage O: Triage performance and ED patient flow Preimplementation: 83,404 ED visits Postimplementation: 91, 244 ED visits	AI triage was associated with reduction in **arrival time to initial care area** (9.0% [95% CI, −7.9 to 23.3%]); **arrival to ED disposition** (0.9% [95% CI, −2.9 to 4.6%]); and **arrival to ED departure** (5.0% [95% CI, −0.7 to 10.4%]).
Kamau et al. (2024)[4] **Kenya** **Smart Triage**	Comparison on Smart Triage with the (ETAT) Guidelines Prospective diagnostic accuracy study	P: Children under the age of 15 years who presented to 2 ED in Kenya I: Smart Triage C: ETAT guidelines O: Performance metrics including sensitivity, specificity, PPV, and NPV N = 5,618 children	Smart Triage is able to identify and categorize patients comparably or better than ETAT guidelines.
Shalev et al. (2024)[17] **Israel** **Telepsychiatry**	Evaluation of TP in the ED setting Scoping Review	P: Adult patients I: TP C: In-person evaluation O: Time of arrival to discharge TP visits in 2 studies = 493 In-person visits in 2 studies = 339	Evaluation of patients with TP was significantly lower compared with TP evaluation.
Rovenolt et al. (2023) [9a] **US** **Wearable biosensor**	Feasibility of wearable biosensor for vital sign monitoring during peak ED times. Prospective study	P: Patients in the ED waiting area I: Patient monitoring with wearable biosensor O: Vital sign completeness, time to deployment, patient and physician experience. N = 80 patients	67.6% of monitored minutes contained a complete set of vital signs including HR, RR, BP, SpO_2, and temperature. Patients felt satisfied as they felt they were being watched despite the long wait. ED staff felt that implementation did not lead to an increase in workload and were open to further expansion to benefit more patients.

Author, year, country, technology	Topic area, study design	Population, comparator, outcomes	Main findings
Novakowski et al. (2022)[21] **Uganda** **Smart Triage**	Health worker perspectives on using Smart Triage in Uganda Descriptive qualitative study	P: children presenting to the ED with an acute illness I: Smart Triage O: Perspectives on usability, feasibility, and acceptability of technology	Smart Triage had a positive impact on reducing **time to treatment** for emergency pediatric patients. Features were usable and feasible to implement.
Joshi et al. (2020)[18] **US** **Teleintake triage**	Triage of patients with telemedicine. Before-after study	P: Patients presenting to the ED between 11 a.m. to 6 p.m. I: Tele-triage C: In-person triage (before implementation) O: Rate of patients LWBS, door-to-provider time, door to disposition times, LWTC, physician experience. Preimplementation = 19, 892 patients Postimplementation = 19,646 patients	Overall **door-to-provider time** decreased Pre: median = 19 (IQR = 9 to 38) minutes vs. Post: median = 16.2 (IQR = 7.8 to 34.3) minutes P < 0.001 Increase in **door-to-admit times** Pre: median = 330 (IQR = 253 to 432) minutes vs. Post: median = 357.6 (IQR = 260.3 to 514.5) minutes P < 0.001

AI = artificial intelligence; BP = blood pressure; ED = emergency department; ESI = Emergency Severity Index; ETAT = Emergency Triage Assessment and Treatment; HR = heart rate; LWBS = leave without being seen; LWTC = left without treatment complete; NPV = negative predictive value; PPV = positive predictive value; RR = respiratory rate; SpO_2 = oxygen saturation; TP = telepsychiatry.

[a]Information retrieved from conference abstract.

Table 5: Characteristics of Ongoing Trials

Title, trial registry ID, country	Technology	Description	Setting	Target population	Outcomes
Artificial Intelligence (IA) Advanced Triage Tool for G & O Emergencies (TIAGO) **Spain** **NCT05382000**	AI triage **Mediktor** Triage	Evaluation of the triage of patients with obstetrics and gynecological emergencies	ED	Adult patients presenting to ED	Agreement of tool between AI triage and standard nurse triage and physician diagnosis, triage time, ED LOS
Artificial Intelligence-powered Virtual Assistant for Emergency Triage in Neurology (AIDEN) **Argentina** **NCT06334796**	AI-powered **virtual assistant**	Testing of AI virtual assistant in identifying and triaging patients with neurologic emergencies in the ED	ED	Adult patients presenting to the ED with neurologic emergency	Diagnostic accuracy and utility, agreement with ED staff, usability, and satisfaction
Contactless Assessment of Patient Vital Signs for Triage Using Remote Photoplethysmography	Camera-based contactless remote vital sign monitoring	Accuracy of technology in measuring vital signs compared to manual	ED	Adult patients triaged with as semiurgent to nonurgent that	Accuracy in measuring vital signs, patient

Title, trial registry ID, country	Technology	Description	Setting	Target population	Outcomes
in the Emergency Department (CAPTURE-1) **Hong Kong** **NCT06536647**	technology, **VitalsTM** platform	measurements done by a nurse		are clinically stable in the ED	satisfaction and patient comfort
DAISY- Diagnostic AI System for Robotic and Automated Triage and Assessment **UK** **NCT06571838**	AI triage **DAISY**	Examination of the duration and timeliness of DAISY system	York and Scarborough Teaching Hospitals	Adult patients presenting to ED able to engage and operate with automated system	Time taken for consultation, patient satisfaction, patient acceptability, and concordance between DAISY and ED clinical staff report
Evaluation of Mobile App to Assist in Pediatric Triage in a Pediatric Emergency Department **France** **NCT05363124**	Mobile smartphone app, **i-Virtual**, that allows parents to input their children's vital signs and symptoms	Evaluation on whether parents can use the app to assess their patient severity using the PEWS	Pediatric hospital	Children presenting to the ED	Agreement between parents and nurse assessments
Evaluation of the Patient Deterioration Warning System **Denmark** **NCT03375658**	**Patient Deterioration Warning System** – a clinical decision support system that aggregating and summarizing vital signs monitored with ED patient monitors. ED clinical staff can use this to identify patients at risk of deterioration.	Cluster randomized trial to evaluate the patient deterioration warning system	2 EDs	Adult patients admitted to the ED	In-hospital deterioration, cost-effectiveness, and acceptance
Klinik - Intelligent Patient Flow Management **Finland** **NCT04577079**	AI-driven triage **Klinik** Frontline, an IPFM which is a clinical decision support tool	Validation of Klinik Frontline in identifying and classifying patients using ESI	University hospital	Adult patients presenting ED, walk-in	Specificity, sensitivity, correlation of differential diagnosis with medical doctor
Noncontact, Hand-held Device for Measurement of Respiratory Rate (BreathEasy)	**BreathEasy**, a noncontact, hand-held device	Performance of device to standard respiratory rate devices	ED	Adults or children that require respiratory rate measured	Agreement between BreathEasy and standard contact-based system

Title, trial registry ID, country	Technology	Description	Setting	Target population	Outcomes
UK **NCT04215887**	that measures respiratory rate				
Novel Emergency Waiting-room Sensing for Safety (NEWS²) Study **Canada**	Wearable **vital sign monitors**	Aims to test wearable vital sign monitors waiting in the ED	Vancouver General hospital	Patients aged ≥ 19 years who have waited in a Canadian ED within the past 5 years	Performance and safety of devices
Remote Device Interrogation in the Emergency Department (REMEDY) **US** **NCT01871090**	Unpaired remote monitoring transmitter: **Merlin@home transmitter**	Evaluate effects of remote monitoring device in ED in 2 sites	St Jude Medical Centre	Adult patients presenting to ED with an implanted pacemaker or defibrillator	Time to interrogation, time to clinical or treatment decision, ED LOS
Respiratory Rates - Accuracy of Contact-free Monitoring of Respiratory Rates **Switzerland** **NCT03393585**	**Contact-free vital sign monitoring** system (camera-based)	Test the accuracy of respiratory monitor in triage setting of ED. Prospective observational study	University hospital	Patients presenting to ED with presumed ESI score of 2 to 3 (indicating emergency or urgent medical needs)	Specificity and sensitivity of prototype application
The safety and performance of an automated robotic system (DAISY) for the triage and assessment of acutely unwell patients in an Emergency Department. **UK** **ISRCTN17905992**	AI triage **DAISY**	Safety and performance of DAISY for triage of acutely unwell patients in the ED	Scarborough General Hospital – district general hospital	Adult patients presenting to the ED who are able to engage or operate with automated system	Generation of report after triage, patient and provider experience with DAISY

AI = artificial intelligence; ED = emergency department; ESI = Emergency Severity Index; IPFM = intelligent patient flow management system; LOS = length of stay; PEWS = Pediatric Early Warning Score.

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