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Investigating the use of data-driven artificial intelligence in computerised decision support systems for health and social care: systematic review

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Abstract

Background: There is growing interest in the potential of artificial intelligence (AI) to support decision making in health and social care settings. There is, however currently limited evidence of the effectiveness of these systems.

Aims: To investigate the effectiveness of AI-based computerised decision support (CDS) systems in health and social care settings.

Methods: We conducted a systematic literature review to identify relevant randomised controlled trials (RCTs) conducted between 2013 and 2018. We searched the following databases: MEDLINE, EMBASE, CINAHL, Psychinfo, Web of Science, Cochrane Library, ASSIA, Emerald, Health Business Fulltext Elite, ProQuest Public Health, Social Care Online, and grey literature sources. Search terms were conceptualised into three groups: AI-related terms, CDS-related terms, and terms relating to health and social care. Terms within groups were combined using the Boolean operator OR, and groups were combined using the Boolean operator AND. Two reviewers independently screened studies against the eligibility criteria and then extracted data on eligible studies were extracted by two independent reviewers onto a customised sheet. The quality of studies was assessed through the Critical Appraisal Skills Programme (CASP) Checklist for RCTs. We then conducted an interpretive synthesis.

Findings: We identified 68 hits of which five studies satisfied the inclusion criteria. These studies varied substantially in relation to quality, settings, outcomes and technologies. None of the studies were conducted in social care settings and three RCTs showed no difference in patient outcomes. Of these, one investigated the use of Bayesian triage algorithms on forced expiratory volume in 1 second (FEV1) and health-related quality of life in lung transplant patients, one investigated the effect of image pattern recognition on neonatal development outcomes in pregnant women, and another investigated the effect of the Kalman filter technique for warfarin dosing suggestions on time in therapeutic range.

The remaining two RCTs, investigating computer vision and neural networks on medication adherence and the impact of learning algorithms on assessment time of patients with gestational diabetes, showed statistically significant and clinically important differences to the control groups receiving standard care. However, these studies tended to be of low quality lacking detailed descriptions of methods and only one study used a double-blind design.

Conclusions and implications: The evidence of effectiveness of AI to support decision making in health and social care settings is limited. Two of the trials demonstrated substantial potential health gains, but there were concerns in relation to the quality of these studies. It is unlikely that any single overall

message surrounding effectiveness will emerge – rather effectiveness of interventions is likely to be context specific.

Background

There is now an increasing focus on health information technology (HIT) to improve the quality, safety and efficiency of care, to tackle demographic shifts, variations in the quality of care, and ongoing concerns around safety, and cope with increasing economic pressures.(1) There is a growing empirical evidence base that knowledge-based computerised decision support (CDS), and in particular knowledge-based Clinical Decision Support Systems which form a subcategory of these, have the potential to improve practitioner performance.(2,3) Such technologies commonly draw on an existing knowledge base of existing research evidence and/or guidelines to provide logical reasoning-based expert advice. Knowledge-based CDS is different from data-driven CDS in that it does not involve the creation of new knowledge.

Recent reviews have shown that artificial intelligence (AI) algorithms in digital health interventions can be effective in improving health outcomes across a range of conditions but none has focused on data-driven CDS systems.(4,5) These systems are designed to emulate human performance typically by analysing large complex datasets. There are now over 16 AI-based products approved by the United States (US) Food and Drug Administration (FDA).[1]

There is growing interest from the public, health service providers, policymakers, system vendors, the media and funding bodies, in the potential of CDS linked to data-driven AI-based algorithms as these can help to quantify risk and facilitate human decision making. However, there has to date been no systematic attempt to scope the empirical evidence base in relation to the effectiveness of CDS systems linked to data-driven AI-based algorithms and some have cautioned against the hype associated with AI-based technologies used in healthcare delivery.(6,7)

We aimed to investigate the effectiveness of data-driven AI to support decision making in health and social care settings.

Methods
Design

We undertook a systematic review of published empirical research. The systematic review protocol is registered with the PROSPERO International Prospective Register of Systematic Reviews and reported

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[1] https://medium.com/syncedreview/ai-powered-fda-approved-medical-health-projects-a19aba7c681

using the Preferred Reporting Items for Systematic Reviews and Meta-analysis (PRISMA) guidelines.(8,9)

We used the PICO framework to form the research questions and to focus the literature search (see Table 1).

Table 1: PICO framework for the review

P (Population)	Health and social care users (patients and citizens), health and social care professionals and managers
I (Intervention)	AI-based CDS systems
C (Comparator(s))	Non-AI-based approaches
O (Outcomes)	Practitioner performance Patient, citizen and population outcomes Health system outcomes

Search strategy

We searched the published empirical literature from 2013 until September 2018 for work investigating AI to support decision making in health and social care settings. The start date was chosen as in 2013 IBM's Watson was first used in the medical field demonstrating the potential usefulness of AI algorithms in healthcare.(10)

We searched the following databases: MEDLINE, EMBASE, CINAHL, Psychinfo, Web of Science, Cochrane Library, ASSIA, Emerald, Health Business Fulltext Elite, ProQuest Public Health, Social Care Online, and grey literature sources. Search terms were divided into three groups: AI-related terms, CDS-related terms, and terms relating to health and social care settings. Terms within groups were combined using the Boolean operator OR, and groups were combined using the Boolean operator AND. We applied methodological filters to find randomised controlled trials (RCTs). Search strategies for each database can be viewed in Appendix 1.

Eligibility criteria

Studies were eligible for inclusion if they were conducted in health and social care settings and published in English; if they focused on AI; and if they used technological systems for clinical, managerial and self-management decision making.

Studies were excluded if they were not RCTs or if they fell outside our scope of interest. This included, for example, studies that evaluated technology that is not commonly associated with systems that are

driven by the analysis of patterns and models emerging from very large datasets, and those that did not focus on a combination of CDS and AI.

Study selection

Titles and abstracts of studies identified from the searches were screened by two investigators (MC and SK for abstracts, MC and ZS for full texts), who screened all retrieved potentially eligible studies independently against the above criteria. Any disagreements were resolved by discussion or, if necessary, through arbitration by KC.

Quality assessment and analysis

Formal quality assessment of eligible studies was undertaken independently by two reviewers (MC and ZS) using the Critical Appraisal Skills Programme (CASP) Checklist for RCTs.(11) Disagreements were resolved through discussion or, if necessary, through arbitration by KC.

Data extraction

Data were abstracted onto a customised data extraction sheet in Microsoft Excel by MC and ZS. Data were extracted on: authors, title, journal, year, country, healthcare setting, participant number and type, age, timescale, type of AI, type of decision support, comparator (non-AI/CDS based approaches), health problem/condition, outcomes assessed, impact on practitioner performance, impact on patient outcomes, impact on patient self-management, other estimates of effectiveness, enablers and barriers, reviewer notes, and reviewer interpretation.

Data analysis

A quantitative synthesis was judged to be inappropriate due to the heterogeneity of technologies being assessed and care contexts. Data were therefore descriptively summarised and narratively synthesised. We followed the following steps in conducting an interpretive synthesis of our findings: (1) describing the various functions of technological systems; (2) noting the context of the various studies and settings; (3) summarising evidence of effectiveness; and (4) summarising study quality.

Results

We identified 69 potentially eligible studies. After removing duplicates, we screened 68 abstracts. At screening stage, 31 abstracts were dropped. Most excluded abstracts (n=16) did not include AI. Study protocols (n=10) and non-randomized studies (n=10) were also excluded. We assessed 37 full-text articles for eligibility, from which 32 were excluded. Ineligible articles did not combine AI and CDS

functionality (n=15), did not have AI as their primary focus (n=7), did not have RCT designs (n=6), did not report our outcomes of interest (n=2), or did not have interventions that were data-driven (n=2) were excluded.

Five papers were included in final review (Figure 1). Of these, two were conducted in the US, one in Spain, one in Denmark, and one in the United Kingdom. Two included RCTs were conducted in inpatient settings, two in a home care setting, and one in an outpatient setting. Key characteristics of included studies are summarised in Table 2.

Figure 1: PRISMA folow diagram for screened and included studies

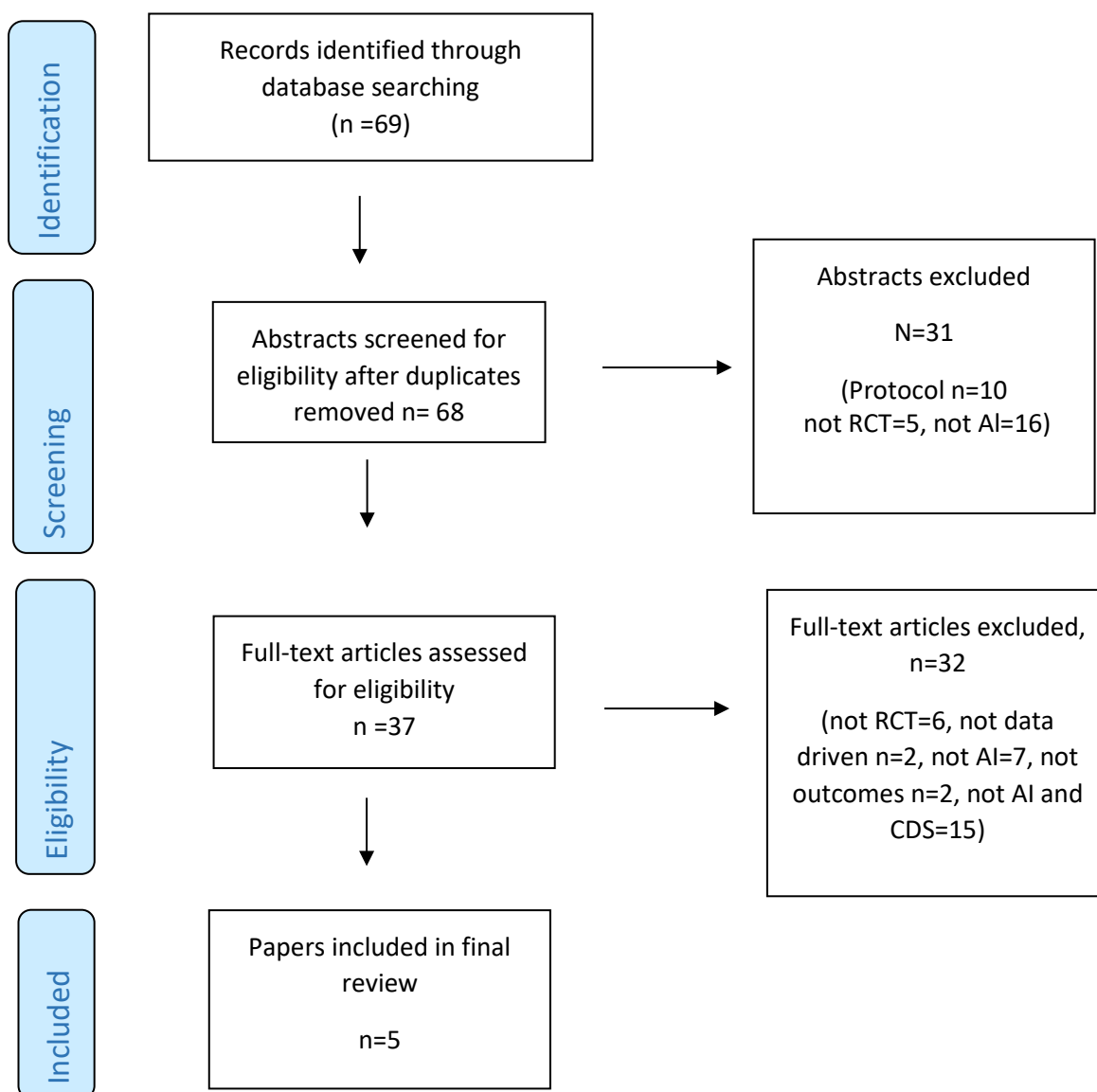|		
Identification	Records identified through database searching (n =69)	
Screening	Abstracts screened for eligibility after duplicates removed n= 68	Abstracts excluded N=31 (Protocol n=10 not RCT=5, not AI=16)
Eligibility	Full-text articles assessed for eligibility n =37	Full-text articles excluded, n=32 (not RCT=6, not data driven n=2, not AI=7, not outcomes n=2, not AI and CDS=15)
Included	Papers included in final review n=5	

Table 2: Characteristics of included studies

Author	Title	Source (Journal)	Year	Country of setting	Healthcare setting	Participant Number and type	Age	Time Scale	Type of AI if include	Type of decision support if included	Comparator (non AI / CDS based approaches)	Health problem / condition	Outcomes assessed	Impact on practitioner performance	Was the AI CDS approach more successful	Impact on patient outcomes	Any impact on patient self-management?	Other estimates of effectiveness	Other enables and barriers
Caballero-Ruiz E, Garcia-Saez G, Rigla M, Villaplana M, Pons B, Hernando ME.	A web-based clinical decision support system for gestational diabetes: Automatic diet prescription and detection of insulin needs.	International Journal of Medical Informatics	2017	Spain	Remote - home	450 Pregnant women	Not stated	17 months	CDS to manage treatment of patients with gestational diabetes through telemedicine	whether patient needed insulin therapy / or patient demonstrate good metabolic control	Standard care	Gestational diabetes managed remotely through telemedicine and patient uploaded data	Access to specialised healthcare assistance, reduce the evaluation time for patients, and avoid gestational diabetes adverse outcomes. Clinical time required per patient number of face to face visits frequen	Assessment time decreased by almost a third. Face to face reduced by 88% but overall time the same, automatic detection of 100% who needed insulin therapy and diet adjustment	Yes	High patient satisfaction (but wasn't compared to a control so basically saying that it is acceptable to patients)	Not explicitly stated but if saves clinical time, saves patient time and travel from fewer visits and effectively is a significant increase in self-management		

													cy and duration of telematic reviews patient compliance to self-monitoring patient satisfaction						
Finkelstein SM, Lindgren BR, Robiner W, Lindquist R, Hertz M, Carlin BP, et al.	A randomized controlled trial comparing health and quality of life of lung transplant recipients following nurse and computer-based triage utilizing home spirometry monitoring. Telemedicine journal	Journal of the American Telemedicine Association	2013	USA	Inpatient	65 lung transplant recipients	37-69	October 2006-April 2009 plus one year follow up		Computer based Bayesian algorithm	Manual nurse decision	Lung transplant	Effectiveness of triaging clinical interventions in lung transplant recipients participating in home monitoring	No differences in outcomes measured. Changes from baseline after year of forced expiratory volume, SF36, QOL	No	No	None	No	

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	and e-health																		
Infant Collaborative Group.	Computerised interpretation of fetal heart rate during labour (INFANT): a randomised controlled trial. (10080): 1719-29.	Lancet. 2017;389 North American Edition	2017	UK and Ireland	Labour Ward	women in labour 35+ weeks gestation having continuous electronic fetal monitoring and number	16 or older	Jan 2010-August 2013	Decision support software	Interpretation of cardiotocographs 'INFANT'	Usual care / no software decision support	Women in labour with continuous electronic fetal monitoring		NA	No difference	No difference in any neonatal outcome of development assessment at age 2	NA	NA	NA

| Labovitz DL, Shafner L, Reyes Gil M, Virmani D, Hanina A. ; a journal of cerebral circulation. 2017;48(5):1416-9. | Using Artificial Intelligence to Reduce the Risk of Nonadherence in Patients on Anticoagulation Therapy | Stroke | 2017 | USA | Outpatient care | 28 adults with recently diagnosed ischemic stroke receiving any anticoagulation | "Adults" but age not specified | 12 week | Computer vision & neural networks | Measuring & increasing medication adherence | No daily monitoring | Ischemic stroke & medication adherence | No primary outcome specified. Outcomes were mean cumulative adherence based on the AI platform and adherence based on plasma concentration levels and pill count. Subgroup analysis was also conducted and the same outcomes were reported for patients who received DOACs. | | Yes | Mean cumulative adherence based on the AI platform was 90.5%. Mean cumulative adherence indicated by plasma drug concentration was 100% for the intervention and 50% for the control group. Mean cumulative adherence indicated by pill count was 97.2% for the intervention and | Requires patients to use the application to visually confirm medication ingestion | | |

																			90.6% for the control group. For patients recceing DOACs, mean cumulative adherence based on the AI platform was 90.1%, mean cumulative adherence indicated by pill count was 96.4% for the intervention and 90.9% for the control group and mean cumulative adherence indicate			

| | | | | | | | | | | | | | | | | | d by plasma drug concentration was 100% for the intervention and 33% for the control. | | |

Author	Title	Journal	Year	Country	Setting	Participants	Age	Enrollment	Intervention						Results				Limitations	
Nielsen PB, Lundbye-Christensen S, van der Male M, Larsen TB.	Using a personalized decision support algorithm for dosing in warfarin treatment: A randomised controlled trial	Clinical Trials and Regulatory Science in Cardiology	2017	Denmark	Home health setting	191 participants	Mean age of 65 years	Patients enrolled from September 2014 to November 2014 and then followed up for at least 90 days with a mean follow up of 140 days	Computerized dosing algorithms for warfarin. If a participant was allocated to intervention, he/she would receive an algorithm-calculated dosage suggestion.	Personalised support for warfarin dosing (Kalman filter technique)	No AI algorithm based support - in contrast, the dosage suggestion in the placebo-arm would equal last week's dose of warfarin.	Eligible participants were patients with an indication for warfarin treatment who were in steady state patient self management (PSM) treatment	No interface with practitioners - this group were on patient self management (PSM) treatment	The intervention arm achieved a TTR of 81.6, while the placebo arm attained a TTR of 80.9 (difference [intervention arm minus placebo arm]: 0.67 (95% confidence interval −2.93 to 4.27)	The number of 'non-compliant' registrations (disagreement with dosage suggestion) was different in the two trial arms, average 15% per participant in the intervention arm and 6% in the placebo arm. Unable	"A secondary study measure was the log-transformed INR variability. This method attempts to describe the degree to which each individual's INR value varies relative to his/hers previous INR	Cannot identify any	No difference between the two trial-arms in a high-quality warfarin treatment setup. However in general, the model performed similarly as to routine patient self-management care.	

| | | | | | | | | | | | | | | | to find clear pattern or reason for this | value. The difference in INR variability was 0.30 (0.14 to 0.47), favouring the placebo arm in terms of lower log transformed variability" | | | |

Variation in study size, technological systems, timescales

We observed substantial variations in the size of studies (from 28 to 47062 participants), technological systems (i.e. type of AI-based CDS) and timescales over which the systems were assessed.(12-16) All included studies focused on specific patient populations (often with long-term conditions), namely: women with gestational diabetes,(12) women in labour,(14), adults with ischemic stroke,(15) thrombosis patients,(16) and lung transplant recipients.(13)

Types of AI facilitated decision support also varied widely. One study assessed learning algorithms to support patient self-management;(12) another study assessed algorithms facilitating automated triaging based on existing datasets;(13) and another study assessed algorithms facilitating the interpretation of fetal cardiotocographs (CTGs) through image pattern recognition.(14) The final two studies assessed the use of neural networks to facilitate medication adherence,(15) and the Kalman filter technique (an algorithm using temporal measurements) to personalise warfarin dosing recommendations for patient self-management.(16)

Three studies investigated decision making in patients,(12,15,16) whereas the others focused on decision making in healthcare professionals.(13,14)

We further found large variations in timescales of studies from 12 weeks to 3.5 years in duration.(14,15)

Patient outcomes needed

In terms of outcomes, studies most frequently assessed impact of the intervention on patient outcomes, but these varied significantly across RCTs due to the differences in study populations. For example, Finkelstein and colleagues assessed forced expiratory volume in 1 second (FEV1) and health-related quality of life in lung transplant patients,(13) whilst others assessed neonatal development outcomes,(14) medication adherence,(15) and time in therapeutic warfarin range.(16) Two studies also assessed impacts on practitioner performance. These were RCTs examining the effectiveness of triaging interventions in lung transplant recipients,(13) and the impact on the clinician assessment time of patients.(12)

Caballero-Ruiz and colleagues applied a learning algorithm to a CDS to manage treatment of patients with gestational diabetes through telemedicine and compared this to standard care.(12) They assessed access to specialised healthcare, evaluation time for patients, adverse gestational diabetes outcomes, clinical time required per patient, number of face-to-face visits, frequency and duration of telematic reviews, patient compliance, and patient satisfaction.

Finkelstein et al investigated the effectiveness of a Bayesian triage algorithm for automated triaging based on analysing data from a home monitoring program in lung transplant patients, and assessed the effectiveness of triaging clinical interventions compared with manual nurse decision.(13)

The INFANT Collaborative Group tested the effectiveness of image pattern recognition in the interpretation of CTGs of women in labour and assessed neonatal outcomes of development at age 2 compared to usual care.(14)

A study conducted by Labovitz and colleagues assessed the effectiveness of computer vision and neural networks in improving medication adherence in patients with ischemic stroke and compared it with no daily monitoring.(15)

The final study conducted by Nielsen and colleagues assessed the effectiveness of an algorithm on warfarin dosing recommendations to patients to prevent thromboembolic events.(16) The control arm included no AI algorithm-based support, with the dosage suggestion equalling the previous week's dose of warfarin.

Quality assessment

The quality of studies was extremely variable. Details of methods were in some instances difficult to find and only one study used a double-blind design.(13) In another study, only patients were blinded,(16) another one used no blinding,(14) and for the remaining two it was unclear whether blinding took place.(12,15) We provide a risk of bias table below (Table 3).

Table 3: Risk of bias table of included studies

Study	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
Caballero-Ruiz et al 2017	Low risk	Low risk	Unclear	Unclear	High risk	High risk	High risk
Finkelstein et al 2013	Low risk	Low risk	Low risk	Unclear	Low risk	Low risk	Low risk

Infant Collaborative Group 2017	Low risk	Low risk	High risk	Unclear	Low risk	Low risk	Low risk
Labovitz et al 2017	Unclear	Low risk	Unclear	Unclear	High risk	Unclear	High risk
Nielsen et al 2017	Low risk	Low risk	Low risk	Unclear	Low risk	Low risk	Low risk

Mixed evidence of effectiveness

Evidence of effectiveness was mixed, with two studies showing no statistically significant difference to the control group,(13,14) and two showing statistically significant and clinically relevant differences between the intervention and the control groups.(12,15,16) Detailed study characteristics and outcomes are provided in Table 2.

One study with high risk of bias, focussing on a learning algorithm to help with managing gestational diabetes reported positive findings. It showed a decrease in assessment time (from 15 minutes in the control group to 2.778 ± 0.858 minutes in the intervention group per patient), and a reduction in face-to-face consultations (3.207 ± 2.846 visits in the control group and 0.367 ± 0.901 in the intervention group).(12) Another study, also with high risk of bias, using computer vision and neural networks reported that the mean cumulative medication adherence indicated by plasma drug concentration was 100% for the intervention and 33% for the control group.(15)

Other RCTs with low risk of bias showed no difference. One trial using a Bayesian algorithm tool for remote monitoring, follow-up and triage of patients after lung transplants, reported no difference in the detection of changes in patients' FEV1 and quality of life between intervention and control groups.(13) Both groups showed non-significantly different decreases over two years, including a 2% FEV1 decrease (p= 0.721) at year 1 and a 3% decrease at year 2 (p= 0.861).

Another trial drawing on image pattern recognition for the computerised interpretation of CTGs during labour did not show an effect on neonatal outcomes.(14) Poor neonatal outcomes were reported in 172 (0.7%) babies in the AI-based CDS group versus 171 (0.7%) in control group.

A third trial showed no difference when comparing personalised algorithm generated warfarin dosing recommendations for thrombosis patients with standard care, showed that the intervention achieved

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a time in therapeutic range of 81.6, while the control group achieved 80.9 (difference: 0.67 (95% confidence interval −2.93 to 4.27).(16)

Discussion

Overall, the evidence of effectiveness of AI to support decision making in health and social care settings is limited. We found a very small number of relevant studies with large variability in quality, settings, outcomes and technologies. No identified studies were conducted in social care settings and none included work investigating any enablers and/or barriers for the use of data-driven AI to support decisions. Three RCTs showed no difference, whereas two showed statistically significant and clinically relevant differences to the control groups.

Strengths and limitations

Our review is a first of type examining the use of data-driven AI to support decision making. However, as we have shown, the number of potentially relevant RCTs is limited, perhaps reflecting the immaturity of the field, but also potentially due to overlapping definitions surrounding CDS and AI. For example, it was at times hard for the research team to distinguish between knowledge-driven and data-driven applications. Moreover, the conclusions that can be drawn from this work are limited as all included studies compared AI-based CDS with standard care. Ideally, the comparison should be AI-enabled CDS versus CDS to see if AI makes a difference to standard knowledge-based CDS.

Integration of findings with the current literature

The lack of eligible studies may call for widening the search criteria to include different methodologies to assess the effectiveness of data-driven AI algorithms to support decision making in health and social care settings.(17)

Nevertheless, despite these perhaps inevitable challenges, we have helped to provide a starting point for work in this area going forward. There is a need to look at potential unintended consequences and challenges associated with novel systems in combination with RCTs.(18) Concurrent qualitative evaluation can help to address some of these issues and also help to identify contextual dynamics and potential reasons for effectiveness (or lack thereof).(19)

It may be that the lack of existing RCTs in the area is due to issues with data access for AI specialists.(20) This may also help to explain the involvement of system developers in 50% of our included studies – they may have had privileged access to data in their systems. The more data algorithms can draw on, the more effective they become, but access to large curated datasets on which algorithms can be trained is currently still hard to achieve.(19,20)

More generally, there is a need to remember that, as in knowledge-driven CDS, the ultimate responsibility of the decision still lies with the human. As such, those at the receiving end of data-driven AI based CDS need to be trained to make decisions informed by these systems. This may require developing new skills and/or ways of considering evidence.(21)

Policy recommendations and implications for practice emerging from this work

Our work may support those cautioning against the assumed effectiveness of AI and the associated hype surrounding these technologies.(7) Policymakers need to be aware that evidence of effectiveness is limited at this stage. In order to address the variability of existing work in this area, strategic decision makers may need to extract key areas of focus for research and innovation within their locales where applications have the greatest potential to meet a major service need and where they are most likely to deliver real impact. Ideally, these should be designed to be comparable in terms of technologies and disease areas, and include qualitative formative evaluation components to capture emerging challenges. The limited details reported in the methods sections of included studies, particularly in relation to AI algorithms, also calls for clearer standards of reporting of studies to ensure rigour and independent assessment of risk of bias.

As the application of AI is gaining momentum, there is likely to be an increasing need for developing associated evaluation frameworks, reporting guidelines and understanding transferability beyond experimental contexts. A focus on unintended consequences, positive or negative, should be fundamental to these efforts.

Conclusions

AI-based data-driven decision making in healthcare settings may have significant potential. Two of the trials included in this work showed substantial gains, but there are concerns in relation to the quality of these studies.

References

1. Black AD, Car J, Pagliari C, Anandan C, Cresswell K, Bokun T, McKinstry B, Procter R, Majeed A, Sheikh A. The impact of eHealth on the quality and safety of health care: a systematic overview. PLoS medicine. 2011 Jan 18;8(1):e1000387.
2. Cresswell K, Majeed A, Bates DW, Sheikh A. Computerised decision support systems for healthcare professionals: an interpretative review. Journal of Innovation in Health Informatics. 2013 Mar 22;20(2):115-28.
3. Kaushal R, Shojania KG, Bates DW. Effects of computerized physician order entry and clinical decision support systems on medication safety: a systematic review. Archives of internal medicine. 2003 Jun 23;163(12):1409-16.
4. Triantafyllidis AK, Tsanas A. Applications of Machine Learning in Real-Life Digital Health Interventions: Review of the Literature. Journal of Medical Internet Research. 2019;21(4):e12286
5. Hosny A, Parmar C, Quackenbush J, Schwartz LH, Aerts HJ. Artificial intelligence in radiology. Nature Reviews Cancer. 2018 May 17:1.
6. Shortliffe EH, Sepúlveda MJ. Clinical decision support in the era of artificial intelligence. Jama. 2018 Dec 4;320(21):2199-200.
7. Academy of Medical Royal Colleges. Artificial Intelligence in healthcare. Available from: http://www.aomrc.org.uk/reports-guidance/artificial-intelligence-in-healthcare/ (last accessed: 15/05/2019).
8. Available from: http://prisma-statement.org/ (last accessed: 28/04/2019).
9. Available from: http://www.crd.york.ac.uk/prospero (last accessed: 28/04/2019).
10. Ferrucci D, Levas A, Bagchi S, Gondek D, Mueller ET. Watson: beyond jeopardy!. Artificial Intelligence. 2013 Jun 1;199:93-105.
11. Higgins JPT, Green S (editors). Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration, 2011. Available from http://handbook.cochrane.org.
12. Caballero-Ruiz E, Garcia-Saez G, Rigla M, Villaplana M, Pons B, Hernando ME. A web-based clinical decision support system for gestational diabetes: Automatic diet prescription and detection of insulin needs. Int J Med Inf. 2017;102:35-49.
13. Finkelstein SM, Lindgren BR, Robiner W, Lindquist R, Hertz M, Carlin BP, et al. A randomized controlled trial comparing health and quality of life of lung transplant recipients following nurse and computer-based triage utilizing home spirometry monitoring. Telemedicine journal and e-health : the official journal of the American Telemedicine Association. 2013;19(12):897-903.
14. Infant Collaborative Group. Computerised interpretation of fetal heart rate during labour (INFANT): a randomised controlled trial. Lancet. 2017;389 North American Edition(10080):1719-29.
15. Labovitz DL, Shafner L, Reyes Gil M, Virmani D, Hanina A. Using Artificial Intelligence to Reduce the Risk of Nonadherence in Patients on Anticoagulation Therapy. Stroke; a journal of cerebral circulation. 2017;48(5):1416-9.
16. Nielsen PB, Lundbye-Christensen S, van der Male M, Larsen TB. Using a personalized decision support algorithm for dosing in warfarin treatment: A randomised controlled trial. Clinical Trials and Regulatory Science in Cardiology. 2017;25:1-6.
17. Lilford RJ, Chilton PJ, Hemming K, Girling AJ, Taylor CA, Barach P. Evaluating policy and service interventions: framework to guide selection and interpretation of study end points. Bmj. 2010 Aug 27;341:c4413.

18. Stefanelli M. The socio-organizational age of artificial intelligence in medicine. Artificial intelligence in medicine. 2001 Aug 1;23(1):25-47.

19. Avery, A.J., Rodgers, S., Cantrill, J.A., Armstrong, S., Cresswell, K., Eden, M., Elliott, R.A., Howard, R., Kendrick, D., Morris, C.J. and Prescott, R.J., 2012. A pharmacist-led information technology intervention for medication errors (PINCER): a multicentre, cluster randomised, controlled trial and cost-effectiveness analysis. The Lancet, 379(9823), pp.1310-1319.

20. Zhou L, Pan S, Wang J, Vasilakos AV. Machine learning on big data: Opportunities and challenges. Neurocomputing. 2017 May 10;237:350-61.

21. Jha S, Topol EJ. Adapting to artificial intelligence: radiologists and pathologists as information specialists. Jama. 2016 Dec 13;316(22):2353-4.

Appendix 1 – Search strategies

Database search record		
Database: e.g. OVIDSP/Medline	**Saved search strategy name**	**Search strategy** (including limits and filters)
Medline	Artificial Intelligence Reviews	1. exp Artificial Intelligence/
		2. (artificial intelligence or AI).tw.
		3. ((comput* or artificial or machine) adj3 intelligence).tw.
		4. exp Machine Learning/
		5. ((machine or artificial or deep) adj3 learning).tw.
		6. exp Algorithms/
		7. algorithm*.tw.
		8. (data driven or data-driven).tw.
		9. (computer adj3 (assist* or generat*)).tw.
		10. neural network*.tw.
		11. perceptron*.tw.
		12. connectionist model.tw.
		13. exp Support Vector Machine/
		14. (support vector adj3 (machine or network*)).tw.
		15. (statistic* adj3 (map* or learn*)).tw.
		16. chatbot*.tw.
		17. Virtual private agent*.tw.
		18. virtual intelligent agent*.tw.

			19. animated character*.tw.
			20. SIRI.tw.
			21. Recommendation system*.tw.
			22. ((image or face or facial) adj3 recogni*).tw.
			23. exp ROBOTICS/
			24. robot*.tw.
			25. (virtual adj3 assistant*).tw.
			26. ((automat* or "computer generated") adj3 decision*).tw.
			27. or/1-26
			28. exp Decision Making/
			29. (decision adj3 (support or making)).tw.
			30. exp Decision Support Techniques/
			31. patient decision aid.tw.
			32. ((practice or decision) adj3 (chang* or alter)).tw.
			33. ((patient or consumer or customer) adj3 (choice* or decision* or decide or choos*)).tw.
			34. ((professional or clinic* or manage* or staff) adj3 (choice* or decision* or decide or choos*)).tw.
			35. or/28-34
			36. meta-analysis/
			37. exp review literature/
			38. (meta-analy$ or meta analy$ or metaanaly$).tw.

			39. meta analysis.pt.
			40. review academic.pt.
			41. review literature.pt.
			42. letter.pt.
			43. review of reported cases.pt.
			44. historical article.pt.
			45. review multicase.pt.
			46. 36 or 37 or 38 or 39 or 40 or 41
			47. 42 or 43 or 44 or 45
			48. 46 not 47
			49. animal/
			50. human/
			51. 49 and 50
			52. 49 not 51
			53. 48 not 52
			54. 27 and 35 and 53
			55. limit 54 to (english language and yr="2013 -Current")
Medline	Artificial Intelligence RCTs		1. exp Artificial Intelligence/
			2. (artificial intelligence or AI).tw.
			3. ((comput* or artificial or machine) adj3 intelligence).tw.
			4. exp Machine Learning/

			5. ((machine or artificial or deep) adj3 learning).tw.
			6. exp Algorithms/
			7. algorithm*.tw.
			8. (data driven or data-driven).tw.
			9. (computer adj3 (assist* or generat*)).tw.
			10. neural network*.tw.
			11. perceptron*.tw.
			12. connectionist model.tw.
			13. exp Support Vector Machine/
			14. (support vector adj3 (machine or network*)).tw.
			15. (statistic* adj3 (map* or learn*)).tw.
			16. chatbot*.tw.
			17. Virtual private agent*.tw.
			18. virtual intelligent agent*.tw.
			19. animated character*.tw.
			20. SIRI.tw.
			21. Recommendation system*.tw.
			22. ((image or face or facial) adj3 recogni*).tw.
			23. exp ROBOTICS/
			24. robot*.tw.
			25. (virtual adj3 assistant*).tw.
			26. ((automat* or "computer generated") adj3 decision*).tw.

			27. or/1-26
			28. exp Decision Making/
			29. (decision adj3 (support or making)).tw.
			30. exp Decision Support Techniques/
			31. patient decision aid.tw.
			32. ((practice or decision) adj3 (chang* or alter)).tw.
			33. ((patient or consumer or customer) adj3 (choice* or decision* or decide or choos*)).tw.
			34. ((professional or clinic* or manage* or staff) adj3 (choice* or decision* or decide or choos*)).tw.
			35. or/28-34
			36. randomized controlled trial.pt.
			37. controlled clinical trial.pt.
			38. randomized controlled trials/
			39. random allocation/
			40. double-blind method/
			41. single-blind method/
			42. 36 or 37 or 38 or 39 or 40 or 41
			43. animal/
			44. human/
			45. 43 and 44
			46. 43 not 45
			47. 42 not 46

			48. 27 and 35 and 47
			49. limit 48 to (english language and yr="2013 -Current")
Embase	Artificial Intelligence Reviews1		1. exp artificial intelligence/
			2. (artificial intelligence or AI).tw.
			3. ((comput* or artificial or machine) adj3 intelligence).tw.
			4. exp machine learning/
			5. ((machine or artificial or deep) adj3 learning).tw.
			6. exp algorithm/
			7. algorithm*.tw.
			8. (data driven or data-driven).tw.
			9. (computer adj3 (assist* or generat*)).tw.
			10. neural network*.tw.
			11. perceptron*.tw.
			12. connectionist model.tw.
			13. exp support vector machine/
			14. (support vector adj3 (machine or network*)).tw.
			15. (statistic* adj3 (map* or learn*)).tw.
			16. chatbot*.tw.
			17. Virtual private agent*.tw.
			18. virtual intelligent agent*.tw.
			19. animated character*.tw.

		20. SIRI.tw.
		21. Recommendation system*.tw.
		22. ((image or face or facial) adj3 recogni*).tw.
		23. exp robotics/
		24. robot*.tw.
		25. (virtual adj3 assistant*).tw.
		26. ((automat* or "computer generated") adj3 decision*).tw.
		27. or/1-26
		28. exp decision making/
		29. (decision adj3 (support or making)).tw.
		30. exp decision support system/
		31. patient decision aid.tw.
		32. ((practice or decision) adj3 (chang* or alter)).tw.
		33. ((patient or consumer or customer) adj3 (choice* or decision* or decide or choos*)).tw.
		34. ((professional or clinic* or manage* or staff) adj3 (choice* or decision* or decide or choos*)).tw.
		35. or/28-34
		36. exp Meta Analysis/
		37. ((meta adj analy$) or metaanalys$).tw.
		38. (systematic adj (review$1 or overview$1)).tw.
		39. or/36-38

			40. cancerlit.ab.
			41. cochrane.ab.
			42. embase.ab.
			43. (psyclit or psychlit).ab.
			44. (psycinfo or psychinfo).ab.
			45. (cinahl or cinhal).ab.
			46. science citation index.ab.
			47. bids.ab.
			48. or/40-47
			49. reference lists.ab.
			50. bibliograph$.ab.
			51. hand-search$.ab.
			52. manual search$.ab.
			53. relevant journals.ab.
			54. or/49-53
			55. data extraction.ab.
			56. selection criteria.ab.
			57. 55 or 56
			58. review.pt.
			59. 57 and 58
			60. letter.pt.
			61. editorial.pt.
			62. animal/

			63. human/
			64. 62 not (62 and 63)
			65. or/60-61,64
			66. 39 or 48 or 54 or 59
			67. 66 not 65
			68. 27 and 35 and 67
			69. limit 68 to (english language and yr="2013 -Current")
Embase	Artificial Intelligence RCTs1		1. exp artificial intelligence/
			2. (artificial intelligence or AI).tw.
			3. ((comput* or artificial or machine) adj3 intelligence).tw.
			4. exp machine learning/
			5. ((machine or artificial or deep) adj3 learning).tw.
			6. exp algorithm/
			7. algorithm*.tw.
			8. (data driven or data-driven).tw.
			9. (computer adj3 (assist* or generat*)).tw.
			10. neural network*.tw.
			11. perceptron*.tw.
			12. connectionist model.tw.
			13. exp support vector machine/
			14. (support vector adj3 (machine or network*)).tw.

			15. (statistic* adj3 (map* or learn*)).tw.
			16. chatbot*.tw.
			17. Virtual private agent*.tw.
			18. virtual intelligent agent*.tw.
			19. animated character*.tw.
			20. SIRI.tw.
			21. Recommendation system*.tw.
			22. ((image or face or facial) adj3 recogni*).tw.
			23. exp robotics/
			24. robot*.tw.
			25. (virtual adj3 assistant*).tw.
			26. ((automat* or "computer generated") adj3 decision*).tw.
			27. or/1-26
			28. exp decision making/
			29. (decision adj3 (support or making)).tw.
			30. exp decision support system/
			31. patient decision aid.tw.
			32. ((practice or decision) adj3 (chang* or alter)).tw.
			33. ((patient or consumer or customer) adj3 (choice* or decision* or decide or choos*)).tw.
			34. ((professional or clinic* or manage* or staff) adj3 (choice* or decision* or decide or choos*)).tw.

			35. or/28-34
			36. Clinical Trial/
			37. Randomized Controlled Trial/
			38. controlled clinical trial/
			39. multicenter study/
			40. Phase 3 clinical trial/
			41. Phase 4 clinical trial/
			42. exp RANDOMIZATION/
			43. Single Blind Procedure/
			44. Double Blind Procedure/
			45. Crossover Procedure/
			46. PLACEBO/
			47. randomi?ed controlled trial$.tw.
			48. rct.tw.
			49. (random$ adj2 allocat$).tw.
			50. single blind$.tw.
			51. double blind$.tw.
			52. ((treble or triple) adj blind$).tw.
			53. placebo$.tw.
			54. Prospective Study/
			55. or/36-54
			56. Case Study/
			57. case report.tw.

			58. abstract report/ or letter/
			59. Conference proceeding.pt.
			60. Conference abstract.pt.
			61. Editorial.pt.
			62. Letter.pt.
			63. Note.pt.
			64. or/56-63
			65. 55 not 64
			66. 27 and 35 and 65
			67. limit 66 to (english language and yr="2013 -Current")
HMIC	Artificial Intelligence		1. exp Artificial intelligence/
			2. (artificial intelligence or AI).tw.
			3. ((comput* or artificial or machine) adj3 intelligence).tw.
			4. Machine Learning.tw.
			5. ((machine or artificial or deep) adj3 learning).tw.
			6. exp Algorithms/
			7. algorithm*.tw.
			8. (data driven or data-driven).tw.
			9. (computer adj3 (assist* or generat*)).tw.
			10. neural network*.tw.
			11. perceptron*.tw.

			12. connectionist model.tw.
			13. (support vector adj3 (machine or network*)).tw.
			14. (statistic* adj3 (map* or learn*)).tw.
			15. chatbot*.tw.
			16. Virtual private agent*.tw.
			17. virtual intelligent agent*.tw.
			18. animated character*.tw.
			19. SIRI.tw.
			20. Recommendation system*.tw.
			21. ((image or face or facial) adj3 recogni*).tw.
			22. robot*.tw.
			23. (virtual adj3 assistant*).tw.
			24. ((automat* or "computer generated") adj3 decision*).tw.
			25. 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24
			26. exp Decision making/
			27. (decision adj3 (support or making)).tw.
			28. patient decision aid.tw.
			29. ((practice or decision) adj3 (chang* or alter)).tw.
			30. ((patient or consumer or customer) adj3 (choice* or decision* or decide or choos*)).tw.

		31. ((professional or clinic* or manage* or staff) adj3 (choice* or decision* or decide or choos*)).tw.
		32. 26 or 27 or 28 or 29 or 30 or 31
		33. 25 and 32
		34. limit 33 to yr="2013 -Current"

CINAHL Artificial Intelligence Reviews

Search Terms	Search Options	Actions
S24	S14 AND S22	**Limiters** - Published Date: 20130101-20181031; English Language; Publication Type: Review **Search modes** - Boolean/Phrase
S23	S14 AND S22	**Search modes** - Boolean/Phrase
S22	S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21	**Search modes** - Boolean/Phrase
S21	TX professional N2 decision OR TX management N2 decision OR TX clinic* N2 decision	**Search modes** - Boolean/Phrase
S20	TX practice N2 chang* OR TX decision N2 chang*	**Search modes** - Boolean/Phrase
S19	TX patient decision aid	**Search modes** - Boolean/Phrase
S18	(MM "Decision Making, Patient")	**Search modes** - Boolean/Phrase
S17	(MM "Decision Support Systems, Clinical") OR (MM "Decision Support Systems, Management") OR (MM "Decision Support Techniques")	**Search modes** - Boolean/Phrase
S16	TX decision N2 support OR TX decision N2 mak*	**Search modes** - Boolean/Phrase

S15	(MM "Decision Making, Computer Assisted") OR (MM "Decision Making") OR (MM "Decision Making, Clinical")	**Search modes** - Boolean/Phrase
S14	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13	**Search modes** - Boolean/Phrase
S13	TX Recommendation system*	**Search modes** - Boolean/Phrase
S12	TX image N2 recognition OR TX fac* N2 recognition	**Search modes** - Boolean/Phrase
S11	TX data driven	**Search modes** - Boolean/Phrase
S10	TX support vector N2 machine	**Search modes** - Boolean/Phrase
S9	TX Virtual private agent* OR TX virtual intelligent agent* OR TX virtual N2 assistant*	**Search modes** - Boolean/Phrase
S8	TX SIRI OR TX chatbot OR TX animated character*	**Search modes** - Boolean/Phrase
S7	TX connectionist model	**Search modes** - Boolean/Phrase
S6	TX perceptron*	**Search modes** - Boolean/Phrase
S5	TX neural network*	**Search modes** - Boolean/Phrase
S4	TX computer N2 assist* OR TX computer N2 generat*	**Search modes** - Boolean/Phrase
S3	TX Machine Learning OR TX computer intelligence OR TX algorithm*	**Search modes** - Boolean/Phrase
S2	TX artificial intelligence	**Search modes** - Boolean/Phrase
S1	(MM "Artificial Intelligence")	**Search modes** - Boolean/Phrase

CINAHL Artificial Intelligence RCTs

Search ID#	Search Terms	Search Options
S24	S14 AND S22	**Limiters** - Published Date: 20130101-20181031; English Language; Randomized Controlled Trials

		Search modes - Boolean/Phrase
S23	S14 AND S22	**Search modes** - Boolean/Phrase
S22	S15 OR S16 OR S17 OR S18 OR S19 OR S20 OR S21	**Search modes** - Boolean/Phrase
S21	TX professional N2 decision OR TX management N2 decision OR TX clinic* N2 decision	**Search modes** - Boolean/Phrase
S20	TX practice N2 chang* OR TX decision N2 chang*	**Search modes** - Boolean/Phrase
S19	TX patient decision aid	**Search modes** - Boolean/Phrase
S18	(MM "Decision Making, Patient")	**Search modes** - Boolean/Phrase
S17	(MM "Decision Support Systems, Clinical") OR (MM "Decision Support Systems, Management") OR (MM "Decision Support Techniques")	**Search modes** - Boolean/Phrase
S16	TX decision N2 support OR TX decision N2 mak*	**Search modes** - Boolean/Phrase
S15	(MM "Decision Making, Computer Assisted") OR (MM "Decision Making") OR (MM "Decision Making, Clinical")	**Search modes** - Boolean/Phrase
S14	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13	**Search modes** - Boolean/Phrase
S13	TX Recommendation system*	**Search modes** - Boolean/Phrase
S12	TX image N2 recognition OR TX fac* N2 recognition	**Search modes** - Boolean/Phrase
S11	TX data driven	**Search modes** - Boolean/Phrase
S10	TX support vector N2 machine	**Search modes** - Boolean/Phrase
S9	TX Virtual private agent* OR TX virtual intelligent agent* OR TX virtual N2 assistant*	**Search modes** - Boolean/Phrase
S8	TX SIRI OR TX chatbot OR TX animated character*	**Search modes** - Boolean/Phrase
S7	TX connectionist model	**Search modes** - Boolean/Phrase

S6	TX perceptron*	**Search modes** - Boolean/Phrase
S5	TX neural network*	**Search modes** - Boolean/Phrase
S4	TX computer N2 assist* OR TX computer N2 generat*	**Search modes** - Boolean/Phrase
S3	TX Machine Learning OR TX computer intelligence OR TX algorithm*	**Search modes** - Boolean/Phrase
S2	TX artificial intelligence	**Search modes** - Boolean/Phrase
S1	(MM "Artificial Intelligence")	**Search modes** - Boolean/Phrase

Health Business Elite

<u>Search ID#</u>	**Search Terms**	**Search Options**
S24	S14 AND S21	**Limiters** - Publication Type: Periodical; Published Date: 20130101-20181031 **Search modes** - Boolean/Phrase
S23	S14 AND S21	**Limiters** - Publication Type: Periodical; Published Date: 20130101-20181031 **Search modes** - Boolean/Phrase
S22	S14 AND S21	**Search modes** - Boolean/Phrase
S21	S15 OR S16 OR S17 OR S18 OR S19 OR S20	**Search modes** - Boolean/Phrase
S20	TX professional N2 decision OR TX management N2 decision OR TX clinic* N2 decision	**Search modes** - Boolean/Phrase
S19	TX practice N2 chang* OR TX decision N2 chang*	**Search modes** - Boolean/Phrase
S18	TX patient decision aid	**Search modes** - Boolean/Phrase
S17	SU Decision Support System	**Search modes** - Boolean/Phrase
S16	TX decision N2 support OR TX decision N2 mak*	**Search modes** - Boolean/Phrase
S15	SU Decision Making	**Search modes** - Boolean/Phrase

S14	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13	**Search modes** - Boolean/Phrase
S13	TX Recommendation system*	**Search modes** - Boolean/Phrase
S12	TX image N2 recognition OR TX fac* N2 recognition	**Search modes** - Boolean/Phrase
S11	TX data driven	**Search modes** - Boolean/Phrase
S10	TX support vector N2 machine	**Search modes** - Boolean/Phrase
S9	TX Virtual private agent* OR TX virtual intelligent agent* OR TX virtual N2 assistant*	**Search modes** - Boolean/Phrase
S8	TX SIRI OR TX chatbot OR TX animated character*	**Search modes** - Boolean/Phrase
S7	TX connectionist model	**Search modes** - Boolean/Phrase
S6	TX perceptron*	**Search modes** - Boolean/Phrase
S5	TX neural network*	**Search modes** - Boolean/Phrase
S4	TX computer N2 assist* OR TX computer N2 generat*	**Search modes** - Boolean/Phrase
S3	TX Machine Learning OR TX computer intelligence OR TX algorithm*	**Search modes** - Boolean/Phrase
S2	TX artificial intelligence	**Search modes** - Boolean/Phrase
S1	SU artificial intelligence	**Search modes** - Boolean/Phrase

PsychInfo Artificial Intelligence Reviews

S14 AND S21	**Limiters** - Publication Year: 2013-2018; Language: English; Methodology: LITERATURE REVIEW; Exclude Dissertations **Search modes** - Boolean/Phrase	**View Results** (119) **View Details** **Edit**
S22	S14 AND S21	**Search modes** - Boolean/Phrase
S21	S15 OR S16 OR S17 OR S18 OR S19 OR S20	**Search modes** - Boolean/Phrase

S20	TX professional N2 decision OR TX management N2 decision OR TX clinic* N2 decision	**Search modes** - Boolean/Phrase
S19	TX patient decision aid	**Search modes** - Boolean/Phrase
S18	MJ decision aid	**Search modes** - Boolean/Phrase
S17	MJ decision support	**Search modes** - Boolean/Phrase
S16	TX decision N2 support OR TX decision N2 mak*	**Search modes** - Boolean/Phrase
S15	MJ decision making	**Search modes** - Boolean/Phrase
S14	S1 OR S2 OR S3 OR S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10 OR S11 OR S12 OR S13	**Search modes** - Boolean/Phrase
S13	TX Recommendation system*	**Search modes** - Boolean/Phrase
S12	TX image N2 recognition OR TX fac* N2 recognition	**Search modes** - Boolean/Phrase
S11	TX data driven	**Search modes** - Boolean/Phrase
S10	TX support vector N2 machine	**Search modes** - Boolean/Phrase
S9	TX Virtual private agent* OR TX virtual intelligent agent* OR TX virtual N2 assistant*	**Search modes** - Boolean/Phrase
S8	TX SIRI OR TX chatbot OR TX animated character*	**Search modes** - Boolean/Phrase
S7	TX connectionist model	**Search modes** - Boolean/Phrase
S6	TX perceptron*	**Search modes** - Boolean/Phrase
S5	TX neural network*	**Search modes** - Boolean/Phrase
S4	TX computer N2 assist* OR TX computer N2 generat*	**Search modes** - Boolean/Phrase
S3	TX Machine Learning OR TX computer intelligence OR TX algorithm*	**Search modes** - Boolean/Phrase
S2	TX artificial intelligence	**Search modes** - Boolean/Phrase

S1   MJ Artificial Intelligence   **Search modes** - Boolean/Phrase

Proquest Public Health and ASSIA

(((((((artificial intelligence) OR ft(artificial intelligence) OR ft(Machine Learning) OR ft(computer intelligence) OR ft(algorithm) OR ft(neural network) OR ft(perceptron) OR ft(connectionist model) OR ft(SIRI) OR ft(chatbot)) AND at.exact("Literature Review" OR "Review")) AND la.exact("English")) AND at.exact("Literature Review" OR "Review")) AND la.exact("English")) AND at.exact("Literature Review" OR "Review")) AND la.exact("English")