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Stakeholders' views on the management-related factors affecting application of Artificial Intelligence in healthcare: a scoping review protocol

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ABSTRACT

Introduction

Artificial Intelligence (AI) offers great potential for transforming healthcare delivery and lead to better patient-outcomes and more efficient care delivery. However, despite these advantages, integration of AI in healthcare has not kept pace with technological advancements. Previous research indicates importance of understanding the social and management factors that shape integration of new technologies in healthcare. Therefore, the aim of this study is to provide an overview of the existing management-related factors influencing adoption of AI in healthcare from the perspectives of different stakeholders. By conducting this review, the various factors that facilitate or hinder AI implementation in healthcare could be identified.

Methods and analysis

This study follows the Joanna Briggs Institute framework which includes the following stages: (1) defining and aligning objectives and questions, (2) developing and aligning the inclusions criteria with objectives and questions, (3) describing the planned approach to evidence searching and selection, (4) searching for the evidence, (5) selecting the evidence, (6) extracting the evidence, (7) charting the evidence, and summarising the evidence with regard to the objectives and questions.

The databases searched will be MEDLINE (Ovid), CINAHL (Plus), PubMed, Cochrane Library, Scopus, MathSciNet, NICE Evidence, OpenGrey, O'REILLY, and Social Care Online from January 2000 to September 2020. Search results will be reported based on The Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for scoping reviews guidelines. The review has adopted Diffusion of Innovations theory, Technology Acceptance Model, and Stakeholder theory as guiding conceptual models. Narrative synthesis is used to integrate the findings.

Ethics and dissemination

Ethics approval will not be sought for this scoping review as it only includes information from the previously published studies. The results will be disseminated through publication in a peer-reviewed journal. In addition, to ensure its findings reach relevant stakeholders, they will be presented at relevant conferences.

ARTICLE SUMMARY

Strength and limitations of this study

- This will be the first scoping review to map out the management-related challenges and opportunities in application of AI in healthcare from the stakeholders' perspectives.
- The findings will be limited to what is reported in peer-reviewed published literature, therefore, the authors aim to conduct a follow-up primary research to include more data sources.
- The proposed scope may exclude some other relevant aspects in application of AI in healthcare.
- While the scope of this review is focused on the management-related issues of AI implementation in general healthcare, the authors recognise that the findings will further need to be contextualised within a specific healthcare environment.

INTRODUCTION

Artificial Intelligence (AI) is a general term used to describe computing technologies, which perform functions that aim to reproduce the capabilities of human mind such as reasoning, learning, adaptation, sensory cognition, and creativity. [1] Rapid technological advances in the last decade broadened the portfolio of AI based tools and widened their areas of applications. The use of AI in the healthcare sector is gradually increasing and expanding into areas such as medical diagnostics and treatment (e.g. disease diagnosis, medical imaging, robot-assisted surgery), management and decision making (e.g. design of patients' pathways, allocation of resources), public health and epidemiology (e.g. predictions about the likelihood of an infectious disease outbreak and its dynamics, risk factors for non-communicable diseases), patient care (e.g. personalised health advice, remote diagnosis, patients' monitoring), elderly care (e.g. healthcare robots assisting older adults at care homes) and many more. [1-4]

Despite the growing use of AI in healthcare and its potential to transform patients' experience and quality of care, there is emerging evidence that the integration of AI based tools has not been happening as quickly as the technology has been advancing. [5] This can be due to the fact that successful introduction of new advanced technologies requires a fundamental transition in the way organisational processes are conducted and need acceptance from a considerable number of stakeholders. [6-8] Furthermore, organisational introduction of new technologies is not just affected by their technical capabilities, but is also driven by other economic, managerial, and social factors. [9]

These issues are prominent when a complex innovation such as AI is introduced in a challenging sector like healthcare. AI is not one technology, but a variety of technologies, algorithms, and software. [10] This increases the areas and settings of healthcare applications and, consequently, the number of stakeholders influencing its implementation and adoption. The sheer size of the health sector and the complexity of care delivery extends the list of managerial, economic, and social factors to consider when new technologies with far reaching effects such as AI are introduced. Consequently, understanding the perspectives of stakeholders and the non-technical factors affecting AI integration in healthcare is an important research topic worth investigating.

There is a growing body of research reporting various non-technical issues related to AI adoption from the perspectives of different stakeholders. For example, some studies indicated that AI can dramatically change the nature of the relationship between patients and healthcare professionals (HCPs) as patients may not want to accept any medical decisions made by AI based tools. [9-10] As for HCPs, such factors like long training requirements, [11] self-governance in regard to the technology use, [12] and the lack of worker's involvement in the implementation process [13] can serve as potential barriers for successful adoption of technology in their practice. For the wider context of healthcare management, the reliance of AI on large datasets brings concerns regarding privacy, security, bias, under-representation of specific populations in datasets, and widening of health inequalities. [1,3,9,14] Certification of new AI technologies for safer use in healthcare requires a new regulatory framework involving a wide range of stakeholders. [9,10,14] The significant financial investment required to implement AI and the changes to operational processes create difficulties to healthcare organisations especially as many are already resource constrained. [3,10] From a legal perspective, there are concerns regarding which parties are liable in case of medical errors and harm to patients due to AI tools technical deficiencies or misuse. [1,9,10]

Therefore, successful adoption and implementation of AI in healthcare go beyond the capabilities of the technologies and the technical innovations they provide. It is a more complex endeavour requiring involvement and acceptance from a wide set of stakeholders and contingent upon a range of economic, social, and managerial factors. The aim of the scoping review is to assess the state of the literature regarding the stakeholders' views on the factors influencing AI adoption in healthcare, to inform future research agenda in this area and provide further evidence for facilitating a smooth integration of the technology in the sector.

STUDY RATIONALE

Various stakeholders influence adoption and implementation of AI in healthcare including patients, HCPs, AI developers, pharmaceutical companies, legislative, regulatory, government and public sector bodies. These stakeholders have different and sometimes conflicting interests and perceptions on the benefits, risks, opportunities, and limitations of integrating AI in healthcare. [3,10,14] There have been several scoping and systematic reviews capturing these various stakeholders' perspectives on implementing AI in healthcare, but they are mostly focusing on clinical outcomes and individual factors shaping AI adoption. However, none of these reviews focused on wider organisational and management-related factors that can facilitate or hinder successful implementation of AI in the sector. Therefore, it is essential to map out the perspectives of the relevant stakeholders on the management-related issues of using AI in healthcare from the existing primary studies to identify how it works, for whom and under which circumstances.

STUDY OBJECTIVE

This study will provide an overview of the perspectives of different relevant stakeholders on the existing management-related challenges and opportunities in application of AI in healthcare. By conducting this review, we aim to identify the various factors that may facilitate or hinder AI implementation and usage in the context of healthcare.

METHODS AND ANALYSIS

Theoretical frameworks

In order to support data analysis, categorisation and synthesis of the results, this scoping review has adopted the Diffusion of Innovations theory (DoI) [15] as a guiding conceptual framework. DoI has been previously successfully employed to predict how individuals make decisions to adopt a new innovation by exploring their adoption patterns and its structure. [16-17] Broadly speaking, this theory can help understand why some new technologies spread faster and wider than others while taking into a consideration not just individual level, but also team and organisational. [18] Rogers defined diffusion of innovation as a process by which a new innovation is communicated through certain channels over time among the members of a social system and highlighted that adoption of an innovation should be considered as a social process. [19] This social process, or the innovation-decision process, comprises of five stages (see Figure 1), which are: i) knowledge: individuals or adoption units gain the first knowledge of an innovation; ii) persuasion: individuals or adoption units form an attitude towards the innovation; iii) decision: individuals/adoption units make a decision on whether to adopt or reject an innovation; iv) implementation: an innovation is implemented by individuals / adoption units (which can also be considered as a trial); and finally v) confirmation: individuals

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3 / adoption units verify their decision to adopt or reject an innovation. The process is influenced
4 by the characteristics of the organisation (or decision-making unit) including socioeconomic
5 characteristics, personality variables and communication behaviours, as well as by the perceived
6 characteristics of the innovation such as relative advantage, compatibility, complexity, trialability
7 and observability.
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12 [Insert Figure 1 here]
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14 **Figure 1: Integrated theoretical framework (adapted from Rogers [15])**

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16 According to Rogers, the first two stages of “knowledge” and “persuasion” are the most critical
17 elements in the innovation-decision process as at these stages, individuals (adopters) and/or decision-
18 making units weight the advantages and disadvantages of a new innovation to reduce uncertainty
19 about its usage. [15] This is why as part of this guiding conceptual framework we will also incorporate
20 Technology Acceptance Model (TAM) [20] which focuses on two key factors influencing individuals’
21 decision about using a new innovation: Perceived Usefulness (PU) and Perceived Ease-of-Use (PEU).
22 The PU can be defined as “the degree to which a person believes that using a particular system would
23 enhance his or her job performance” and the PEU as “the degree to which a person believes that using
24 a particular system would be free from effort”. [21] Integrating both of these theories will not only
25 help explore the specific management issues of adopting and implementing AI (by using DIT) but also
26 explain the stakeholders’ general perception towards AI use in the healthcare context (by using TAM).
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32 Lastly, given that we aim to map management-related challenges and opportunities of application of
33 AI in healthcare through the lens of the relevant stakeholders’ perspectives, we will also incorporate
34 the stakeholder theory. [22] Stakeholder theory provides an alternative to a traditional input/output
35 view of an organisation and it considers the interests of all stakeholders to be of intrinsic value. In its
36 normative form [23] it serves to identify different individuals or groups who have legitimate interest
37 in procedural and/or substantive aspects of organisational activity. In the healthcare domain,
38 stakeholders can be defined as “any person or group of people who have a significant interest in
39 services provided, or will be affected by, any planned changes in an organisation or local health
40 community”. [24] Clarkson [25] advised that in the context of organisational management, it is useful
41 to distinguish between primary and secondary stakeholders: primary (or participant stakeholders) are
42 the one without whose direct participation the organisation cannot survive, and secondary (or non-
43 participant stakeholders) are those who influence (or can be influenced by) organisation) without
44 directly participating in its transactions. [26] The Stakeholder theory can be linked with the DoI which
45 assumes that there are different types of “users” who are involved at the process of technology
46 adoption at various stages. [27] The stakeholder theory expands the notion of a “user” to all individual
47 or organisations that might have an impact or be impacted by the introduction of the innovation.
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52 **Protocol design**

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54 This study will follow the methodological framework suggested by the Joanna Briggs Institute (JBI),
55 [28] which comprises of the following stages: (1) defining and aligning the objectives and questions,
56 (2) developing and aligning the inclusions criteria with the objectives and questions, (3) describing the
57 planned approach to evidence searching and selection, (4) searching for the evidence, (5) selecting
58 the evidence, (6) extracting the evidence, (7) charting the evidence, and summarising the evidence in
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3 relation to the objectives and questions. Throughout the process, feedback will be sought from the
4 Life and Medical sciences librarian as well as a medical expert with a related background when
5 required. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)
6 extension for scoping reviews guidelines (PRISMA-ScR) [29] have been followed to ensure that the
7 structure and content of this protocol comprise all the required elements, which is provided in online
8 supplementary appendix 1.
9

11 Stage 1: Defining and aligning the objective(s) and question(s)

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13 Both the objective of this scoping review and research questions were developed using the PCC
14 mnemonic (P = Population, C = Concept, C = Context) where possible. The population of interest will
15 be any relevant stakeholders who have had experience of directly (e.g., utilising AI as part of a medical
16 treatment) or indirectly (e.g., managing a surgery/ hospital where AI is used) employing AI in the
17 context of healthcare. We do not have predefined groups of the relevant stakeholders as these will
18 be mapped as part of this scoping review, however, it is expected that these will be comprised of the
19 patients / members of the general public, health workers, and IT developers. [30] The following four
20 broad groupings proposed by the World Health Organisation classification of health workers [31] will
21 be used: *health professionals* (i.e. those, who study, advise on or provide preventive, curative,
22 rehabilitative and promotional health services based on an extensive body of theoretical and factual
23 knowledge), *health associate professionals* (i.e. those who perform technical and practical tasks to
24 support the healthcare delivery), *personal care workers in health services* (i.e. those who provide
25 direct personal care services in health care and residential settings), and *health management and*
26 *support personnel* (i.e. those who form management and support personnel including a wide range of
27 other types of health systems personnel, such as health service managers, health economists, health
28 policy lawyers, biomedical engineers etc.). As for the concept of interest, any types and subfields of AI
29 employed in healthcare will be considered as this area is currently emerging. Lastly, the context of
30 interest in this study is the general context of healthcare. Based on the objective of the scoping review,
31 we will aim to answer the following primary research question (RQ1) "What are the stakeholders'
32 perspectives on the management-related issues in application of AI in healthcare?". In addition, three
33 secondary research questions will be used to guide this scoping review: (RQ2) "What factors might
34 facilitate or hinder application of AI in healthcare?", (RQ3) "How converging or diverging are the
35 perspectives of different types of stakeholders on application of AI in healthcare?", and (RQ4) "How
36 similar or dissimilar are stakeholders' perceptions on AI adoption across different healthcare services
37 and functions?".
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46 Stage 2: Developing and aligning the inclusion criteria with the objectives and questions

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48 To identify and refine eligibility criteria as well as formulate the search strategy and search terms, an
49 initial limited search of two appropriate online databases (PubMed and MEDLINE[Ovid]) was
50 conducted to explore what keywords / index terms are used in the abstracts of the retrieved papers.
51 After that, a preliminary search strategy was developed with the help of a University librarian and in
52 conjunction with topic area knowledge as well as discussion amongst the authors of this scoping
53 review. The preliminary search strategy is shown in online supplementary appendix 2.
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56 The initial search has been limited to studies that are meeting all three PCC criteria and explore the
57 views / perspectives of the relevant stakeholders on AI use in healthcare only. The type of studies that
58 will be included are any primary research studies, which were published in peer-review journals and
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3 written in English. Publication date will be limited to dates between the year 2000 and September
4 2020 to include studies that focus on the use of contemporary data-driven AI based on machine-
5 learning techniques as opposed to more traditional rule-based AI (e.g. Expert Systems). Studies
6 reporting only clinical outcomes of using AI in healthcare without taking into a consideration any
7 management-related issues will be excluded from the review. In addition, studies exploring the use of
8 “ordinary” computer systems and / or any other non-AI based technologies in healthcare will also be
9 considered as ineligible. Lastly, we will exclude studies focusing only on technical aspects of using a
10 particular type of AI in healthcare (e.g. performance improvements of the AI algorithms).

14 Stage 3: Describing the planned approach to evidence searching and selection

16 Before commencing the literature search, a pilot search will be performed, and the first 30 documents
17 will be screened on the two online data bases (PubMed and MEDLINE[Ovid]). Two of the authors (TH
18 and MC) will independently screen the titles and abstracts against the eligibility criteria. Any
19 disagreements will be then discussed by the authors, and if the agreement cannot be reached the
20 opinion of the third author will be sought. The authors will then screen three randomly selected full
21 texts of the eligible articles to pilot-test data extraction and agree on the charting form. Once the data
22 extraction form is refined, the new five randomly selected papers will be reviewed by all three authors
23 to compare and discuss the captured information following the recommendations of Valaitis et al. [32]
24 To assess the level of agreement between the reviewers, inter-rater reliability will be calculated using
25 Cohen’s kappa to iteratively calibrate and refine the process. Overall, this approach will enable the
26 review team to become familiar with the scoping review protocol and minimise the effect of reporting
27 bias. [33] In addition, it will help ensure that the eligibility criteria are feasible and used by the authors
28 in a consistent manner.

33 Stage 4: Searching for the evidence

35 Following the recommendations of the JBI, [34] the literature search will comprise three steps. During
36 the first step, all the previously selected keywords will be augmented to formulate a comprehensive
37 search strategy. The second step will comprise of creating search strings according to the
38 requirements of the databases using Medical Subject Heading (MeSH) terms, Boolean operators, as
39 well as date and language limiters as search filters. The databases that will be searched are MEDLINE
40 (Ovid), CINAHL (Plus), PubMed, Cochrane Library, Scopus, MathSciNet, NICE Evidence, OpenGrey,
41 O’REILLY, and Social Care Online. During the final third step, manual search of the reference lists of all
42 the selected papers for full-text review will be conducted in order to identify more relevant studies.
43 The PRISMA flow diagram will be used to record how many studies are included / excluded at each
44 stage of the search process and from what databases. [35]

49 Stage 5: Selecting the evidence

51 All the search results will be imported onto EndNote bibliographic software (V.9, Clarivate Analytics,
52 Philadelphia, Pennsylvania, USA) and merged. Once the duplicates are screened and removed (both
53 electronically and manually) the titles, abstracts, and summaries of the remaining articles will be
54 screened against the set eligibility criteria by two authors (TH and MC) independently. The reason for
55 excluding each article will be recorded. Any articles with yes/yes or yes/maybe will be advanced to
56 full-text review. Any disagreements will be resolved by another author (RL). Subsequently, the full text
57 versions of the articles will be reviewed by two authors (TH and MC) independently.

Stage 6: Extracting the evidence

The charted data from the included studies will be managed using an Excel spreadsheet. All data will be extracted by two authors (TH and MC) independently, and then agreed and merged. Disagreements will be resolved by RL. The data extraction sheet will include as a minimum the following information: source ID, full citations, authors' names, title and a year of publications, name of a journal, publication type, study purpose(s), study design, sample size, types of AI being discussed, the healthcare context, the relevant stakeholders, management-related benefits and challenges, management recommendations, and reviewers' notes.

Stage 7: Charting the evidence, and summarising the evidence in relation to the objectives and questions

To synthesise the results of this review, a narrative synthesis approach will be adopted in accordance with the "Guidance on the Conduct of Narrative Synthesis in Systematic Reviews" and the JBI guidelines. Firstly, preliminary synthesis of the findings will be conducted to identify various patterns across included articles while taking into account the chosen theoretical frameworks. Secondly, a thematic analysis, the findings will be analysed by following the six-phase thematic analysis framework developed by Braun and Clarke. [36] These six stages comprise familiarisation with the extracted data, generation of initial codes, identifying and reviewing themes, naming themes and writing-up the results.

LIMITATIONS

Some of the limitations of this study are related to the nature of scoping reviews which use secondary data and are prone to subjectivity and bias in selection and analysis of primary sources. The authors plan to use the results of this study as a basis for an extended programme of research that will include primary data collection from relevant stakeholders. The intent is also to reduce the potential for subjectivity and bias by involving all three authors in the review process. Moreover, it is expected that different background of the authors (psychology, healthcare management, operational research, computer science) will provide additional lenses for analysing data and synthesising the results. Finally, while the scope of the review is healthcare in general, the authors recognise that the results will need to be contextualised within specific healthcare services and functions.

DISCUSSION

It is a statement of the obvious that the benefits and capabilities that AI can provide in the context of healthcare are tremendous. However, given that the various AI based technologies and tools are developing rapidly, the key task is to ensure that healthcare organisations and other relevant bodies have the necessary strategies and plans to support AI applications and the right infrastructure to facilitate a seamless implementation. Achieving these objectives requires a holistic approach, which goes beyond the technical aspects of AI to include the social, economic, and managerial factors influencing its adoption and integration. On that basis, it is important to map out the views of the relevant stakeholders on these factors to shed light on how the technology may smoothly fit into healthcare systems and become part of the routine and activities of healthcare services.

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5 **ETHICS AND DISSEMINATION**
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7 Ethics approval will not be sought for this scoping review as it will only include information from the
8 previously published studies. The results of study will be disseminated through publication in a peer-
9 reviewed journal. In addition, to ensure that its findings reach the relevant stakeholders and wider
10 academic and non-academic communities, they will be presented at relevant conferences.
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STUDY STATUS

The review is ongoing and is expected to be completed by the end of 2020.

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None declared.

PATIENT CONSENT

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Appendix 1

Prisma-ScR Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Page 2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Page 5
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Page 5
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	N/A
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Page 7
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Page 8
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Page 14

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Page 8
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Page 8
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	N/A
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	N/A
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Page 9
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	N/A
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	N/A
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	N/A
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	N/A
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	N/A
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions	N/A

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
		and objectives, and consider the relevance to key groups.	
Limitations	20	Discuss the limitations of the scoping review process.	Page 9
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	N/A
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Page 13

Appendix 2

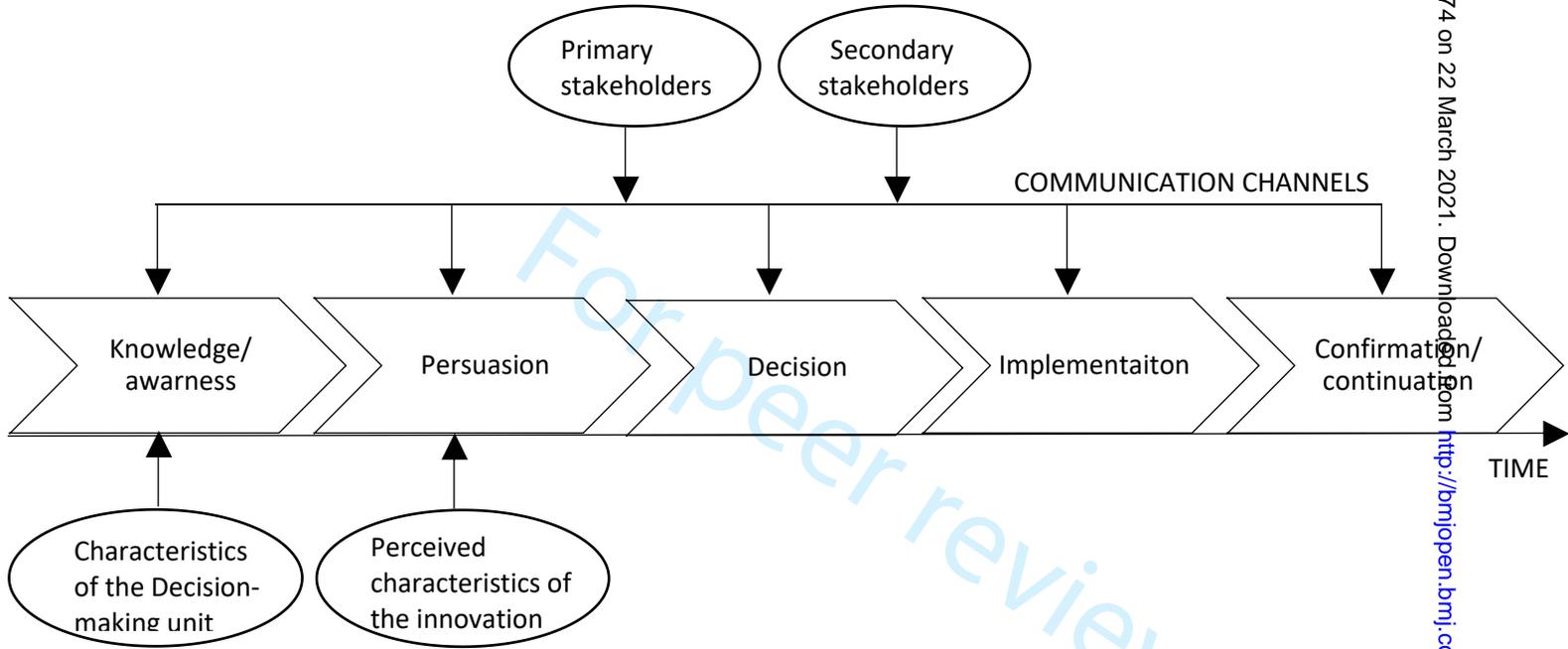
Proposed Initial Strategy Developed for PubMed

Concept	Selected keywords combinations
Artificial Intelligence	(Artificial Intelligence OR Expert system* OR Fuzzy logic OR Machine learning OR Genetic algorithm* OR Support Vector Machine OR SVM OR Natural Language Processing OR NLP OR Neural Network* OR ANN OR Backpropagation OR Convolutional Network* OR CNN OR Deep Learning OR Representation Learning OR Feature learning OR Supervised Learning OR Unsupervised Learning OR reinforcement learning OR Automated Reasoning OR Data Mining OR Big Data OR Bayes* Network* OR Computer Vision OR Image Recognition OR Fac* Recognition OR Gesture Recognition OR Visual Search OR Voice Recognition OR Semantic Search OR Semantic Web OR CLAM OR Robot* OR RPA OR Chat*bot OR intelligent agent OR conversational agent OR Virtual Assistant OR Automatic Diagnostic System* OR Computer-aided detection OR CAD OR SAR OR RAS OR da*Vinci) TI, AB.
Perceptions / Views	(perception* OR perceiv* OR expect* OR perspective* OR experienc* OR attitude* OR view* OR survey OR interview OR focus group OR expert panel OR observ* OR inquiry OR qualitative OR narrative OR ethnograph*) TI, AB
Management-related Issues	(manage* OR cost OR budget* OR schedule* OR resource* OR benefit* OR risk* OR mitigate* OR change OR quality OR assurance OR requirement* OR scope OR efficien* OR performance OR metric OR critical OR stakeholder* OR user OR client OR provider OR supplier OR sponsor* OR leader* OR procurement OR integration OR team* OR communicat* OR collaborat* OR coordinat* OR relation* OR organis* OR process* OR procedur* OR method* OR path* OR operation* OR decision OR opportunity OR problem*solving OR strateg* OR project OR programme OR portfolio OR product OR service OR supply*chain OR sustainab* OR accountab* OR legal* OR privacy OR confidential* OR safety OR security OR employment OR discrimination OR fairness OR workforce OR contract* OR ethic* OR trust OR recruit*) TI, AB
Healthcare	delivery of health care [MeSH Terms]

Search Strategy:

1. All four concepts' keywords will be combined with AND.
1. Date range: 2000/01/01 - 2020/08/01
2. English only

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BMJ Open

Stakeholders' views on the organisational factors affecting application of Artificial Intelligence in healthcare: a scoping review protocol

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Primary Subject Heading:	Health policy
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3 **Title: Stakeholders' views on the organisational factors affecting application of Artificial Intelligence**
4 **in healthcare: a scoping review protocol**
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ABSTRACT

Introduction

Artificial Intelligence (AI) offers great potential for transforming healthcare delivery leading to better patient-outcomes and more efficient care delivery. However, despite these advantages, integration of AI in healthcare has not kept pace with technological advancements. Previous research indicates the importance of understanding various organisational factors that shape integration of new technologies in healthcare. Therefore, the aim of this study is to provide an overview of the existing organisational factors influencing adoption of AI in healthcare from the perspectives of different relevant stakeholders. By conducting this review, the various organisational factors that facilitate or hinder AI implementation in healthcare could be identified.

Methods and analysis

This study will follow the Joanna Briggs Institute framework, which includes the following stages: (1) defining and aligning objectives and questions, (2) developing and aligning the inclusions criteria with objectives and questions, (3) describing the planned approach to evidence searching and selection, (4) searching for the evidence, (5) selecting the evidence, (6) extracting the evidence, (7) charting the evidence, and summarising the evidence with regard to the objectives and questions.

The databases searched will be MEDLINE (Ovid), CINAHL (Plus), PubMed, Cochrane Library, Scopus, MathSciNet, NICE Evidence, OpenGrey, O'REILLY, and Social Care Online from January 2000 to June 2021. Search results will be reported based on The Preferred Reporting Items for Systematic Reviews and Meta-Analysis extension for scoping reviews guidelines. The review will adopt Diffusion of Innovations theory, Technology Acceptance Model, and Stakeholder theory as guiding conceptual models. Narrative synthesis will be used to integrate the findings.

Ethics and dissemination

Ethics approval will not be sought for this scoping review as it only includes information from previously published studies. The results will be disseminated through publication in a peer-reviewed journal. In addition, to ensure its findings reach relevant stakeholders, they will be presented at relevant conferences.

ARTICLE SUMMARY

Strength and limitations of this study

- This will be the first scoping review to map out the organisational barriers and facilitators in application of AI in healthcare from the key stakeholders' perspectives.
- The findings will be limited to what is reported in peer-reviewed published literature, therefore, the authors aim to conduct a follow-up primary research to include more data sources.
- The proposed scope may exclude some other relevant aspects in application of AI in healthcare.
- While the scope of this review is focused on the organisational issues related to AI implementation in the healthcare sector, the authors recognise that the findings will further need to be contextualised within a specific healthcare environment.

INTRODUCTION

Artificial Intelligence (AI) is a general term used to describe computing technologies, which perform functions that aim to reproduce the capabilities of human mind such as reasoning, learning, adaptation, sensory cognition, and creativity. [1] Rapid technological advances in the last decade broadened the portfolio of AI based tools and widened their areas of applications. The use of AI in the healthcare sector is gradually increasing and expanding into areas such as medical diagnostics and treatment (e.g. disease diagnosis, medical imaging, robot-assisted surgery), management and decision making (e.g. design of patients' pathways, allocation of resources), public health and epidemiology (e.g. predictions about the likelihood of an infectious disease outbreak and its dynamics, risk factors for non-communicable diseases), patient care (e.g. personalised health advice, remote diagnosis, patients' monitoring), elderly care (e.g. healthcare robots assisting older adults at care homes) and many more. [1-4]

Despite the growing use of AI in healthcare and its potential to transform patients' experience and quality of care, there is emerging evidence that the integration of AI based tools has not been happening as quickly as the technology has been advancing. [5] Quite often AI developers and software vendors are held responsible for failures in AI implementation due to their inability to deliver reliable products. [6,7] However, previous studies suggest that technical factors can only explain up to 20% of AI failures, while most of the unsuccessful cases are directly linked to the lack of socio-technical consideration. [8-10] This means that failures in the introduction of AI should be considered not just as a problem in technology, but also as a problem in organisational change.

Consequently, there is a growing body of research suggesting that to accelerate the integration of AI based tools in healthcare organisations, the interactions between an innovation and the complex organisational setting and factors must be taken into a consideration. Organisational factors can be thought of as conditions, strategies, operational attributes and processes, which may hinder or facilitate the use of AI in a healthcare organisation. [11] These factors can also include administrative support, procurement, training, communication and coordination mechanisms, team resources and many more. [11,12] Although a little is known about the organisational changes required to enhance AI adoption, there is a growing body of research suggesting that this issue should be given more attention. [13,14] For example, some studies reported that healthcare workers may be resistant to accept a new advanced technology as it may change work processes and routines, which can consequently result in a heavier workload. [15,16] There is also evidence suggesting that in order to incentivise healthcare workers to use AI, a review of current payment systems should be conducted. [17] The authors jointly concluded that adequate funding would overall incentivise healthcare organisations as the introduction of AI requires significant financial expenditures and changes to operational processes. [3,10,17,18] Another reported organisational issue is related to a perceived loss of clinician control and autonomy, as some healthcare workers are concerned that policymakers, insurers and administrators may use technology as a way to influence clinical decision-making and actions. [18] Some studies also reported that the absence of a clear legal framework and relevant policy developments, especially when it comes to data protection and accountability for the care outcomes, can serve as potential organisational barriers for successful adoption of AI. [19,20] Finally, one of the most commonly reported issues affecting AI adoption is training and competencies of healthcare workers as the end-users. [21,22] Some studies advised that such factors like too long or

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3 too short training requirements, [21] the lack of an AI champion [23] and the lack of user involvement
4 during system design [22] can make healthcare workers feel less comfortable using AI based tools.

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6 It is evident that AI has a potential to transfer the overall healthcare system, which indicates that a
7 holistic approach should be taken when implementing new advanced technologies incorporating
8 different organisational management perspectives and knowledge from cognate disciplines. Given
9 that healthcare organisations comprise many professional subgroups and power structures, it is
10 important that all the relevant stakeholders, who are either direct (e.g. utilising AI as part of a medical
11 treatment) or indirect (e.g., managing a surgery/ hospital where AI is used) users of AI, have a shared
12 vision on its usage in healthcare. In addition, these stakeholder groups should also include those
13 professionals, who support AI implementation on different levels (policymakers, AI experts, health
14 managers, etc.). This means that AI implementation should be considered as a multidisciplinary
15 process and engage various clinical teams, healthcare managers, AI experts, policy makers and other
16 stakeholders to enhance its successful adoption. Therefore, the aim of the scoping review is to assess
17 the state of the literature regarding the stakeholders' views on the organisational factors influencing
18 AI adoption in healthcare, to inform future research agenda in this area and provide further evidence
19 to facilitate a smooth integration of the technology in the sector.
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25 STUDY RATIONALE

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27 As previously mentioned, various stakeholders influence adoption and implementation of AI in
28 healthcare including health workers, AI experts, pharmaceutical companies, legislative, regulatory,
29 government and public sector bodies. These stakeholders have different and sometimes conflicting
30 interests and perceptions on the benefits, risks, opportunities, and limitations of integrating AI in
31 healthcare. [3,9] There have been several scoping and systematic reviews capturing these various
32 stakeholders' perspectives on implementing AI in healthcare, [2,3,9] but they are mostly focusing on
33 clinical outcomes and individual factors shaping AI adoption. However, none of these reviews focused
34 on wider organisational factors that can facilitate or hinder successful implementation of AI in the
35 sector. Therefore, it is essential to map out the perspectives of the relevant stakeholders on the
36 organisational factors affecting AI implementation in healthcare from the existing primary studies to
37 identify how it works, for whom and under which circumstances.
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42 STUDY OBJECTIVE

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44 This study will provide an overview of the perspectives of different relevant stakeholders on the
45 existing organisational barriers and facilitators in application of AI in healthcare. By conducting this
46 review, we aim to identify the various organisational factors that may enhance AI implementation and
47 usage in the healthcare sector.
48

49 METHODS AND ANALYSIS

50 Theoretical frameworks

51
52 In order to support data analysis, categorisation and synthesis of the results, this scoping review will
53 adopt the Diffusion of Innovations theory (DoI) [24] as a guiding conceptual framework. DoI has been
54 previously successfully employed to predict how individuals make decisions to adopt a new innovation
55 by exploring their adoption patterns and its structure. [25,26] Broadly speaking, this theory can help
56 understand why some new technologies spread faster and wider than others while taking into a
57 consideration not just individual level, but also team and organisational. [27] Rogers defined diffusion
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3 of innovation as a process by which a new innovation is communicated through certain channels over
4 time among the members of a social system and highlighted that adoption of an innovation should be
5 considered as a social process. [28] This social process, or the innovation-decision process, comprises
6 of five stages (see Figure 1), which are: i) knowledge: individuals or adoption units gain the first
7 knowledge of an innovation; ii) persuasion: individuals or adoption units form an attitude towards the
8 innovation; iii) decision: individuals/adoption units make a decision on whether to adopt or reject an
9 innovation; iv) implementation: an innovation is implemented by individuals / adoption units (which
10 can also be considered as a trial); and finally v) confirmation: individuals / adoption units verify their
11 decision to adopt or reject an innovation. The process is influenced by the characteristics of the
12 organisation (or decision-making unit) including socioeconomic characteristics, personality variables
13 and communication behaviours, as well as by the perceived characteristics of the innovation such as
14 relative advantage, compatibility, complexity, trialability and observability.

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19 [Insert Figure 1 here]

20
21 Figure 1: Integrated theoretical framework (adapted from Rogers [24])

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23 According to Rogers, the first two stages of “knowledge” and “persuasion” are the most critical
24 elements in the innovation-decision process as at these stages, individuals (adopters) and/or decision-
25 making units weight the advantages and disadvantages of a new innovation to reduce uncertainty
26 about its usage. [24] This is why as part of this guiding conceptual framework we will also incorporate
27 Technology Acceptance Model (TAM) [29] which focuses on two key factors influencing individuals’
28 decision about using a new innovation: Perceived Usefulness (PU) and Perceived Ease-of-Use (PEU).
29 The PU can be defined as “the degree to which a person believes that using a particular system would
30 enhance his or her job performance” and the PEU as “the degree to which a person believes that using
31 a particular system would be free from effort”. [30] Integrating both of these theories will not only
32 help explore the specific organisational issues of adopting and implementing AI (by using DIT) but also
33 explain the stakeholders’ general perception towards AI use in the healthcare context (by using TAM).

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38 Lastly, given that we aim to map out organisational factors affecting AI implementation in healthcare
39 through the lens of the relevant stakeholders’ perspectives, we will also incorporate the stakeholder
40 theory. [31] Stakeholder theory provides an alternative to a traditional input/output view of an
41 organisation and it considers the interests of all stakeholders to be of intrinsic value. In its normative
42 form [32] it serves to identify different individuals or groups who have legitimate interest in procedural
43 and/or substantive aspects of organisational activity. In the healthcare domain, stakeholders can be
44 defined as “any person or group of people who have a significant interest in services provided, or will
45 be affected by, any planned changes in an organisation or local health community”. [33] Clarkson [34]
46 advised that in the context of organisational management, it is useful to distinguish between primary
47 and secondary stakeholders: primary (or participant stakeholders) are the one without whose direct
48 participation the organisation cannot survive, and secondary (or non-participant stakeholders) are
49 those who influence (or can be influenced by) organisation) without directly participating in its
50 transactions. [35] Stakeholder theory can be linked with the DoI which assumes that there are
51 different types of “users” who are involved at the process of technology adoption at various stages.
52 [36] Stakeholder theory expands the notion of a “user” to all individual or organisations that might
53 have an impact or be impacted by the introduction of the innovation.

Protocol design

This study will follow the methodological framework suggested by the Joanna Briggs Institute (JBI), [37] which comprises of the following stages: (1) defining and aligning the objectives and questions, (2) developing and aligning the inclusions criteria with the objectives and questions, (3) describing the planned approach to evidence searching and selection, (4) searching for the evidence, (5) selecting the evidence, (6) extracting the evidence, (7) charting the evidence, and summarising the evidence in relation to the objectives and questions. Throughout the process, feedback will be sought from the Life and Medical sciences librarian as well as a medical expert with a related background when required. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) extension for scoping reviews guidelines (PRISMA-ScR) [38] have been followed to ensure that the structure and content of this protocol comprise all the required elements, which is provided in online supplementary appendix 1.

Stage 1: Defining and aligning the objective(s) and question(s)

Both the objective of this scoping review and research questions were developed using the PCC mnemonic (P = Population, C = Concept, C = Context) where possible. The population of interest will be any relevant stakeholders who have had experience of directly (e.g., utilising AI as part of a medical treatment) or indirectly (e.g., managing a surgery/ hospital where AI is used) employing AI in the context of healthcare. We do not have predefined groups of the relevant stakeholders as these will be mapped as part of this scoping review, however, it is expected that these will be comprised of health workers, health managers and decision makers, and AI experts. [39] The following four broad groupings proposed by the World Health Organisation classification of health workers [40] will be used: *health professionals* (i.e. those, who study, advise on or provide preventive, curative, rehabilitative and promotional health services based on an extensive body of theoretical and factual knowledge), *health associate professionals* (i.e. those who perform technical and practical tasks to support the healthcare delivery), *personal care workers in health services* (i.e. those who provide direct personal care services in health care and residential settings), and *health management and support personnel* (i.e. those who form management and support personnel including a wide range of other types of health systems personnel, such as health service managers, health economists, health policy lawyers, biomedical engineers etc.). As for the concept of interest, any types and subfields of AI employed in healthcare will be considered as this area is currently emerging. Lastly, the context of interest in this study is the general context of healthcare. Based on the objective of the scoping review, we will aim to answer the following primary research question (RQ1) "What are the stakeholders' perspectives on the organisational issues in application of AI in healthcare?". In addition, three secondary research questions will be used to guide this scoping review: (RQ2) "What organisational factors might facilitate or hinder application of AI in healthcare?", (RQ3) "How converging or diverging are the perspectives of different types of stakeholders on application of AI in healthcare?", and (RQ4) "How similar or dissimilar are stakeholders' perceptions on AI adoption across different healthcare services and functions?".

Stage 2: Developing and aligning the inclusion criteria with the objectives and questions

To identify and refine eligibility criteria as well as formulate the search strategy and search terms, an initial limited search of two appropriate online databases (PubMed and MEDLINE[Ovid]) will be conducted to explore what keywords / index terms are used in the abstracts of the retrieved papers.

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3 After that, a preliminary search strategy was developed with the help of a University librarian and in
4 conjunction with topic area knowledge as well as discussion amongst the authors of this scoping
5 review. The preliminary search strategy is shown in online supplementary appendix 2.
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8 The initial search will be limited to studies that are meeting all three PCC criteria and explore the views
9 / perspectives of the relevant stakeholders on AI use in healthcare only. The type of studies that will
10 be included are any primary research studies, which were published in peer-review journals and
11 written in English. Publication date will be limited to dates between 01 January 2000 and 31 June 2021
12 to include studies that focus on the use of contemporary data-driven AI based on machine-learning
13 techniques as opposed to more traditional rule-based AI (e.g. Expert Systems). Studies reporting only
14 clinical outcomes of using AI in healthcare without taking into a consideration any organisational
15 issues will be excluded from the review. In addition, studies exploring the use of “ordinary” computer
16 systems and / or any other non-AI based technologies in healthcare will also be considered as
17 ineligible. Lastly, we will exclude studies focusing only on technical aspects of using a particular type
18 of AI in healthcare (e.g. performance improvements of the AI algorithms).
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22 Stage 3: Describing the planned approach to evidence searching and selection

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24 Before commencing the literature search, a pilot search will be performed, and the first 30 documents
25 will be screened on the two online data bases (PubMed and MEDLINE[Ovid]). Two researchers will
26 independently screen the titles and abstracts against the eligibility criteria. Any disagreements will be
27 then discussed by the authors, and if the agreement cannot be reached the opinion of the third author
28 will be sought. The authors will then screen three randomly selected full texts of the eligible articles
29 to pilot-test data extraction and agree on the charting form. Once the data extraction form is refined,
30 the new five randomly selected papers will be reviewed by all three authors to compare and discuss
31 the captured information following the recommendations of Valaitis et al. [41] To assess the level of
32 agreement between the reviewers, inter-rater reliability will be calculated using Cohen’s kappa to
33 iteratively calibrate and refine the process. Overall, this approach will enable the review team to
34 become familiar with the scoping review protocol and minimise the effect of reporting bias. [42] In
35 addition, it will help ensure that the eligibility criteria are feasible and used by the authors in a
36 consistent manner.
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42 Stage 4: Searching for the evidence

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44 Following the recommendations of the JBI, [43] the literature search will comprise three steps. During
45 the first step, all the previously selected keywords will be augmented to formulate a comprehensive
46 search strategy. The second step will comprise of creating search strings according to the
47 requirements of the databases using Medical Subject Heading (MeSH) terms, Boolean operators, as
48 well as date and language limiters as search filters. The databases that will be searched are MEDLINE
49 (Ovid), CINAHL (Plus), PubMed, Cochrane Library, Scopus, MathSciNet, NICE Evidence, OpenGrey,
50 O’REILLY, and Social Care Online. During the final third step, manual search of the reference lists of all
51 the selected papers for full-text review will be conducted in order to identify more relevant studies.
52 The PRISMA flow diagram will be used to record how many studies are included / excluded at each
53 stage of the search process and from what databases. [44]
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Stage 5: Selecting the evidence

All the search results will be imported onto EndNote bibliographic software (V.9, Clarivate Analytics, Philadelphia, Pennsylvania, USA) and merged. Once the duplicates are screened and removed (both electronically and manually) the titles, abstracts, and summaries of the remaining articles will be screened against the set eligibility criteria by two independent researchers (R1 and R2). The reason for excluding each article will be recorded. Any articles with yes/yes or yes/maybe will be advanced to full-text review. Any disagreements will be resolved by the third researcher (R3). Subsequently, the full text versions of the articles will be reviewed by the researchers R1 and R2 independently.

Stage 6: Extracting the evidence

The charted data from the included studies will be managed using an Excel spreadsheet. All data will be extracted by the researchers R1 and R2 independently, and then agreed and merged. Disagreements will be resolved by the researcher R3. The data extraction sheet will include as a minimum the following information: source ID, full citations, authors' names, title and a year of publications, name of a journal, publication type, study purpose(s), study design, sample size, types of AI being discussed, the healthcare context, the relevant stakeholders, organisational barriers and facilitators, recommendations for organisational change, and reviewers' notes.

Stage 7: Charting the evidence, and summarising the evidence in relation to the objectives and questions

To synthesise the results of this review, a narrative synthesis approach will be adopted in accordance with the "Guidance on the Conduct of Narrative Synthesis in Systematic Reviews" and the JBI guidelines. Firstly, preliminary synthesis of the findings will be conducted to identify various patterns across included articles while taking into account the chosen theoretical frameworks. Secondly, a thematic analysis, the findings will be analysed by following the six-phase thematic analysis framework developed by Braun and Clarke. [45] These six stages comprise familiarisation with the extracted data, generation of initial codes, identifying and reviewing themes, naming themes and writing-up the results.

Patient and Public Involvement

No patient involved

LIMITATIONS

Some of the limitations of this study are related to the nature of scoping reviews, which use secondary data and are prone to subjectivity and bias in selection and analysis of primary sources. The authors plan to use the results of this study as a basis for an extended programme of research that will include primary data collection from relevant stakeholders. The intent is also to reduce the potential for subjectivity and bias by involving all three authors in the review process. Moreover, it is expected that different background of the authors (psychology, healthcare management, operational research, computer science) will provide additional lenses for analysing data and synthesising the results. Finally, while the scope of the review is healthcare in general, the authors recognise that the results will need to be contextualised within specific healthcare services and functions.

DISCUSSION

Various AI based technologies and tools are developing rapidly with many being introduced and deployed in healthcare organisations. Consequently, healthcare organisations need to put in place the necessary strategies and plans to support AI applications and the right infrastructure to facilitate a seamless AI implementation in order to benefit from the technologies. Achieving these objectives requires a holistic approach, which goes beyond the technical aspects of AI to include the organisational management factors influencing its adoption and integration. On that basis, it is important to map out the views of the relevant stakeholders on the organisational consequences of implementing AI to get the understanding of how they react to new advanced technologies, as well as to shed light on how the technology may smoothly fit into healthcare systems and become part of the routine and activities of healthcare services.

ETHICS AND DISSEMINATION

Ethics approval will not be sought for this scoping review as it will only include information from the previously published studies. The results of study will be disseminated through publication in a peer-reviewed journal. In addition, to ensure that its findings reach the relevant stakeholders and wider academic and non-academic communities, they will be presented at relevant conferences.

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STUDY STATUS

The review is ongoing and is expected to be completed by the end of 2021. The authors have now completed Stage 3 “Describing the planned approach to evidence searching and selection” and started Stage 4 “Searching for the evidence” of the protocol design.

ACKNOWLEDGEMENTS

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CONTRIBUTORS: The study was initiated by RL. The topic was selected after discussion and consensus between all team members (RL, TH, RA, MC). The protocol was drafted by TH, with inputs from all team members. The search strategy was developed by MC and TH. The initial search was developed by TH. All authors (RL, TH, RA, MC) contributed to the writing of the paper.

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COMPETING INTERESTS

None declared.

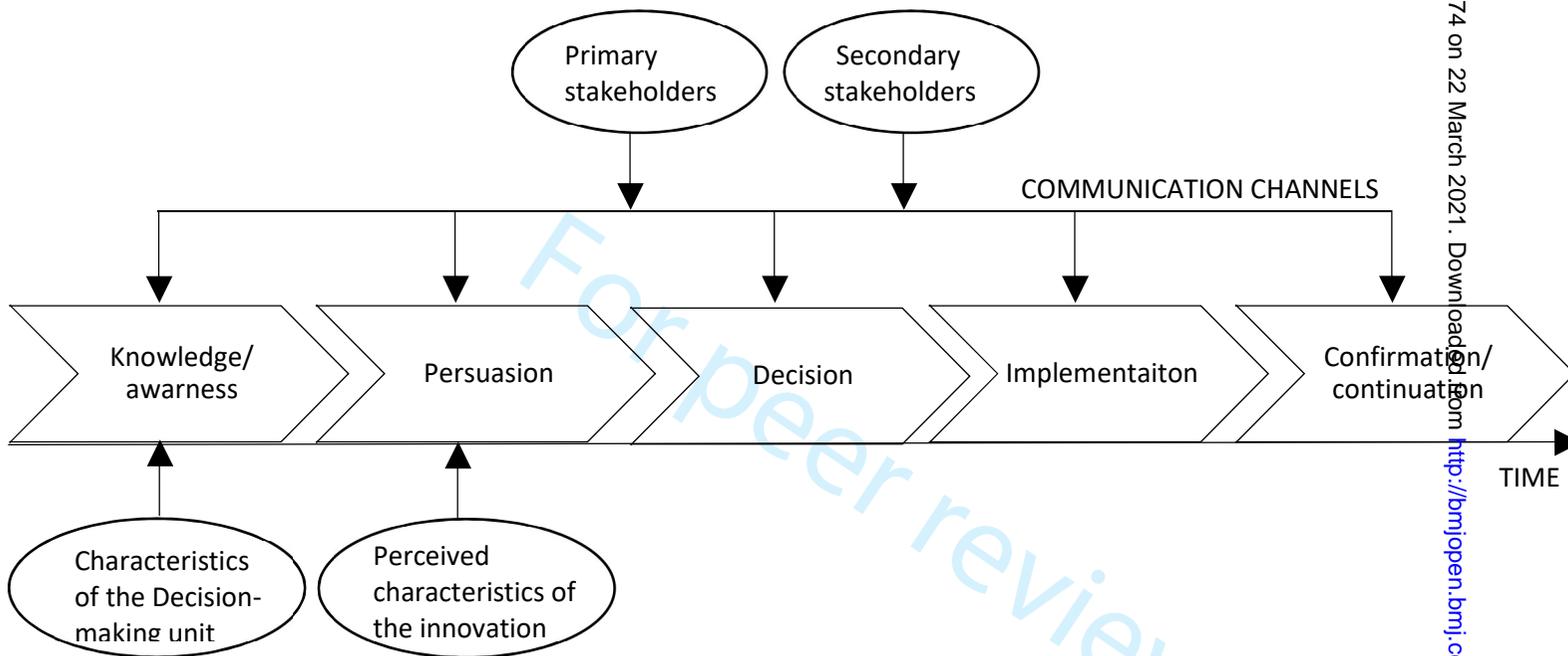
PATIENT CONSENT

Not required as no patients were involved in this research.

PROVENANCE AND PEER REVIEW

Not commissioned; externally peer reviewed.

WORD COUNT: 3942 words



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Appendix 1

Prisma-ScR Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Page 2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Page 5
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Page 5
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	N/A
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Page 7
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Page 8
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Page 14
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Page 8

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Page 8
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	N/A
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	N/A
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Page 9
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	N/A
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	N/A
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	N/A
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	N/A
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	N/A
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	N/A
Limitations	20	Discuss the limitations of the scoping review process.	Page 9

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	N/A
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Page 13

For peer review only

Appendix 2

Proposed Initial Strategy Developed for PubMed

Concept	Selected keywords combinations
Artificial Intelligence	(Artificial Intelligence OR Expert system* OR Fuzzy logic OR Machine learning OR Genetic algorithm* OR Support Vector Machine OR SVM OR Natural Language Processing OR NLP OR Neural Network* OR ANN OR Backpropagation OR Convolutional Network* OR CNN OR Deep Learning OR Representation Learning OR Feature learning OR Supervised Learning OR Unsupervised Learning OR reinforcement learning OR Automated Reasoning OR Data Mining OR Big Data OR Bayes* Network* OR Computer Vision OR Image Recognition OR Face Recognition OR Gesture Recognition OR Visual Search OR Voice Recognition OR Semantic Search OR Semantic Web OR LAM OR Robot* OR RPA OR Chat*bot OR intelligent agent OR conversational agent OR Virtual Assistant OR Automatic Diagnostic System* OR Computer-aided detection OR CAD OR SAR OR RAS OR da*Vinci) TI, AB.
Perceptions / Views	(perception* OR perceived* OR expect* OR perspective* OR experience* OR attitude* OR view* OR survey OR interview OR focus group OR expert panel OR observed* OR inquiry OR qualitative OR narrative OR ethnography*) TI, AB
Organisational Factors	(manage* OR cost OR budget* OR schedule* OR resource* OR benefit* OR risk* OR mitigate* OR change OR quality OR assurance OR requirement* OR scope OR efficient* OR performance OR metric OR critical OR stakeholder* OR user OR client OR provider OR supplier OR sponsor* OR leader* OR procurement OR integration OR team* OR communication* OR collaboration* OR coordination* OR relation* OR organisation* OR process* OR procedure* OR method* OR path* OR operation* OR decision OR opportunity OR problem*solving OR strategy* OR project OR programme OR portfolio OR product OR service OR supply*chain OR sustainable* OR accountable* OR legal* OR privacy OR confidential* OR safety OR security OR employment OR discrimination OR fairness OR workforce OR contract* OR ethic* OR trust OR recruit*) TI, AB
Healthcare	delivery of health care [MeSH Terms]

Search Strategy:

1. All four concepts' keywords will be combined with AND.
2. Date range: 2000/01/01 - 2021/06/31
3. English only

Appendix 1

Prisma-ScR Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	Page 1
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Page 2
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Page 5
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Page 5
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	N/A
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Page 7
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Page 8
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Page 14

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Page 8
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Page 8
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	N/A
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	N/A
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Page 9
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	N/A
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	N/A
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	N/A
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	N/A
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	N/A
DISCUSSION			

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	N/A
Limitations	20	Discuss the limitations of the scoping review process.	Page 9
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	N/A
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Page 13