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CADTH Horizon Scan

Artificial Intelligence in Prehospital Emergency Health Care

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Key Messages

What Is the Issue?

- Health care systems in Canada, including prehospital emergency health care services, are facing staffing shortages and increased patient volumes, and are looking for creative solutions to ensure the provision of high-quality care.

What Is the Technology?

- Artificial intelligence (AI) combines computer science and data to mimic human thought processes, problem solving, and responses.
- AI relies on statistical models, algorithms, data analysis, and machine learning to make predictions based on past behaviours or results (predictive AI) or to learn from past data to generate new content (generative AI). Chatbots, such as ChatGPT, are examples of generative AI.

What Is the Potential Impact?

- In health care settings, AI can be used to automate some clinical and administrative processes to create efficiencies and reduce burden on health care providers and health administrators.
- In a prehospital setting, this can include AI used at the dispatch stage (e.g., analyzing the conversation and prompting a dispatcher with additional questions, or translating speech to help a dispatcher understand a caller in real time) or in an ambulance (e.g., providing traffic analysis or information to support optimal patient management).

What Else Do We Need to Know?

- The use of AI in prehospital emergency health care is still in the early stages of development and implementation. Early implementation of AI programs such as those to detect out of hospital cardiac events and to triage emergency calls during peak times are underway in some countries.
- More real-world clinical trials and research are required before widespread implementation will take place.

What Is the Technology and How Does it Work?

Artificial intelligence (AI) is a field that combines computer science and data to mimic human thought processes, problem solving, and responses.¹ **Predictive AI** uses statistical models, data analysis, and machine learning algorithms to make predictions based on past behaviours or results (e.g., algorithms to interpret medical imaging or test results). **Generative AI** relies on AI, algorithms, and large language models to learn from past data and generate new and original content (e.g., ChatGPT producing text or images).²

AI is being incorporated into prehospital emergency health care in different ways:

- at dispatch:
 - “listening” to the call and analyzing the conversation in real time to provide prompts to the emergency operator on which questions to ask based on the caller’s speech patterns and description of the situation;³ these systems can also extract patient information and transcribe the call
 - translating emergency calls in real time, where the AI program “listens” to the caller and translates the conversation to text for the operator when the emergency operator does not speak the same language as the caller to improve the operator’s understanding of the call⁴
- in the ambulance:
 - providing real-time traffic analysis, including road closures, other emergencies or events, and weather conditions, to determine the most efficient route to the emergency scene and then to the nearest available medical facility⁵
 - analyzing patient data using AI-powered system to provide suggestions and support the optimal management of the patient and remove some of the guesswork for the paramedic during a stressful emergency situation⁵
 - using generative AI systems (e.g., ChatGPT) to help emergency responders ensure they have access to information about the most current medical protocols, drug treatments, and procedures relevant to their patient while caring for them in the field.⁶

Who Might Benefit?

AI has the potential to improve patient care and the delivery of health services across a range of clinical areas and provide benefit to both patients and health care providers. Some specialties have been incorporating AI into their workflow for a long time while others, like prehospital emergency medicine, have only recently started incorporating AI capabilities into their work.

How Is It Used in Canada?

AI is currently being used across many different sections of the Canadian health care system; however, uptake in the prehospital emergency services space seems to be limited.

New Brunswick implemented a computer-aided dispatch system, Intelligent Decision Support by Logis, in January 2023.⁷ The system uses AI and cellular devices to alert paramedics to the emergencies they are assigned to respond to.

What Does It Cost?

No information was found regarding the price of AI-enabled systems for prehospital emergency health care in Canada or internationally.

Although pricing was not available, it is known that these systems have costs associated with their initial procurement and set up, as well as the cost to train staff to properly use them.⁵ Like many computer and data-based solutions, some systems will likely require an ongoing subscription and updates to keep the AI system running and its dataset current. Not all jurisdictions will have the same resources available and the cost-benefit of using AI systems should be considered when choosing whether to implement them.⁴

There is the potential for these systems to provide cost-savings to the health care system or enable the reallocation of health care resources by improving the efficiency of health care providers and possibly improving patient outcomes. The use of AI support in patient triage may result in patients receiving appropriate care that is less resource intensive.

An AI-enabled reduction in administrative burden to emergency dispatchers, physicians, and nurses can free up their time to manage more patients in the same amount of time.

What Is the Evidence?

The authors of a 2023 systematic scoping review of AI and machine learning in prehospital emergency care described the existing research literature as “scattered and diverse.”⁸ Very few prospective randomized controlled trials have been conducted to assess the effectiveness and safety of these AI technologies in prehospital emergency medicine. The majority of the literature published in the space involves applying AI algorithms to retrospective patient data to test their ability to accurately predict patient outcomes.⁸ In the studies identified, AI was most often used for triaging patients before arriving to the hospital or in prognostic models used to help identify patients at higher risk of poor outcomes to guide them to more intensive early treatment and management upon arrival at the emergency department.⁸ AI was also used to optimize dispatch systems to improve response time and efficiency of emergency services by using AI to predict ambulance travel time and forecast ambulance demand.⁸ Based on the results of their review, the authors concluded that more prospective, externally validated clinical studies may be required before many of these AI technologies should be used in real-world emergency settings.⁸

An Example of AI Use in Prehospital Emergency Health Care

A retrospective study was identified that used Corti.AI – a machine learning system that listens to emergency calls and provides real-time suggestions to the dispatcher – to analyze past emergency calls and determine what difference the use of AI might have made for those patients' outcomes.⁹ For people experiencing out-of-hospital cardiac arrest (OHCA) in Sweden:⁹

- The machine learning system was able to recognize 36% (305 of 851) of OHCA within the first minute of the call as compared to 25% (213 of 851) for human dispatchers.
- The ability of the machine learning system to identify OHCA at any time during the call was similar to dispatchers (86% versus 84%) with the system able to identify the OHCA an average of 28 seconds faster.
- The authors concluded the machine learning system could be a support to the human dispatchers to help alert them to OHCA more quickly during emergency calls.⁹

Where Is It Being Used?

Within the National Health Service (NHS) of the UK, Corti.AI is being implemented in Wales to detect critical illness during emergency calls.¹⁰ In a real-world example of the technology used in the previously described retrospective study, dispatchers will use AI to help detect OHCA based on the description provided by the patient or bystander's conversation. Although the AI system has been trained on a very large dataset based on American and Danish data, it will need additional training to detect the specifics of the Welsh accent and dialects and will be trained using historical emergency calls from the region.¹⁰

In Portugal, ChatGPT will be tested to determine whether it could be used to triage emergency calls during times of peak demand for emergency services.¹¹ Callers currently experience a 5 to 6 minute wait to reach a dispatcher at peak times. This typically happens when many people are trying to call about the same incident, like a large fire or accident. With the AI system, the calls will initially be assessed by AI and then the most urgent ones will be directed to an emergency dispatcher.¹¹ The hope is that the system will be ready for broad implementation by 2025 after extensive system testing.¹¹

Issues to Consider

Facilitators to Implementation

There may be an increase in patient trust in their interactions with different health care providers when there is confidence that those providers are all accessing the same health care information in the same way through AI tools.⁶ This may provide clinicians with access to information that they are not familiar with or have forgotten. Similarly, if all health care providers are relying on the same set of information, unconscious bias should be reduced and standardization of care should increase.⁶ AI relies only on facts when producing its output and the personal bias and opinion of the health care provider is removed from the process.⁶ The potential increase in efficiencies gained through the transfer of some tasks to AI (e.g., administration and

record keeping) could free up additional time for the provider that would allow them to spend more time building treatment plans and interacting directly with patients.⁶

Barriers to Implementation

Lack of interpretability of AI outputs is a barrier to uptake for health care providers.⁸ Health care providers are hesitant to accept “black box” AI model predictions without being provided with sufficient rationale to support the output. These hesitations are heightened in high pressure emergency situations.⁸

Some paramedics in New Brunswick are reportedly concerned about the change of their dispatch system from radio to AI and cellular devices due to their skepticism around the reliability of the system.⁷ The paramedics are unsure whether the output of the system will be reliable based on their own experiences using cellular-based mapping services and with cellular reception coverage and missed text messages. Now, only the paramedics receiving the call will be aware of the location and nature of the emergency, whereas, with the previous radio system, all paramedics were able to listen in to the dispatch and have a sense of where other teams were at all times; consequently, there are concerns about feelings of isolation resulting from this change. However, the previous radio system will remain in place as a backup in case of issues with the new technology.⁷

Data Inputs and Generalizability

The output of an AI model is only as good as the dataset it is drawn from. This can lead to issues with the generalizability of the AI model outputs used in health care. If the model only draws on patient data from a subset of a patient group, the results will only be accurate for that same group.¹² Using outputs from a limited dataset can result in missed diagnoses or improper treatment recommendations when applied to a more diverse patient population. For example, OpenAI (the company that created ChatGPT), does not disclose the sources of information it has used to train the AI.¹³ Health information received from this tool may not be relevant to the person searching for it and could prove to be harmful.¹³

Additionally, generative AI tools are not search engines. They do not have access to the most current information available.

The currently available versions of ChatGPT were trained on a dataset that included information up to 2021, which means they do not have access to any health-related information published after that date.¹³

Ethical and Privacy Concerns

Opaque, or “black box,” AI models do not provide information as to which datasets they draw from or how their predictions are made. These types of models raise some ethical concerns as there is a lack of accountability to the developer for any adverse outcomes, which may result in biased decision-making.⁸

Current versions of predictive and generative AI systems that were not developed specifically for the health care setting are not compliant with Canadian or American legislation for the protection of personal

information (e.g., the Personal Information Protection and Electronic Documents Act [PIPEDA] in Canada, and the Health Insurance Portability and Accountability Act [HIPAA] in the US).^{13,14} There is potential for personal information related to search terms and patient characteristics to be shared or accessed inadvertently by people who work outside of the health care system.¹³ Plans for the secure storage and handling of sensitive personal information will be required before AI tools can be used consistently and effectively in the health care setting.¹⁴ Internationally, the use of ChatGPT by physicians has been banned in some health settings due to privacy concerns related to informed consent and patient data.¹⁴

Legal Considerations

Questions remain about liability risk for health care providers when they rely on AI tools to care for patients. Currently, it is unlikely that a health care provider would be protected from malpractice if an error occurred due to reliance on AI.¹³ As AI tools are not trained on an unlimited set of health data, it is important to remember that not all patients or conditions will be adequately represented and the content of the data can be inaccurate.¹⁴ Human judgment should override the output of a computer program and AI systems should be used only as a tool to support decision-making.

ChatGPT is not currently intended to be used as a medical device and is not classified as such. If you ask it whether it is a medical device, it will say no.¹³ In 2021, Health Canada, the US FDA, and the UK's Medicines and Healthcare products Regulatory Agency published 10 guiding principles for the development AI and machine learning in medical devices, recognizing the increased presence AI will continue to have in health care.¹⁵

Related Developments

CADTH previously published an [overview of clinical applications of AI](#) in 2022.¹⁶ This report describes developments and the use of AI in medical imaging, dermatology, pathology, genetics and genomics, oncology, neurology, mental health, diabetes care, eye care, critical care, and population and public health.

In 2019, Unity Health Network in Toronto established a data science department to facilitate the use of data analytics and AI within the hospital network. More than 40 programs have been initiated within the network since the group was founded.¹⁷ The department has recently partnered with Signal 1, a Toronto-based startup that specializes in commercializing and deploying AI technologies. The goal of the partnership is to build on and commercialize the systems developed at Unity Health Network so these tools can be marketed internationally.¹⁸

A nonexhaustive summary of examples of current uses and ongoing development of AI tools in Canadian health care is provided in [Table 1](#).

Table 1: Current Uses and Development of AI in Canadian Health Care

Health care institution or region	AI intervention	Goal of intervention	Outcomes
Ambulance NB; New Brunswick	Intelligent Decision Support (Logis)	To add efficiency to emergency dispatch and paramedic routing	NR
Centre hospitalier de l'Université de Montréal; Montreal, QC	GrayOS ¹⁹	Automated and optimized scheduling of appointments for patients with cancer	The intervention led to a 5% increase in efficiency at the infusion clinic, resulting in 11 hours of extra treatment capacity per day and an 80% decrease in administrative burden.
McGill University Health Centre; Montreal, QC	AI analysis of emergency medical images ²⁰	Specialists from McGill review medical imaging from a community in northern QC. The AI system will prioritize images that present potentially fatal conditions and send them directly to the specialist on duty who can alert the hospital in QC to the conditions that need to be treated immediately (e.g., collapsed lung, bowel perforation, stroke).	The goal of the program is to reduce the number of images reviewed by the specialist while decreasing the need for patients to be transported from their remote communities when higher-level care is not required.
	Adaptive optimization of surgery schedules ¹⁹	Predictive and prescriptive decision-support tool for central OR booking	The optimization of joint OR scheduling identified opportunities to perform additional surgeries. The prediction of postsurgical bed availability supports discharge planning.
Ontario	GEMINI ¹⁷	To measure the quality of care in general medicine wards in 30 hospitals and identify hospital rates of delirium	NR
Princess Margaret Cancer Centre (UHN); Toronto, ON	AI automated radiotherapy scheduling platform ¹⁹	To prioritize patient appointments based on severity of disease and incorporate patient preference into appointment scheduling	The intervention resulted in a 13% decrease in mortality rate from delayed access to radiotherapy. The reduction in scheduling time allowed care coordinators to spend more time on patient support and more complex tasks.
Sick Kids Hospital; Toronto, ON	AI tool to proactively order tests upon arrival to the ED based on symptoms ^{18,21}	To reduce ED wait times by having test results ready before the patient is assessed by a physician	The intervention is expected to reduce ED wait times by 2 to 3 hours per patient and provide test results approximately 2 hours earlier.

Health care institution or region	AI intervention	Goal of intervention	Outcomes
St. Michael's Hospital (UHN); Toronto, ON	AI to assist nurse scheduling in the ED ¹⁷	Accounts for rules around staffing and provides an optimized schedule for the next 4 days	The error rate fell from more than 20% to less than 5%.
	CHARTWatch ¹⁷	Runs every hour gathering 100 patient variables to predict the risk of ICU admission or death in the next 48 hours	NR
	COBRA ¹⁷	An advance warning system that gives a warning 3 days ahead of an inpatient bed shortage to allow for staff planning and patient discharge in anticipation	NR
	ED Volume Forecasting Tool ^{17,18}	Uses historical data to predict ED patient volumes and informs staffing requirements and scheduling	The tool was introduced in 2020 and has been able to accurately predict ED patient volume 94% to 96% of the time.
	MuScRAT ^{17,22}	Used in the MS clinic, the program summarizes key points from the patient's years of medical information, including symptoms and treatments, into a single-page visual that provides links to more detailed information	NR

AI = artificial intelligence; ED = emergency department; ICU = intensive care unit; MS = multiple sclerosis; MuScRAT = Multiple Sclerosis Reporting and Analytics Tool; NB = New Brunswick; NR = not reported; ON = Ontario; OR = operating room; QC = Quebec; UHN = Unity Health Network.

Final Remarks

The use of AI systems within prehospital emergency health care should be considered as a support to human responders and their expertise, not as a replacement for them. AI is a tool that can be used to create efficiency within the emergency response process, potentially decreasing a person's time to treatment and increasing their chances for a favourable health outcome. Questions remain about the integrity of patient privacy and data safety with current publicly available AI systems, like ChatGPT. While some AI systems are currently being implemented in the prehospital emergency health care space, more research and testing may be required before the systems are ready for widespread implementation.

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Appendix 1: Methods

Literature Search Strategy

An information specialist conducted a literature search on key resources including MEDLINE, Embase, the Cochrane Database of Systematic Reviews, the International HTA Database, the websites of Canadian and major international health technology agencies, as well as a focused internet search. The search approach was customized to retrieve a limited set of results, balancing comprehensiveness with relevancy. 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 ChatGPT/artificial intelligence and emergency health services. The search was completed on July 13, 2023 and limited to English-language documents published since January 1, 2020.

Selection Criteria

One author screened the literature search results and reviewed the full text of all potentially relevant studies. Studies were considered for inclusion if the intervention was an AI tool or program used in the prehospital emergency health care setting. Conference abstracts and grey literature were included when they provided additional information to that available in the published studies.

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