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Complete List of Authors:
Coulibaly, Daouda; Université de Montréal, Department of Management, Evaluation and Health Policy; Laboratoire Transformation Numérique en Santé
Bayani, Azadeh; Laboratoire Transformation Numérique en Santé; Centre de recherche en santé publique, Université de Montréal et CIUSSS du Centre-Sud-de-l'Île-de-Montréal
Motulsky, Aude; Centre hospitalier de l'Université de Montréal, Research Center
Nikiema, Jean Noël; Université de Montréal, Department of Health Management, Evaluation & Policy
Bosson-Rieutort, Delphine; Université de Montréal, Department of Management, Evaluation and Health Policy; Centre de recherche en santé publique, Université de Montréal et CIUSSS du Centre-Sud-de-l'Île-de-Montréal

Title : Identifying Key Characteristics of developed Artificial Intelligence algorithms to achieve meaningful impact on Canadian Healthcare: A scoping review protocol

Daouda Coulibaly[a,b,c]; Azadeh Bayani[a,c] ; Aude Motulsky[b,c,d]; Jean Noel Nikiema [a,b,c]; Delphine Bosson-Rieutort [a,b,]

[a] Centre de recherche en santé publique, Université de Montréal et CIUSSS du Centre-Sud-de-l'Île-de-Montréal, Canada.

[b] Department of Management, Evaluation and Health Policy, School of Public Health, Université de Montréal, Canada

[c] Laboratoire Transformation Numérique en Santé (LabTNS), Canada

[d] Research Center, Centre hospitalier de l'Université de Montréal (CRCHUM), Canada

Abstract

Introduction:
Empirical data on the barriers limiting artificial intelligence's impact on healthcare are scarce, particularly within the Canadian context. This study aims to address this gap by conducting a scoping review to identify and evaluate AI algorithms developed by researchers affiliated with Canadian institutions for patient triage, diagnosis, and care management. The goal is to identify characteristics in the developed AI algorithms that can be leveraged for a better impact.

Methods and Analysis:
A scoping review will be conducted following the JBI Methodology for Scoping Reviews and reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. Relevant literature will be identified through comprehensive searches of MEDLINE (PubMed), CINAHL (EBSCO), and Web of Science (Clarivate) databases, combining keywords related to artificial intelligence, clinical management, and the Canadian context. Studies published between 2014 and March 24, 2024, in English or French, that discuss AI algorithms developed for patient triage, diagnosis, or care management by researchers affiliated with Canadian institutions will be included. Data from the selected articles will be extracted and analyzed descriptively, and findings will be presented in tabular form accompanied by a narrative summary.

Ethics and Dissemination:
Ethical approval is not required for this study as it involves the review of publicly available literature. The scoping review is expected to be completed by November 2025. The findings will be disseminated through publications in peer-reviewed journals and presentations at conferences focused on artificial intelligence and healthcare practice.

Strengths and limitations of this study

- By focusing on the developed AI algorithm for healthcare practice, the study addresses a timely and pressing issue.
- The use of established methods for the review with the inclusion of multiple databases enhance the likelihood of capturing a wide range of relevant studies.
- While the focus on Canada allows for in-depth analysis within a specific jurisdiction, it limits the generalizability of the findings to other countries but allows for opportunities of comparative studies

- The reliance on authors' affiliations with Canadian research institutions may exclude relevant studies where Canadian data was used but the researchers are affiliated with institutions outside Canada. This could result in an incomplete picture of AI development relevant to Canadian healthcare.
- The protocol acknowledges but does not plan to address practical constraints related to the deployment and use of AI tools in healthcare settings

1. Introduction

1.1 Difficulty of having meaningful impact of artificial intelligence (AI) in healthcare

Artificial Intelligence (AI) can be defined as a machine's ability to perform "human-like cognitive functions (e.g. learning, understanding, reasoning or interacting)" [1]. AI has made significant progress in recent years and is attracting growing interest in a variety of fields [2]. The exponential growth of data and the significant evolution of computing power are key factors in this evolution. AI represents considerable potential in many areas of activity, including the economy, robotics, agriculture and healthcare.

When it comes to healthcare, AI has tremendous potential in this field.[3] Indeed, AI can help to: reduce complications, prevent hospitalizations, ease administrative burdens [1], diagnose diseases early [4], and assist in triage and patient management. It can also reduce diagnostic errors made by healthcare professionals [5]. This significant potential is leading researchers to take a greater interest in developing artificial intelligence tools and algorithms to support healthcare practice.

Despite this growing desire to develop AI algorithms for healthcare and its progress in various fields of activity, the general observation is that its contribution has so far not lived up to expectations [6]. Indeed, the implementation of AI in healthcare still faces numerous difficulties [5] linked, among other things, to the specificity of the healthcare field, lack of maturity of the tools and algorithms developed, and lack of studies of the obstacles to meaningful impact in healthcare based on empirical data.

1.2 Healthcare sector specificity:

The specific nature of activities in the healthcare sector is one of the main obstacles to the meaningful impact of AI. This specificity can be highlighted by several aspects. These include the complexity and sensitivity of the healthcare field, issues associated with the availability of quality data, issues associated with data access policies and, finally, the problems associated with the strict ethical rules governing the protection of patient privacy.

Healthcare is a highly sensitive and complex field. Patient safety remains one of the main concerns of healthcare professionals. The level of error tolerance is very low. And yet, models can often make serious errors, especially if they are learned from unreliable data. These errors can lead to patient complications or even death. The stakes are even higher when it comes to public health. For example, IBM Watson oncology, an AI model used to analyze data from patient's medical records and help doctors explore cancer treatment options for their patients, recently came under scrutiny for allegedly making "risky and erroneous" suggestions for cancer prevention [5]. Another factor contributing to the

limited impact of AI in healthcare is its restricted adoption due to the necessity of explaining algorithm results. Indeed, advanced artificial intelligence models are black boxes. They can predict with very high scores but give virtually nothing about the logic behind their choices, apart from the data and the nature of the algorithm used [2]. As evidence-based medicine relies on the highest standards of explicability [7], the lack of explicability poses a problem for the acceptance of AI by healthcare professionals [2]. The complexity and sensitivity of the healthcare field are therefore obstacles to the effective adoption of AI in this domain. However, they are not the only elements to be considered.

In addition to the specificity of the healthcare field, the availability of quality data is also an aspect to consider for healthcare AI. An AI model is only as safe as the data it has learned from. Indeed, implementing AI models requires large datasets from several sources (pharmacies, electronic health records...) [5,7], representing a handicap to the development of AI models based on these real-world data. Furthermore, the models may assimilate biases from the data they have learned from. If, for example, the data used to train an AI is mainly collected in academic centers, that AI will be less attentive to patients from populations that don't regularly visit these centers and, consequently, treat them less appropriately. Differences between images of racialized and non-racialized patients can implicitly introduce disparities in model decisions [7]. Thus, the availability of quality data is a key factor in the successful integration of AI in healthcare.

Together with the aforementioned obstacles to the meaningful impact of AI by healthcare, there are the politics of data access and patient privacy. Indeed, healthcare is one of the fields with the strictest privacy rules. Patient medical records, for example, are protected by strict laws, so sharing this information, even for research purposes, could be challenging. Indeed, to guarantee access to information, the patient's consent must be obtained. It has to be said that doing this on a large scale can be a major logistical challenge [5]. Also, even de-identified data can often be re-identified when combined with other datasets [7]. These considerations create major risks for initiatives seeking to make healthcare data available for use in the development of artificial intelligence models, particularly for cases where, in public health, data from very large segments of the population are required. Strategies to preserve patient privacy are central considerations for initiatives to implement AI algorithms for healthcare, but not the only ones.

Finally, considerations relating to the reuse of models developed in other environments must also be considered. Indeed, the problems associated with the widespread use of artificial intelligence algorithms and tools are not the least of the obstacles to the meaningful impact of AI by healthcare. It represents a major challenge. Most tools and algorithms are specific to the environments in which they were developed. This makes them difficult to transpose from one country to another, or even from one establishment to another. To enhance the contribution of AI in healthcare, the development and implementation of artificial intelligence algorithms must consider the specificity of the healthcare field (jurisdiction, and organization specificities). This is a key consideration but is not enough on its own to solve the problem of integrating AI in healthcare.

1.3 Lack of maturity of tools developed in the healthcare field:

In addition to the problems associated with the specificity of the healthcare field and generalization, there is also the problem of the maturity of artificial intelligence tools and applications [8]. Indeed, in response to the pandemic, several tools and algorithms have been developed around the world [9]. BlueDot [10] in Canada and HealthMap [11] in the United States are examples of software based on artificial intelligence algorithms used as "epidemic alert" tools. XrAI [12], developed by the Canadian

company 1Qbit, and COVID-Net, a convolutional neural network developed by Wang et al [13], are diagnostic tools. They raised great expectations when they were first introduced. Most of these AI tools generated enthusiasm and hope about their potential to provide significant help in response to the pandemic. However, it has to be said that their contribution has not lived up to expectations [14]. This modest contribution of AI to the fight against the pandemic is partly due to the fact that very few of the tools developed have reached maturity [15]. The lack of data but also, paradoxically, the excess of data, especially from social networks (often biased), has progressively worked against the predictive capacity of these tools and algorithms, and at the same time led to a regression in their contribution to the fight against the pandemic.

1.4 Lack of empirical data on barriers limiting meaningful impact of AI in healthcare

As we have just discussed, there are several obstacles to have a meaningful impact of AI in healthcare (specificity of the healthcare field, difficulty of generalization, lack of maturity of the developed models). Several studies in the literature are devoted to these difficulties [16], but, despite the abundant literature, we do not yet have a global viewpoint, based on empirical data, of the obstacles for AI to have the expected impact in healthcare. Most studies are based on anecdotal evidence, narrative or analytical commentary, and lack empirical data [16]. Consequently, the determinants of these limits are still insufficiently understood [5]. If the healthcare system is to be adequately transformed to meet new needs, we need a clear typology of the characteristics of the AI algorithm being developed, to identify ways of improving their impact on healthcare in general, and on the Canadian healthcare system in particular. To address the need for empirical data in a Canadian context, we propose to conduct a scoping review to identify characteristics of AI algorithms developed by Canadian researchers or researchers with affiliations in Canadian research institutions to support the clinical management of patients. Its aim is to identify areas for improvement in the Canadian context for AI algorithms in the clinical field. The aim is to identify levers for action to improve their contribution to the provision of quality care.

2 Research question

This study aims to answer the following research question: What are the characteristics of the developed artificial intelligence algorithms that are essential as leverage point for their better impact in Canadian healthcare? In other words, what are the levers of action for a better contribution of the developed artificial intelligence algorithms to healthcare practice in Canada?

3. Method and analysis

To meet the research objective, a scoping review will be carried out, consisting of retrieving artificial intelligence algorithms developed by researchers with affiliations in Canadian research institutions, available in the literature, for patient triage, diagnosis and care management. This protocol was developed in accordance with the JBI Scoping Review Methodology Group's best practices for scoping review protocols [17]. The Preferred Reporting Items for Systematic Reviews and Meta Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines [18] will be followed for the scoping review. The various studies will thus be divided according to the main characteristics identified (sources and types of data, calculation method, analysis objective, level of data integration, etc.).

3.1 Identification of relevant articles

The research strategy aims to identify sources of evidence on artificial intelligence algorithms developed by researchers with affiliations with Canadian research centers. The MEDLINE (PubMed) and CINAHL (EBSCO) databases, and Web of Science (Clarivate) are the sources of information. The search strategy was developed in consultation with a university librarian specializing in health sciences and consisted in the combination of three concepts: 1) Artificial Intelligence, 2) Clinical management of patients, 3) Canadian context (see appendix 1). The words contained in the titles and abstracts of the relevant data sources, together with the indexing terms used to describe the data sources, were used to develop a comprehensive search strategy for the selected databases (Appendix 2).

3.2 Eligibility criteria

After extracting the articles using the built query, the following inclusion and exclusion criteria will be used to sort the identified studies:

- **Inclusion criteria**: (1) the article concerns an artificial intelligence algorithm developed for the triage, diagnosis or care management of patients, (2) the language of publication of the article is French or English, (3) the date of publication of the article is between 2014 and March 24, 2024 (search date).
- **Exclusion criteria**: (1) the article full text is not open access or not available by academic subscription (2) the article presents fundamental algorithm development that does not directly address a clinical activity need, (3) the article is a review, (4) the article is a commentary or editorial, (5) the article is an abstract, (6) the objectives of the authors of the article are other than to make predictions (e.g. exclude the article if the methodology/algorithm is used to determine characteristics only).

3.3 Data selection

After the search, all identified article from each sources will be imported into Covidence and duplicates were removed. Titles and abstracts will be reviewed by two reviewers against the study's inclusion and exclusion criteria. A more detailed evaluation based on the full text of the selected data sources will then be carried out, still in Covidence, according to the inclusion criteria, by the two evaluators. Reasons for excluding full-text data sources that do not meet the inclusion criteria will be recorded and reported in the scoping review. Disagreements between the two reviewers at each stage of the selection process will be resolved by discussion or by a third reviewer. The results of the search and the process of inclusion of evidence sources will be reported in full in the final version of the scoping review and presented in a PRISMA-ScR flowchart [12]. Actually, the query retrieves 5,000 articles from each source database (Appendix 2).

3.4 Data extraction

Once the list of final articles to be included in the analysis validate, data will be extracted from the evidence sources included in the scoping review by two people using the data extraction tool provided by Covidence. The extracted data will include specific details on the authors, the algorithms and the training data used in the algorithms (Table 1).

Table 1: Data extraction grid

Article information	Information on the algorithms used	Information on the clinical data support for the algorithm development
- Author affiliation - Place of publication (Province and city) - Publication date - Clinical domain (Cardiology, oncology, radiology, etc)	- Type of developed algorithm (machine learning, deep learning, large language model, expert systems, etc) - Targeted users (patients, cliniciens) - Tageted usage (Triage, diagnosis and treatment, etc) - Evaluation criteria identified (Performance metrics, benchmarks, ethical aspects	- Data source (international open-source database, public databases, hospital records, primary care, clinical studies, medico-economic data, etc) - Data type (medical images, clinical texts, physiological signals etc) - Sample size - Level of data integration

3.5 Data summaries and results synthesis

Data analysis will consist of a descriptive analysis. Results will be presented in tabular form. A narrative summary will accompany the results, describing how the results relate to the objective of the scoping review.

4. Ethics and Dissemination

This study does not require ethical approval, as it involves the review and collection of data from published and/or publicly available articles. It is expected to be completed by November 2025. The dissemination strategy includes a publication of the results of the scoping review, as well as presentations at conferences on artificial intelligence and care practice. The results of the study will map, according to previously defined criteria, artificial intelligence algorithms developed for triage, diagnosis and care management by researchers with affiliations in Canadian research institutions. In particular, it will identify levers for action to better integrate artificial intelligence algorithms into care practice. A dissemination workshop will be conducted towards the conclusion of the scoping review. This workshop will bring together researchers, patients, and other key stakeholders to 1) present the findings, 2) develop the recommendations, and 3) collect other insights and feedback to refine the conclusion of the study.

5. Discussion

This study will enable us to map the trends in health research in Canada around artificial intelligence algorithms. It should allow us to highlight the challenges that need to be addressed to achieve a greater impact of artificial intelligence algorithms in everyday healthcare. The review will help identify areas for improvement and provide relevant recommendations within the Canadian context, showing how the conditions enabling the development of these algorithms can be significantly improved to support their implementation.

The study is limited to the Canadian context as it ensures feasibility given the high productivity of the AI field and allows for an in-depth analysis within a jurisdiction. It will allow a comparison of the situation in its provinces that share similar contexts. It does not extend to other countries, which may have different healthcare systems. The specificity of the healthcare domain and the need to reconcile data realities in the development of AI algorithms necessitate jurisdiction-specific analyses. Comparisons with other jurisdictions can be performed in a subsequent analysis.

The study is in an early stage but several point has already beeb achieved. Several stages of the research have been completed. We developed a concept plan and formulated a search strategy, which was refined through consultation with a librarian. Data sources were identified, and research was conducted within these sources. The collected data were imported into Covidence, and the data are being integrated to remove redundancy.

This study has certain limitations. One limitation is the failure to account for constraints related to the deployment and use of the tools implemented. Additionally, the selection process was based on authors' affiliations; some authors who work with Canadian data may not be affiliated with Canadian research centers, which could influence the comprehensiveness of the study.

6. Conclusion

This project will produce a map of artificial intelligence–based tools developed in the healthcare domain to better understand their potential and limitations in their implementation within the health system. The aim of this approach is to identify action levers, in the Canadian context, to enhance their impact on the quality of care. If this approach is jurisdiction-specific, it can then be replicated in different jurisdictions to either enable local analyses or facilitate interjurisdictional comparisons of implementation differences.

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Authors' contributions:

JNN conceived the original idea; with DBR they contributed to the drafting of the manuscript, as well as the development of the research question and methods. DC drafted the first version of the manuscript, assisted with editing, formatting, and further refinement of the research question and methods. AM contributed to developing the research question and methodology, while AB supported the initial steps of the research implementation. All authors approved the final manuscript.

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Nothing to declare

Appendix 1: research strategy

Concepts	Concepts definition	Search terms
Artificial Intelligence	Artificial Intelligence encompasses a range of computational techniques and algorithms that enable machines to perform tasks that typically require human cognition. These tasks include learning from data (machine learning), understanding natural language (natural language processing), recognizing patterns (pattern recognition), and making decisions or predictions.	Artificial intelligence Intelligence program Machine Learning Deep Learning Natural Language processing Large language model Computer vision Reinforcement learning Predictive analytics Neural networks Supervised learning Unsupervised learning semi-supervised-learning Generative Adversarial network Neural network Sentiment Analysis Clustering DBSCAN Principal Component Analysis Linear regression Polynomial Regression Logistic regression Naive Bayes Decision tree Random forest K-nearest neighbor K-means Support vector Machine Gradient boosting Dimensionality reduction AdaBoosting AdaBoost Autoencoder Q-learning Deep Q-Network Policy Gradient Monte Carlo Ordinary Least Square Regression Orthogonal Matching Pursuit Bayesian Regression Quantile Regression Isotonic regression Stepwise regression Least-angle regression "Stochastic Gradient Descent Ensemble Learning Convolutional Neural Networks Recurrent Neural Networks

		Long Short-Term Memory network Generative Adversarial network Transformer Network Deep Belief network Deep Q-network Variational Autoencoder Graph Neural network
Clinical management of patients	This concept encompasses patient orientation, assessment and diagnosis, patient treatment and care with their planning and coordination, patient monitoring and follow-up, patient education and engagement.	healthcare practice ("health care" AND Procedure) ("healthcare" AND Procedure) care practices medical care Delivery of Healthcare Healthcare Delivery Health Care Delivery Delivery of Dental Care Dental Care Delivery Clinical Decision-Making Delayed Diagnosis Diagnosis Diagnosis, Dual Diagnostic Errors Early Diagnosis Incidental Findings Overdiagnosis Prodromal Symptoms triage Prognosis Theranostic Nanomedicine
Canadian context	At least one of the authors is affiliated with a Canadian institution	Canada Canadian context Canadian Quebec Alberta British Columbia Manitoba New Brunswick Labrador Newfoundland Nova Scotia Ontario Prince Edward Island Saskatchewan Yukon Nunavut Northwest Territories

Table 1: Medline search strategy (Pubmed)

Date: 18-09-2024

Search	Query	Results
#15	Search: #9 AND #10 Filters: Humans, English, French, from 2014 - 2024 Sort by: First Author	5 245
#14	Search: #9 AND #10 Filters: Humans, English, from 2014 - 2024 Sort by: First Author	5 238
#13	Search: #9 AND #10 Filters: Humans, from 2014 - 2024 Sort by: First Author	5 248
#12	Search: #9 AND #10 Filters: from 2014 - 2024 Sort by: First Author	6 400
#11	Search: #9 AND #10 Sort by: First Author	8 291
#10	Search: Canada[Affiliation] Sort by: First Author	998 332
#9	Search: #6 AND #8 Sort by: First Author	195 640
#8	Search: #5 OR #7 Sort by: First Author	3 453 946
#7	Search: #3 AND #4 Sort by: First Author	914 670
#6	Search: #1 OR #2 Sort by: First Author	1 202 197
#5	Search: "healthcare practice"[Title/Abstract] OR ("health care"[Title/Abstract] AND Procedure[Title/Abstract]) OR (healthcare[Title/Abstract] AND Procedure[Title/Abstract]) OR "care practices"[Title/Abstract] OR "medical care"[Title/Abstract] OR "Delivery of Healthcare"[Title/Abstract] OR "Healthcare Delivery"[Title/Abstract] OR "Health Care Delivery"[Title/Abstract] OR "Delivery of Dental Care"[Title/Abstract] OR "Dental Care Delivery"[Title/Abstract] OR "Clinical Decision-Making"[Title/Abstract] OR "Delayed Diagnosis"[Title/Abstract] OR "Diagnosis"[Title/Abstract] OR "Diagnosis, Dual"[Title/Abstract] OR "Diagnostic Errors"[Title/Abstract] OR "Early	2 636 672

	Diagnosis"[Title/Abstract] OR "Incidental Findings"[Title/Abstract] OR "Overdiagnosis"[Title/Abstract] OR "Prodromal Symptoms"[Title/Abstract] OR "triage"[Title/Abstract] OR "Prognosis"[Title/Abstract] OR "Theranostic Nanomedicine"[Title/Abstract] Sort by: First Author	
#4	Search: "Delivery of Health Care"[Mesh] Sort by: First Author	1 333 208
#3	Search: "Analytical, Diagnostic and Therapeutic Techniques and Equipment Category"[Mesh] Sort by: First Author	21 459 874
#2	Search: "Artificial intelligence"[Title/Abstract] OR "Intelligence program"[Title/Abstract] OR "Machine Learning"[Title/Abstract] OR "Deep Learning"[Title/Abstract] OR "Natural Language processing"[Title/Abstract] OR "Large language model"[Title/Abstract] OR "Computer vision"[Title/Abstract] OR "Reinforcement learning"[Title/Abstract] OR "Predictive analytics"[Title/Abstract] OR "Neural networks"[Title/Abstract] OR "Supervised learning"[Title/Abstract] OR "Unsupervised learning"[Title/Abstract] OR "semi-supervised-learning"[Title/Abstract] OR "Generative Adversarial network"[Title/Abstract] OR "Neural network"[Title/Abstract] OR "Sentiment Analysis"[Title/Abstract] OR "Clustering"[Title/Abstract] OR "DBSCAN"[Title/Abstract] OR "Principal Component Analysis"[Title/Abstract] OR "Linear regression"[Title/Abstract] OR "Polynomial Regression"[Title/Abstract] OR "Logistic regression"[Title/Abstract] OR "Naive Bayes"[Title/Abstract] OR "Decision tree"[Title/Abstract] OR "Random forest"[Title/Abstract] OR "K-nearest neighbor"[Title/Abstract] OR "K-means"[Title/Abstract] OR "Support vector Machine"[Title/Abstract] OR "Gradient boosting"[Title/Abstract] OR "Dimensionality reduction"[Title/Abstract] OR "AdaBoosting"[Title/Abstract] OR "AdaBoost"[Title/Abstract] OR "Autoencoder"[Title/Abstract] OR "Q-learning"[Title/Abstract] OR "Deep Q-Network"[Title/Abstract] OR "Policy Gradient"[Title/Abstract] OR "Monte Carlo"[Title/Abstract] OR "Ordinary Least Square Regression"[Title/Abstract] OR "Orthogonal Matching Pursuit"[Title/Abstract] OR "Bayesian Regression"[Title/Abstract] OR "Quantile Regression"[Title/Abstract] OR "Isotonic regression"[Title/Abstract] OR "Stepwise regression"[Title/Abstract] OR "Least-angle regression"[Title/Abstract] OR "Stochastic Gradient Descent"[Title/Abstract] OR "Ensemble Learning"[Title/Abstract] OR "Convolutional Neural Networks"[Title/Abstract] OR "Recurrent Neural Networks"[Title/Abstract] OR "Long Short-Term Memory network"[Title/Abstract] OR "Generative Adversarial network"[Title/Abstract] OR "Transformer Network"[Title/Abstract] OR "Deep Belief network"[Title/Abstract] OR "Deep Q-	1 130 728

	network"[Title/Abstract] OR "Variational Autoencoder"[Title/Abstract] OR "Graph Neural network"[Title/Abstract] Sort by: First Author	
#1	Search: "Artificial Intelligence"[Mesh] Sort by: First Author	208 521

Table 2: CINAHL search strategy

Date: 18-09-2024

	Search Terms	Search Options	Actions
S18	S14 AND S15	Limiters - Date de publication: 20140101-20241231 Expanders - Appliquer des sujets équivalents Search modes - Proximity	7 361
S17	S14 AND S15	Limiters - Date de publication: 20140101-20241231 Expanders - Appliquer des sujets équivalents Search modes - Proximity	7 361
S16	S14 AND S15	Expanders - Appliquer des sujets équivalents Search modes - Proximity	10 287
S15	AF Canada	Expanders - Appliquer des sujets équivalents Search modes - Proximity	267 390
S14	S12 AND S13	Expanders - Appliquer des sujets équivalents Search modes - Proximity	229 187
S13	S5 OR S11	Expanders - Appliquer des sujets équivalents Search modes - Proximity	3 996 790
S12	S1 OR S8	Expanders - Appliquer des sujets équivalents Search modes - Proximity	349 778
S11	S9 OR S10	Expanders - Appliquer des sujets équivalents Search modes - Proximity	518 435
S10	AB("healthcare practice" OR ("health care" AND Procedure) OR (healthcare AND Procedure) OR "care practices" OR "medical care" OR "Delivery of Healthcare" OR "Healthcare Delivery" OR "Health Care Delivery" OR "Delivery of Dental Care" OR "Dental Care Delivery" OR "Clinical Decision-Making" OR "Delayed Diagnosis" OR "Diagnosis" OR "Diagnosis, Dual" OR "Diagnostic Errors" OR "Early Diagnosis" OR "Incidental Findings" OR "Overdiagnosis" OR "Prodromal Symptoms" OR "triage" OR "Prognosis" OR "Theranostic Nanomedicine")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	448 826

S9	TI ("healthcare practice" OR ("health care" AND Procedure) OR (healthcare AND Procedure) OR "care practices" OR "medical care" OR "Delivery of Healthcare" OR "Healthcare Delivery" OR "Health Care Delivery" OR "Delivery of Dental Care" OR "Dental Care Delivery" OR "Clinical Decision-Making" OR "Delayed Diagnosis" OR "Diagnosis" OR "Diagnosis, Dual" OR "Diagnostic Errors" OR "Early Diagnosis" OR "Incidental Findings" OR "Overdiagnosis" OR "Prodromal Symptoms" OR "triage" OR "Prognosis" OR "Theranostic Nanomedicine")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	116 613
S8	S6 OR S7	Expanders - Appliquer des sujets équivalents Search modes - Proximity	249 326
S7	AB ("Artificial intelligence" OR "Intelligence program" OR "Machine Learning" OR "Deep Learning" OR "Natural Language processing" OR "Large language model" OR "Computer vision" OR "Reinforcement learning" OR "Predictive analytics" OR "Neural networks" OR "Supervised learning" OR "Unsupervised learning" OR "semi-supervised-learning" OR "Generative Adversarial network" OR "Neural network" OR "Sentiment Analysis" OR "Clustering" OR "DBSCAN" OR "Principal Component Analysis" OR "Linear regression" OR "Polynomial Regression" OR "Logistic regression" OR "Naive Bayes" OR "Decision tree" OR "Random forest" OR "K-nearest neighbor" OR "K-means" OR "Support vector Machine" OR "Gradient boosting" OR "Dimensionality reduction" OR "AdaBoosting" OR "AdaBoost" OR "Autoencoder" OR "Q-learning" OR "Deep Q-Network" OR "Policy Gradient" OR "Monte Carlo" OR "Ordinary Least Square Regression" OR "Orthogonal Matching Pursuit" OR "Bayesian Regression" OR "Quantile Regression" OR "Isotonic regression" OR "Stepwise regression" OR "Least-angle regression" OR "Stochastic Gradient Descent" OR "Ensemble Learning" OR "Convolutional Neural Networks" OR "Recurrent Neural Networks" OR "Long Short-Term Memory network" OR "Generative Adversarial network" OR "Transformer	Expanders - Appliquer des sujets équivalents Search modes - Proximity	233 455

	Network" OR "Deep Belief network" OR "Deep Q-network" OR "Variational Autoencoder" OR "Graph Neural network")		
S6	TI ("Artificial intelligence" OR "Intelligence program" OR "Machine Learning" OR "Deep Learning" OR "Natural Language processing" OR "Large language model" OR "Computer vision" OR "Reinforcement learning" OR "Predictive analytics" OR "Neural networks" OR "Supervised learning" OR "Unsupervised learning" OR "semi-supervised-learning" OR "Generative Adversarial network" OR "Neural network" OR "Sentiment Analysis" OR "Clustering" OR "DBSCAN" OR "Principal Component Analysis" OR "Linear regression" OR "Polynomial Regression" OR "Logistic regression" OR "Naive Bayes" OR "Decision tree" OR "Random forest" OR "K-nearest neighbor" OR "K-means" OR "Support vector Machine" OR "Gradient boosting" OR "Dimensionality reduction" OR "AdaBoosting" OR "AdaBoost" OR "Autoencoder" OR "Q-learning" OR "Deep Q-Network" OR "Policy Gradient" OR "Monte Carlo" OR "Ordinary Least Square Regression" OR "Orthogonal Matching Pursuit" OR "Bayesian Regression" OR "Quantile Regression" OR "Isotonic regression" OR "Stepwise regression" OR "Least-angle regression" OR "Stochastic Gradient Descent" OR "Ensemble Learning" OR "Convolutional Neural Networks" OR "Recurrent Neural Networks" OR "Long Short-Term Memory network" OR "Generative Adversarial network" OR "Transformer Network" OR "Deep Belief network" OR "Deep Q-network" OR "Variational Autoencoder" OR "Graph Neural network")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	30 239
S5	S2 OR S3 OR S4	Expanders - Appliquer des sujets équivalents Search modes - Proximity	3 805 326)
S4	(MH "Diagnosis+")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	2249461
S3	(MH "Triage")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	11,411

S2	(MH "Health Services Administration+")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	2 387 587
S1	(MH "Artificial Intelligence+") OR (MH "Decision Making, Computer Assisted+") OR (MH "Image Processing, Computer Assisted+")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	122 101

Table 3: Web of science search strategy

Date: 18-09-2024

#	Search Query	Results
#1	TI=("Artificial intelligence" OR "Intelligence program" OR "Machine Learning" OR "Deep Learning" OR "Natural Language processing" OR "Large language model" OR "Computer vision" OR "Reinforcement learning" OR "Predictive analytics" OR "Neural networks" OR "Supervised learning" OR "Unsupervised learning" OR "semi-supervised-learning" OR "Generative Adversarial network" OR "Neural network" OR "Sentiment Analysis" OR "Clustering" OR "DBSCAN" OR "Principal Component Analysis" OR "Linear regression" OR "Polynomial Regression" OR "Logistic regression" OR "Naive Bayes" OR "Decision tree" OR "Random forest" OR "K-nearest neighbor" OR "K-means" OR "Support vector Machine" OR "Gradient boosting" OR "Dimensionality reduction" OR "AdaBoosting" OR "AdaBoost" OR "Autoencoder" OR "Q-learning" OR "Deep Q-Network" OR "Policy Gradient" OR "Monte Carlo" OR "Ordinary Least Square Regression" OR "Orthogonal Matching Pursuit" OR "Bayesian Regression" OR "Quantile Regression" OR "Isotonic regression" OR "Stepwise regression" OR "Least-angle regression" OR "Stochastic Gradient Descent" OR "Ensemble Learning" OR "Convolutional Neural Networks" OR "Recurrent Neural Networks" OR "Long Short-Term Memory network" OR "Generative Adversarial network" OR "Transformer Network" OR "Deep Belief network" OR "Deep Q-network" OR "Variational Autoencoder" OR "Graph Neural network")	802 632
#2	AB=("Artificial intelligence" OR "Intelligence program" OR "Machine Learning" OR "Deep Learning" OR "Natural Language processing" OR "Large language model" OR "Computer vision" OR "Reinforcement learning" OR "Predictive analytics" OR "Neural networks" OR "Supervised learning" OR "Unsupervised learning" OR "semi-supervised-learning" OR "Generative Adversarial network" OR "Neural network" OR "Sentiment Analysis" OR "Clustering" OR "DBSCAN" OR "Principal Component Analysis" OR "Linear regression" OR "Polynomial Regression" OR "Logistic regression" OR "Naive Bayes" OR "Decision tree" OR "Random forest" OR "K-nearest neighbor" OR "K-means" OR "Support vector Machine" OR "Gradient boosting" OR "Dimensionality reduction" OR "AdaBoosting" OR "AdaBoost" OR "Autoencoder" OR "Q-learning" OR "Deep Q-Network" OR "Policy Gradient" OR "Monte Carlo" OR "Ordinary Least Square Regression" OR "Orthogonal Matching Pursuit" OR "Bayesian Regression" OR "Quantile Regression" OR "Isotonic regression" OR "Stepwise regression" OR "Least-angle regression" OR "Stochastic Gradient Descent" OR "Ensemble Learning" OR "Convolutional Neural Networks" OR "Recurrent Neural Networks" OR "Long Short-Term Memory network" OR "Generative Adversarial network" OR "Transformer Network" OR "Deep Belief network" OR "Deep Q-network" OR "Variational Autoencoder" OR "Graph Neural network")	2 581 931
#3	TI=("healthcare practice" OR ("health care" AND Procedure) OR (healthcare AND Procedure) OR "care practices" OR "medical care" OR "Delivery of Healthcare" OR "Healthcare Delivery" OR "Health Care Delivery" OR	595 301

	"Delivery of Dental Care" OR "Dental Care Delivery" OR "Clinical Decision-Making" OR "Delayed Diagnosis" OR "Diagnosis" OR "Diagnosis, Dual" OR "Diagnostic Errors" OR "Early Diagnosis" OR "Incidental Findings" OR "Overdiagnosis" OR "Prodromal Symptoms" OR "triage" OR "Prognosis" OR "Theranostic Nanomedicine")	
#4	AB=("healthcare practice" OR ("health care" AND Procedure) OR (healthcare AND Procedure) OR "care practices" OR "medical care" OR "Delivery of Healthcare" OR "Healthcare Delivery" OR "Health Care Delivery" OR "Delivery of Dental Care" OR "Dental Care Delivery" OR "Clinical Decision-Making" OR "Delayed Diagnosis" OR "Diagnosis" OR "Diagnosis, Dual" OR "Diagnostic Errors" OR "Early Diagnosis" OR "Incidental Findings" OR "Overdiagnosis" OR "Prodromal Symptoms" OR "triage" OR "Prognosis" OR "Theranostic Nanomedicine")	2 040 026
#5	#1 OR #2	2 710 456
6	#3 OR #4	2 378 126
#7	#5 AND #6	183 246
#8	AD=(Canada)	3 253 169
9	#7 AND #8	7 688
#10	#7 AND #8 and 2024 or 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 or 2016 or 2015 or 2014 (Publication Years)	5 955
#11	#7 AND #8 and 2024 or 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 or 2016 or 2015 or 2014 (Publication Years) and English or French (Languages)	5 946

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Identifying Key Characteristics of developed Artificial Intelligence algorithms to achieve meaningful impact on Canadian Healthcare: A scoping review protocol

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Title : Identifying Key Characteristics of developed Artificial Intelligence algorithms to achieve meaningful impact on Canadian Healthcare: A scoping review protocol

Daouda Coulibaly[a,b,c]; Azadeh Bayani[a,c] ; Bry Sylla [c,e]; Aude Motulsky[b,c,d]; Jean Noel Nikiema [a,b,c]; Delphine Bosson-Rieutort [a,b,]

[a] Centre de recherche en santé publique, Université de Montréal et CIUSSS du Centre-Sud-de-l'Île-de-Montréal, Canada.

[b] Department of Management, Evaluation and Health Policy, School of Public Health, Université de Montréal, Canada

[c] Laboratoire Transformation Numérique en Santé (LabTNS), Canada

[d] Research Center, Centre hospitalier de l'Université de Montréal (CRCHUM), Canada

[e] Team AHead, Bordeaux Population Health INSERM-U1219, Univ. Bordeaux, Bordeaux, 33000, France

Abstract

Introduction:
Empirical data on the barriers limiting artificial intelligence's impact on healthcare are scarce, particularly within the Canadian context. This study aims to address this gap by conducting a scoping review to identify and evaluate AI algorithms developed by researchers affiliated with Canadian institutions for patient triage, diagnosis, and care management. The goal is to identify characteristics in the developed AI algorithms that can be leveraged for a better impact.

Methods and Analysis:
A scoping review will be conducted following the JBI Methodology for Scoping Reviews and reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) guidelines. Relevant literature will be identified through comprehensive searches of MEDLINE (PubMed), CINAHL (EBSCO), and Web of Science (Clarivate) databases, combining keywords related to artificial intelligence, clinical management, and the Canadian context. Studies published after 2014, in English or French, that discuss AI algorithms developed for patient triage, diagnosis, or care management by researchers affiliated with Canadian institutions will be included. Data from the selected articles will be extracted and analyzed descriptively, and findings will be presented in tabular form accompanied by a narrative summary.

Ethics and Dissemination:
Ethical approval is not required for this study as it involves the review of publicly available literature. The scoping review is expected to be completed by November 2025. The findings will be disseminated through publications in peer-reviewed journals and presentations at conferences focused on artificial intelligence and healthcare practice.

Strengths and limitations of this study

- The use of established methods for the review with the inclusion of multiple databases enhance the likelihood of capturing a wide range of relevant studies.

- While the method focus on Canada allowing for in-depth analysis within a specific jurisdiction, it limits the generalizability of the findings to other countries but allows for opportunities of comparative studies
- By only relying on scientific literature, models that have an observable impact on the Canadian market, regardless of where they were developed, could be excluded
- The reliance on authors' affiliations with Canadian research institutions may exclude relevant studies where Canadian data was used but the researchers are affiliated with institutions outside Canada.
- The method does not include plan to address practical constraints related to the deployment and use of AI tools in healthcare settings

1. Introduction

1.1 Difficulty of having meaningful impact of artificial intelligence (AI) in healthcare

Artificial Intelligence (AI) can be defined as a machine's ability to perform "human-like cognitive functions (e.g., learning, understanding, reasoning or interacting)" [1]. AI has made significant progress in recent years and is attracting growing interest in a variety of fields [2]. The exponential growth of data and the significant evolution of computing power are key factors in this evolution. AI represents considerable potential in many areas of activity, including the economy, robotics, agriculture and healthcare.

When it comes to healthcare, AI has tremendous potential in this field [3] as it can help to: reduce complications, prevent hospitalizations, ease administrative burdens [1] , diagnose diseases early [4], and assist in triage and patient management. It can also reduce diagnostic errors made by healthcare professionals [5]. This significant potential is leading researchers to take a greater interest in developing AI tools and algorithms to support healthcare practice.

Despite this growing desire to develop AI algorithms for healthcare and its progress in various fields of activity, the general observation is that, so far, its contribution has not lived up to expectations [6]. Indeed, the implementation of AI in healthcare still faces numerous difficulties [5] linked, among other things, to the specificity of the healthcare field, lack of maturity of the tools and algorithms developed, and lack of studies of the obstacles to meaningful impact in healthcare based on empirical data.

1.2 Healthcare sector specificity:

The specific nature of activities in the healthcare sector is one of the main obstacles to the meaningful impact of AI. This specificity can be highlighted by several aspects; these include the complexity and sensitivity of the healthcare field, issues associated with the availability of quality data or with data access policies and, finally, the problems associated with the strict ethical rules governing the protection of patient privacy [2,5].

Healthcare is a highly sensitive and complex field. Patient safety remains one of the main concerns of healthcare professionals. The level of error tolerance is very low. And yet, models can often make serious errors, especially if they are learned from unreliable data. These errors can lead to patient

complications or even death. The stakes are even higher when it comes to public health. For example, IBM Watson oncology, an AI model used to analyze data from patient's medical records and help doctors explore cancer treatment options for their patients, recently came under scrutiny for allegedly making "risky and erroneous" suggestions for cancer prevention [5]. Another factor contributing to the limited impact of AI in healthcare is its restricted adoption due to the necessity of explaining algorithm results. Indeed, advanced AI models are black boxes. They can predict with very high scores but give virtually nothing about the logic behind their choices, apart from the data and the nature of the algorithm used [2]. As evidence-based medicine relies on the highest standards of explicability [7], the lack of explicability poses a problem for the acceptance of AI by healthcare professionals [2]. The complexity and sensitivity of the healthcare field are therefore obstacles to the effective adoption of AI in this domain. However, they are not the only elements to be considered.

In addition to the specificity of the healthcare field, the availability of quality data is also an aspect to consider for healthcare AI. An AI model is only as safe as the data it has learned from. Indeed, implementing AI models requires large datasets from several sources (pharmacies, electronic health records...) [5,7], representing a handicap to the development of AI models based on these real-world data. Furthermore, the models may assimilate biases from the data they have learned from. If, for example, the data used to train an AI is mainly collected in academic centers, that AI will be less attentive to patients from populations that do not regularly visit these centers and, consequently, treat them less appropriately. Differences between images of racialized and non-racialized patients can implicitly introduce disparities in model decisions [7]. Thus, the availability of quality data is a key factor in the successful integration of AI in healthcare.

Together with the aforementioned obstacles to the meaningful impact of AI by healthcare, there are the politics of data access and patient privacy. Indeed, healthcare is one of the fields with the strictest privacy rules [8]. Patient medical records, for example, are protected by strict laws, so sharing this information, even for research purposes, could be challenging. Indeed, to guarantee access to information, the patient's consent must be obtained. It has to be said that doing this on a large scale can be a major logistical challenge [5]. Also, even de-identified data can often be re-identified when combined with other datasets [7] . These considerations create major risks for initiatives seeking to make healthcare data available for use in the development of AI models, particularly for cases where, in public health, data from very large segments of the population are required. Strategies to preserve patient privacy are central considerations for initiatives to implement AI algorithms for healthcare, but not the only ones.

Finally, considerations relating to the reuse of models developed in other environments must also be considered. Indeed, the problems associated with the widespread use of AI algorithms and tools are not the least of the obstacles to the meaningful impact of AI by healthcare. It represents a major challenge. Most tools and algorithms are specific to the environments in which they were developed. This makes them difficult to transpose from one country to another, or even from one establishment to another. To enhance the contribution of AI in healthcare, the development and implementation of AI algorithms must consider the specificity of the healthcare field (jurisdiction, and organization specificities). This is a key consideration but is not enough on its own to solve the problem of integrating AI in healthcare [9].

1.3 Lack of maturity of tools developed in the healthcare field:

In addition to the problems associated with the specificity of the healthcare field and generalization, there is also the problem of the maturity of AI tools and applications [10]. Indeed, in response to the pandemic, several tools and algorithms have been developed around the world [11]. BlueDot [12] in Canada and HealthMap [13] in the United States are examples of software based on AI algorithms used as "epidemic alert" tools. XrAI [14], developed by the Canadian company 1Qbit, and COVID-Net, a convolutional neural network developed by Wang et al [15], are diagnostic tools. They raised great expectations when they were first introduced. Most of these AI tools generated enthusiasm and hope about their potential to provide significant help in response to the pandemic. However, it has to be said that their contribution has not lived up to expectations [11]. This modest contribution of AI to the fight against the pandemic is partly due to the fact that very few of the tools developed have reached maturity [16]. The lack of data but also, paradoxically, the excess of data, especially from social networks (often biased), has progressively worked against the predictive capacity of these tools and algorithms, and at the same time led to a regression in their contribution to the fight against the pandemic [17].

1.4 Lack of empirical data on barriers limiting meaningful impact of AI in healthcare

As we have just discussed, there are several obstacles to have a meaningful impact of AI in healthcare (specificity of the healthcare field, difficulty of generalization, lack of maturity of the developed models). Several studies in the literature are devoted to these difficulties [18], but, despite the abundant literature, we do not yet have a global viewpoint, based on empirical data, of the obstacles for AI to have the expected impact in healthcare. Most studies are based on anecdotal evidence, narrative or analytical commentary, and lack empirical data [18]. Consequently, the determinants of these limits are still insufficiently understood [5]. If the healthcare system is to be adequately transformed to meet new needs, we need a clear typology of the characteristics of the AI algorithm being developed, to identify ways of improving their impact on healthcare in general, and on the Canadian healthcare system in particular. To address the need for empirical data in a Canadian context, we propose to conduct a scoping review to identify characteristics of AI algorithms developed by Canadian researchers or researchers with affiliations in Canadian research institutions to support the clinical management of patients. Its aim is to identify areas for improvement in the Canadian context for AI algorithms in the clinical field. The aim is to identify levers for action to improve their contribution to the provision of quality care.

2 Research question

This study aims to answer the following research question: What are the characteristics of the developed AI algorithms in Canadian setting and which of these characteristics can be essential as leverage point for AI algorithms better impact in Canadian healthcare?

- Population : AI algorithms developed by researchers affiliated with Canadian institutions.
- Concept : Characteristics of AI algorithms, including (but not limited to) their purpose, clinical application, validation processes, data sources for development, testing and implementation, etc.
- Context : Impact of AI algorithm on Canadian Healhcare systems
-

3. Method and analysis

To meet the research objective, a scoping review will be carried out, consisting of retrieving AI algorithms developed by researchers with affiliations in Canadian research institutions, available in the literature, for patient triage, diagnosis and care management. This protocol was developed in accordance with the JBI Scoping Review Methodology Group's best practices for scoping review protocols [19]. The Preferred Reporting Items for Systematic Reviews and Meta Analyses Extension for Scoping Reviews (PRISMA-ScR) guidelines [20] will be followed for the scoping review. The various studies will thus be divided according to the main characteristics identified (sources and types of data, calculation method, analysis objective, level of data integration, etc.).

3.1 Identification of relevant articles

The research strategy aims to identify sources of evidence on AI algorithms developed by researchers with affiliations with Canadian research centers. The MEDLINE (PubMed) and CINAHL (EBSCO) databases, and Web of Science (Clarivate) are the sources of information. The search strategy was developed in consultation with a university librarian specializing in health sciences and consisted in the combination of three concepts: 1) Artificial Intelligence, 2) Clinical management of patients, 3) Canadian context (see appendix 1). The words contained in the titles and abstracts of the relevant data sources, together with the indexing terms used to describe the data sources, were used to develop a comprehensive search strategy for the selected databases (Appendix 2).

3.2 Eligibility criteria

After extracting the articles using the built query, the following inclusion and exclusion criteria will be used to sort the identified studies:

- **Inclusion criteria**: (1) the article concerns an AI algorithm developed for the triage, diagnosis or care management of patients, (2) the language of publication of the article is French or English, (3) the date of publication of the article is between 2014 and December, 2024. An update is planned for summer 2025 to include articles published after this period.
- **Exclusion criteria**: (1) the article full text is not open access or not available by academic subscription (2) the article presents fundamental algorithm development that does not directly address a clinical activity need, (3) the article is a review, (4) the article is a commentary or editorial, (5) the article is an abstract, (6) the objectives of the authors of the article are other than to make predictions (e.g., exclude the article if the methodology/algorithm is used to determine characteristics only).

3.3 Data selection

After the search, all identified articles from each source will be imported into Covidence and duplicates will be removed. Titles and abstracts will be reviewed by two reviewers against the study's inclusion and exclusion criteria. A more detailed evaluation based on the full text of the selected data sources will then be carried out, still in Covidence, according to the inclusion criteria, by the two evaluators. Reasons for excluding full-text data sources that do not meet the inclusion criteria will be recorded and reported in the scoping review. Disagreements between the two reviewers at each stage of the selection process will be resolved by discussion or by a third reviewer. The results of the search and the process of inclusion of evidence sources will be reported in full in the final version of the scoping review and presented in a PRISMA-ScR flowchart [20] . To date, the query retrieves 5,000 articles from each source database (Appendix 2).

3.4 Data extraction

Once the list of final articles to be included approved by all reviewers, data will be extracted from the evidence sources included in the scoping review by two people using the data extraction tool provided by Covidence. The extracted data will include specific details on the authors, the algorithms and the training data used in the algorithms (Table 1).

Table 1: Data extraction grid

Article information	Information on the algorithms used	Information on the clinical data support for the algorithm development
- Author affiliation - Place of publication (Province and city) - Publication date - Clinical domain (Cardiology, oncology, radiology, etc)	- Type of developed algorithm (machine learning, deep learning, large language model, expert systems, etc.) - Targeted users (patients, clinicians) - Targeted usage (Triage, diagnosis and treatment, etc.) - Evaluation criteria identified (Performance metrics, benchmarks, ethical aspects)	- Data source (international open-source database, public databases, hospital records, primary care, clinical studies, medico-economic data, etc.) - Data type (medical images, clinical texts, physiological signals etc.) - Sample size - Level of data integration

3.5 Data summaries and results synthesis

Data analysis will consist of a descriptive analysis. Results will be presented in tabular form. A narrative summary will accompany the results, describing how the results relate to the objective of the scoping review.

3.6 Patient and Public Involvement

A dissemination workshop will be conducted towards the conclusion of the scoping review. This workshop will bring together researchers, patients, and other key stakeholders to 1) present the findings, 2) develop the recommendations, and 3) collect other insights and feedback to refine the conclusion of the study.

4. Ethics and Dissemination

This study does not require ethical approval, as it involves the review and collection of data from published and/or publicly available articles. It is expected to be completed by November 2025. The dissemination strategy includes a publication of the results of the scoping review, as well as presentations at conferences on AI and care practice. The results of the study will map, according to previously defined criteria, AI algorithms developed for triage, diagnosis and care management by researchers with affiliations in Canadian research institutions. In particular, it will identify levers for action to better integrate AI algorithms into Canadian care practice. A dissemination workshop will be conducted towards the conclusion of the scoping review. This workshop will bring together researchers, patients, and other key stakeholders to 1) present the findings, 2) develop the recommendations, and 3) collect other insights and feedback to refine the conclusion of the study.

5. Discussion

This study will enable us to map the trends in health research in Canada around AI algorithms. It should allow us to highlight the challenges that need to be addressed to achieve a greater impact of AI algorithms in everyday healthcare. The review will help identify areas for improvement and provide relevant recommendations within the Canadian context, showing how the conditions enabling the development of these algorithms can be significantly improved to support their implementation.

The study is limited to the Canadian context as it ensures feasibility given the high productivity of the AI field and allows for an in-depth analysis within a jurisdiction. It will allow a comparison of the situation in its provinces that share similar contexts. It does not extend to other countries, which may have different healthcare systems. The specificity of the healthcare domain and the need to reconcile data realities in the development of AI algorithms necessitate jurisdiction-specific analyses. Comparisons with other jurisdictions can be performed in a subsequent analysis.

The study is in an early stage, but several points has already been achieved. We developed a concept plan and formulated a search strategy, which was refined through consultation with a librarian. Data sources were identified, and research was conducted within these sources. The collected data were imported into Covidence, and the data are being integrated to remove redundancy.

This study has certain limitations. One limitation is the failure to account for constraints related to the deployment and use of the tools implemented. Additionally, the selection process was based on authors' affiliations; some authors who work with Canadian data may not be affiliated with Canadian research centers, which could influence the comprehensiveness of the study.

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JNN conceived the original idea; with DBR they contributed to the drafting of the manuscript, as well as the development of the research question and methods. DC drafted the first version of the manuscript, assisted with editing, formatting, and further refinement of the research question and methods. AM contributed to developing the research question and methodology, while AB, SB supported the initial steps of the research implementation. All authors approved the final manuscript. Guarantor is JNN.

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Appendix 1: research strategy

Concepts	Concepts definition	Search terms
Artificial Intelligence	Artificial Intelligence encompasses a range of computational techniques and algorithms that enable machines to perform tasks that typically require human cognition. These tasks include learning from data (machine learning), understanding natural language (natural language processing), recognizing patterns (pattern recognition), and making decisions or predictions.	Artificial intelligence Intelligence program Machine Learning Deep Learning Natural Language processing Large language model Computer vision Reinforcement learning Predictive analytics Neural networks Supervised learning Unsupervised learning semi-supervised-learning Generative Adversarial network Neural network Sentiment Analysis Clustering DBSCAN Principal Component Analysis Linear regression Polynomial Regression Logistic regression Naive Bayes Decision tree Random forest K-nearest neighbor K-means Support vector Machine Gradient boosting Dimensionality reduction AdaBoosting AdaBoost Autoencoder Q-learning Deep Q-Network Policy Gradient Monte Carlo Ordinary Least Square Regression Orthogonal Matching Pursuit Bayesian Regression Quantile Regression Isotonic regression Stepwise regression Least-angle regression "Stochastic Gradient Descent Ensemble Learning Convolutional Neural Networks Recurrent Neural Networks

		Long Short-Term Memory network Generative Adversarial network Transformer Network Deep Belief network Deep Q-network Variational Autoencoder Graph Neural network
Clinical management of patients	This concept encompasses patient orientation, assessment and diagnosis, patient treatment and care with their planning and coordination, patient monitoring and follow-up, patient education and engagement.	healthcare practice ("health care" AND Procedure) ("healthcare" AND Procedure) care practices medical care Delivery of Healthcare Healthcare Delivery Health Care Delivery Delivery of Dental Care Dental Care Delivery Clinical Decision-Making Delayed Diagnosis Diagnosis Diagnosis, Dual Diagnostic Errors Early Diagnosis Incidental Findings Overdiagnosis Prodromal Symptoms triage Prognosis Theranostic Nanomedicine
Canadian context	At least one of the authors is affiliated with a Canadian institution	Canada Canadian context Canadian Quebec Alberta British Columbia Manitoba New Brunswick Labrador Newfoundland Nova Scotia Ontario Prince Edward Island Saskatchewan Yukon Nunavut Northwest Territories

Table 1: Medline search strategy (Pubmed)

Date: 18-09-2024

Search	Query	Results
#15	Search: #9 AND #10 Filters: Humans, English, French, from 2014 - 2024 Sort by: First Author	5 245
#14	Search: #9 AND #10 Filters: Humans, English, from 2014 - 2024 Sort by: First Author	5 238
#13	Search: #9 AND #10 Filters: Humans, from 2014 - 2024 Sort by: First Author	5 248
#12	Search: #9 AND #10 Filters: from 2014 - 2024 Sort by: First Author	6 400
#11	Search: #9 AND #10 Sort by: First Author	8 291
#10	Search: Canada[Affiliation] Sort by: First Author	998 332
#9	Search: #6 AND #8 Sort by: First Author	195 640
#8	Search: #5 OR #7 Sort by: First Author	3 453 946
#7	Search: #3 AND #4 Sort by: First Author	914 670
#6	Search: #1 OR #2 Sort by: First Author	1 202 197
#5	Search: "healthcare practice"[Title/Abstract] OR ("health care"[Title/Abstract] AND Procedure[Title/Abstract]) OR (healthcare[Title/Abstract] AND Procedure[Title/Abstract]) OR "care practices"[Title/Abstract] OR "medical care"[Title/Abstract] OR "Delivery of Healthcare"[Title/Abstract] OR "Healthcare Delivery"[Title/Abstract] OR "Health Care Delivery"[Title/Abstract] OR "Delivery of Dental Care"[Title/Abstract] OR "Dental Care Delivery"[Title/Abstract] OR "Clinical Decision-Making"[Title/Abstract] OR "Delayed Diagnosis"[Title/Abstract] OR "Diagnosis"[Title/Abstract] OR "Diagnosis, Dual"[Title/Abstract] OR "Diagnostic Errors"[Title/Abstract] OR "Early	2 636 672

	Diagnosis"[Title/Abstract] OR "Incidental Findings"[Title/Abstract] OR "Overdiagnosis"[Title/Abstract] OR "Prodromal Symptoms"[Title/Abstract] OR "triage"[Title/Abstract] OR "Prognosis"[Title/Abstract] OR "Theranostic Nanomedicine"[Title/Abstract] Sort by: First Author	
#4	Search: "Delivery of Health Care"[Mesh] Sort by: First Author	1 333 208
#3	Search: "Analytical, Diagnostic and Therapeutic Techniques and Equipment Category"[Mesh] Sort by: First Author	21 459 874
#2	Search: "Artificial intelligence"[Title/Abstract] OR "Intelligence program"[Title/Abstract] OR "Machine Learning"[Title/Abstract] OR "Deep Learning"[Title/Abstract] OR "Natural Language processing"[Title/Abstract] OR "Large language model"[Title/Abstract] OR "Computer vision"[Title/Abstract] OR "Reinforcement learning"[Title/Abstract] OR "Predictive analytics"[Title/Abstract] OR "Neural networks"[Title/Abstract] OR "Supervised learning"[Title/Abstract] OR "Unsupervised learning"[Title/Abstract] OR "semi-supervised-learning"[Title/Abstract] OR "Generative Adversarial network"[Title/Abstract] OR "Neural network"[Title/Abstract] OR "Sentiment Analysis"[Title/Abstract] OR "Clustering"[Title/Abstract] OR "DBSCAN"[Title/Abstract] OR "Principal Component Analysis"[Title/Abstract] OR "Linear regression"[Title/Abstract] OR "Polynomial Regression"[Title/Abstract] OR "Logistic regression"[Title/Abstract] OR "Naive Bayes"[Title/Abstract] OR "Decision tree"[Title/Abstract] OR "Random forest"[Title/Abstract] OR "K-nearest neighbor"[Title/Abstract] OR "K-means"[Title/Abstract] OR "Support vector Machine"[Title/Abstract] OR "Gradient boosting"[Title/Abstract] OR "Dimensionality reduction"[Title/Abstract] OR "AdaBoosting"[Title/Abstract] OR "AdaBoost"[Title/Abstract] OR "Autoencoder"[Title/Abstract] OR "Q-learning"[Title/Abstract] OR "Deep Q-Network"[Title/Abstract] OR "Policy Gradient"[Title/Abstract] OR "Monte Carlo"[Title/Abstract] OR "Ordinary Least Square Regression"[Title/Abstract] OR "Orthogonal Matching Pursuit"[Title/Abstract] OR "Bayesian Regression"[Title/Abstract] OR "Quantile Regression"[Title/Abstract] OR "Isotonic regression"[Title/Abstract] OR "Stepwise regression"[Title/Abstract] OR "Least-angle regression"[Title/Abstract] OR "Stochastic Gradient Descent"[Title/Abstract] OR "Ensemble Learning"[Title/Abstract] OR "Convolutional Neural Networks"[Title/Abstract] OR "Recurrent Neural Networks"[Title/Abstract] OR "Long Short-Term Memory network"[Title/Abstract] OR "Generative Adversarial network"[Title/Abstract] OR "Transformer Network"[Title/Abstract] OR "Deep Belief network"[Title/Abstract] OR "Deep Q-	1 130 728

	network"[Title/Abstract] OR "Variational Autoencoder"[Title/Abstract] OR "Graph Neural network"[Title/Abstract] Sort by: First Author	
#1	Search: "Artificial Intelligence"[Mesh] Sort by: First Author	208 521

Table 2: CINAHL search strategy

Date: 18-09-2024

	Search Terms	Search Options	Actions
S18	S14 AND S15	Limiters - Date de publication: 20140101-20241231 Expanders - Appliquer des sujets équivalents Search modes - Proximity	7 361
S17	S14 AND S15	Limiters - Date de publication: 20140101-20241231 Expanders - Appliquer des sujets équivalents Search modes - Proximity	7 361
S16	S14 AND S15	Expanders - Appliquer des sujets équivalents Search modes - Proximity	10 287
S15	AF Canada	Expanders - Appliquer des sujets équivalents Search modes - Proximity	267 390
S14	S12 AND S13	Expanders - Appliquer des sujets équivalents Search modes - Proximity	229 187
S13	S5 OR S11	Expanders - Appliquer des sujets équivalents Search modes - Proximity	3 996 790
S12	S1 OR S8	Expanders - Appliquer des sujets équivalents Search modes - Proximity	349 778
S11	S9 OR S10	Expanders - Appliquer des sujets équivalents Search modes - Proximity	518 435
S10	AB("healthcare practice" OR ("health care" AND Procedure) OR (healthcare AND Procedure) OR "care practices" OR "medical care" OR "Delivery of Healthcare" OR "Healthcare Delivery" OR "Health Care Delivery" OR "Delivery of Dental Care" OR "Dental Care Delivery" OR "Clinical Decision-Making" OR "Delayed Diagnosis" OR "Diagnosis" OR "Diagnosis, Dual" OR "Diagnostic Errors" OR "Early Diagnosis" OR "Incidental Findings" OR "Overdiagnosis" OR "Prodromal Symptoms" OR "triage" OR "Prognosis" OR "Theranostic Nanomedicine")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	448 826

S9	TI ("healthcare practice" OR ("health care" AND Procedure) OR (healthcare AND Procedure) OR "care practices" OR "medical care" OR "Delivery of Healthcare" OR "Healthcare Delivery" OR "Health Care Delivery" OR "Delivery of Dental Care" OR "Dental Care Delivery" OR "Clinical Decision-Making" OR "Delayed Diagnosis" OR "Diagnosis" OR "Diagnosis, Dual" OR "Diagnostic Errors" OR "Early Diagnosis" OR "Incidental Findings" OR "Overdiagnosis" OR "Prodromal Symptoms" OR "triage" OR "Prognosis" OR "Theranostic Nanomedicine")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	116 613
S8	S6 OR S7	Expanders - Appliquer des sujets équivalents Search modes - Proximity	249 326
S7	AB ("Artificial intelligence" OR "Intelligence program" OR "Machine Learning" OR "Deep Learning" OR "Natural Language processing" OR "Large language model" OR "Computer vision" OR "Reinforcement learning" OR "Predictive analytics" OR "Neural networks" OR "Supervised learning" OR "Unsupervised learning" OR "semi-supervised-learning" OR "Generative Adversarial network" OR "Neural network" OR "Sentiment Analysis" OR "Clustering" OR "DBSCAN" OR "Principal Component Analysis" OR "Linear regression" OR "Polynomial Regression" OR "Logistic regression" OR "Naive Bayes" OR "Decision tree" OR "Random forest" OR "K-nearest neighbor" OR "K-means" OR "Support vector Machine" OR "Gradient boosting" OR "Dimensionality reduction" OR "AdaBoosting" OR "AdaBoost" OR "Autoencoder" OR "Q-learning" OR "Deep Q-Network" OR "Policy Gradient" OR "Monte Carlo" OR "Ordinary Least Square Regression" OR "Orthogonal Matching Pursuit" OR "Bayesian Regression" OR "Quantile Regression" OR "Isotonic regression" OR "Stepwise regression" OR "Least-angle regression" OR "Stochastic Gradient Descent" OR "Ensemble Learning" OR "Convolutional Neural Networks" OR "Recurrent Neural Networks" OR "Long Short-Term Memory network" OR "Generative Adversarial network" OR "Transformer	Expanders - Appliquer des sujets équivalents Search modes - Proximity	233 455

	Network" OR "Deep Belief network" OR "Deep Q-network" OR "Variational Autoencoder" OR "Graph Neural network")		
S6	TI ("Artificial intelligence" OR "Intelligence program" OR "Machine Learning" OR "Deep Learning" OR "Natural Language processing" OR "Large language model" OR "Computer vision" OR "Reinforcement learning" OR "Predictive analytics" OR "Neural networks" OR "Supervised learning" OR "Unsupervised learning" OR "semi-supervised-learning" OR "Generative Adversarial network" OR "Neural network" OR "Sentiment Analysis" OR "Clustering" OR "DBSCAN" OR "Principal Component Analysis" OR "Linear regression" OR "Polynomial Regression" OR "Logistic regression" OR "Naive Bayes" OR "Decision tree" OR "Random forest" OR "K-nearest neighbor" OR "K-means" OR "Support vector Machine" OR "Gradient boosting" OR "Dimensionality reduction" OR "AdaBoosting" OR "AdaBoost" OR "Autoencoder" OR "Q-learning" OR "Deep Q-Network" OR "Policy Gradient" OR "Monte Carlo" OR "Ordinary Least Square Regression" OR "Orthogonal Matching Pursuit" OR "Bayesian Regression" OR "Quantile Regression" OR "Isotonic regression" OR "Stepwise regression" OR "Least-angle regression" OR "Stochastic Gradient Descent" OR "Ensemble Learning" OR "Convolutional Neural Networks" OR "Recurrent Neural Networks" OR "Long Short-Term Memory network" OR "Generative Adversarial network" OR "Transformer Network" OR "Deep Belief network" OR "Deep Q-network" OR "Variational Autoencoder" OR "Graph Neural network")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	30 239
S5	S2 OR S3 OR S4	Expanders - Appliquer des sujets équivalents Search modes - Proximity	3 805 326)
S4	(MH "Diagnosis+")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	2249461
S3	(MH "Triage")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	11,411

S2	(MH "Health Services Administration+")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	2 387 587
S1	(MH "Artificial Intelligence+") OR (MH "Decision Making, Computer Assisted+") OR (MH "Image Processing, Computer Assisted+")	Expanders - Appliquer des sujets équivalents Search modes - Proximity	122 101

Table 3: Web of science search strategy

Date: 18-09-2024

#	Search Query	Results
#1	TI=("Artificial intelligence" OR "Intelligence program" OR "Machine Learning" OR "Deep Learning" OR "Natural Language processing" OR "Large language model" OR "Computer vision" OR "Reinforcement learning" OR "Predictive analytics" OR "Neural networks" OR "Supervised learning" OR "Unsupervised learning" OR "semi-supervised-learning" OR "Generative Adversarial network" OR "Neural network" OR "Sentiment Analysis" OR "Clustering" OR "DBSCAN" OR "Principal Component Analysis" OR "Linear regression" OR "Polynomial Regression" OR "Logistic regression" OR "Naive Bayes" OR "Decision tree" OR "Random forest" OR "K-nearest neighbor" OR "K-means" OR "Support vector Machine" OR "Gradient boosting" OR "Dimensionality reduction" OR "AdaBoosting" OR "AdaBoost" OR "Autoencoder" OR "Q-learning" OR "Deep Q-Network" OR "Policy Gradient" OR "Monte Carlo" OR "Ordinary Least Square Regression" OR "Orthogonal Matching Pursuit" OR "Bayesian Regression" OR "Quantile Regression" OR "Isotonic regression" OR "Stepwise regression" OR "Least-angle regression" OR "Stochastic Gradient Descent" OR "Ensemble Learning" OR "Convolutional Neural Networks" OR "Recurrent Neural Networks" OR "Long Short-Term Memory network" OR "Generative Adversarial network" OR "Transformer Network" OR "Deep Belief network" OR "Deep Q-network" OR "Variational Autoencoder" OR "Graph Neural network")	802 632
#2	AB=("Artificial intelligence" OR "Intelligence program" OR "Machine Learning" OR "Deep Learning" OR "Natural Language processing" OR "Large language model" OR "Computer vision" OR "Reinforcement learning" OR "Predictive analytics" OR "Neural networks" OR "Supervised learning" OR "Unsupervised learning" OR "semi-supervised-learning" OR "Generative Adversarial network" OR "Neural network" OR "Sentiment Analysis" OR "Clustering" OR "DBSCAN" OR "Principal Component Analysis" OR "Linear regression" OR "Polynomial Regression" OR "Logistic regression" OR "Naive Bayes" OR "Decision tree" OR "Random forest" OR "K-nearest neighbor" OR "K-means" OR "Support vector Machine" OR "Gradient boosting" OR "Dimensionality reduction" OR "AdaBoosting" OR "AdaBoost" OR "Autoencoder" OR "Q-learning" OR "Deep Q-Network" OR "Policy Gradient" OR "Monte Carlo" OR "Ordinary Least Square Regression" OR "Orthogonal Matching Pursuit" OR "Bayesian Regression" OR "Quantile Regression" OR "Isotonic regression" OR "Stepwise regression" OR "Least-angle regression" OR "Stochastic Gradient Descent" OR "Ensemble Learning" OR "Convolutional Neural Networks" OR "Recurrent Neural Networks" OR "Long Short-Term Memory network" OR "Generative Adversarial network" OR "Transformer Network" OR "Deep Belief network" OR "Deep Q-network" OR "Variational Autoencoder" OR "Graph Neural network")	2 581 931
#3	TI=("healthcare practice" OR ("health care" AND Procedure) OR (healthcare AND Procedure) OR "care practices" OR "medical care" OR "Delivery of Healthcare" OR "Healthcare Delivery" OR "Health Care Delivery" OR	595 301

	"Delivery of Dental Care" OR "Dental Care Delivery" OR "Clinical Decision-Making" OR "Delayed Diagnosis" OR "Diagnosis" OR "Diagnosis, Dual" OR "Diagnostic Errors" OR "Early Diagnosis" OR "Incidental Findings" OR "Overdiagnosis" OR "Prodromal Symptoms" OR "triage" OR "Prognosis" OR "Theranostic Nanomedicine")	
#4	AB=("healthcare practice" OR ("health care" AND Procedure) OR (healthcare AND Procedure) OR "care practices" OR "medical care" OR "Delivery of Healthcare" OR "Healthcare Delivery" OR "Health Care Delivery" OR "Delivery of Dental Care" OR "Dental Care Delivery" OR "Clinical Decision-Making" OR "Delayed Diagnosis" OR "Diagnosis" OR "Diagnosis, Dual" OR "Diagnostic Errors" OR "Early Diagnosis" OR "Incidental Findings" OR "Overdiagnosis" OR "Prodromal Symptoms" OR "triage" OR "Prognosis" OR "Theranostic Nanomedicine")	2 040 026
#5	#1 OR #2	2 710 456
6	#3 OR #4	2 378 126
#7	#5 AND #6	183 246
#8	AD=(Canada)	3 253 169
9	#7 AND #8	7 688
#10	#7 AND #8 and 2024 or 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 or 2016 or 2015 or 2014 (Publication Years)	5 955
#11	#7 AND #8 and 2024 or 2023 or 2022 or 2021 or 2020 or 2019 or 2018 or 2017 or 2016 or 2015 or 2014 (Publication Years) and English or French (Languages)	5 946