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ORIGINAL RESEARCH

Evaluating the use of clinical decision aids in an Australian emergency department: A cross-sectional survey

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Abstract

Objective: To identify healthcare professionals' knowledge, self-reported use, and documentation of clinical decision aids (CDAs) in a large ED in Australia, to identify behavioural determinants influencing the use of CDAs, and healthcare professionals preferences for integrating CDAs into the electronic medical record (EMR) system.

Methods: Healthcare professionals (doctors, nurses and physiotherapists) working in the ED at the Gold Coast Hospital, Queensland were invited to complete an online survey. Quantitative data were analysed using descriptive statistics, and where appropriate, mapped to the theoretical domains framework to identify potential barriers to the use of CDAs. Qualitative data were analysed using content analysis.

Results: Seventy-four healthcare professionals (34 medical officers, 31 nurses and nine physiotherapists) completed the survey. Healthcare professionals' knowledge and self-reported use of 21 validated CDAs was low but differed considerably across CDAs. Only 4 out of 21 CDAs were reported to be used 'sometimes' or 'always' by the majority of respondents (Ottawa Ankle Rule for ankle injury, Wells' criteria for pulmonary embolism, Wells' criteria for deep vein thrombosis and PERC rule for pulmonary

Key findings

- Healthcare professionals' knowledge and self-reported use of 21 commonly used CDA was generally low but differed considerably across CDAs. Only four CDAs were reported to be used "sometimes" or "always" by the majority of respondents: Ottawa Ankle Rule for ankle injury, Wells' criteria for pulmonary embolism, Wells' criteria for deep vein thrombosis, PERC rule for pulmonary embolism.
- Most respondents wanted to increase their use of valid and reliable CDAs and supported integration of CDAs into the electronic medical record system to facilitate their use and support documentation. Healthcare professionals' needs, preferences and the clinical workflow need to be considered to optimise the integration of CDAs into the electronic medical record system.
- Of the nine behavioural domains evaluated, knowledge, social and professional role and identity, and social influences were identified to impact on the widespread uptake and use of CDAs evaluated. Behavioural determinants need to be considered and addressed when developing an implementation approach to integrate CDAs into the electronic medical record system.

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embolism). Most respondents wanted to increase their use of valid and reliable CDAs and supported the integration of CDAs into the EMR to facilitate their use and support documentation. Potential barriers impacting the use of CDAs represented three theoretical domains of knowledge, social/professional role and identity, and social influences.
Conclusions: CDAs are used variably by healthcare professionals and are inconsistently applied in the clinical encounter. Preferences of healthcare professionals need to be considered to allow the successful integration of CDAs into the EMR.

Key words: *clinical decision support, decision-making, evidence-based emergency medicine, hospital emergency service, patient and public involvement, survey.*

Introduction

Clinical decision aids (CDAs), also referred to as clinical decision rules, clinical decision support tools, clinical prediction rules or risk scores, are tools used by healthcare professionals to help them interpret clinical information and manage clinical uncertainty.[1] CDAs are research-derived tools that synthesise three or more variables from the patient history, physical examination or simple tests to inform diagnostic, prognostic and therapeutic decisions.[2] Hundreds of CDAs are available for use by healthcare professionals. A search of MDCalc, a free online or app-based medical reference of CDAs, identified over 500 CDAs relevant to the subspecialty of Emergency Medicine.[3]

Validated CDAs are recommended for use in EDs worldwide due to the potential benefits to patients, healthcare professionals and healthcare systems.[4] CDA use has been shown to improve quality of care, patient satisfaction and reduce length of stay.[5–8] Despite these benefits, significant variation in healthcare professionals' knowledge and use of CDAs has been reported, with many rules underutilised in clinical practice.[2,9,10] Self-reported use of CDAs was found to vary significantly between countries and was generally considerably lower than medical officer's awareness of the rules.[10,11] Increasingly digitally enabled and integrated healthcare systems present a promising solution to improving the translation of knowledge into practice and optimising evidence-based clinical decision-making at the point of care. Critical to the successful design and meaningful integration of CDAs into existing electronic medical support systems is a comprehensive understanding of users' needs, and barriers and enablers to implementation in the local context.[12]

Our hospital recently introduced an electronic medical record (EMR) system, which presented an opportunity to integrate clinical tools such as CDAs into the digital workflow. The present study represents an initial phase of a larger programme aimed at guiding the implementation of validated CDAs. To inform decisions about which CDAs to implement, we first needed to identify ED healthcare professionals' current knowledge and use of CDAs, and their preferences around the optimal format and delivery of clinical decision support within the EMR. Therefore, the aim of the present study, in a large ED in Australia, was to (i) determine ED healthcare professionals' knowledge, self-reported use, priorities and documentation of specific CDAs, and (ii) to identify behavioural determinants influencing the implementation of CDAs.

Methods

Study design and setting

This survey was conducted between March and April 2021 at the Gold Coast Hospital and Health Service (GCHHS), Queensland, Australia. The GCHHS has two EDs: the Gold Coast University Hospital (GCUH), a tertiary facility, which had approximately 120 000 ED attendances in 2020, and Robina Hospital, a general hospital with approximately 66 000 attendances in 2020. The GCHHS Human Research Ethics Committee approved the study (LNR/2020/QGC/65661).

The survey contained three sections on: (i) demographic information, (ii) knowledge and application of CDAs and (iii) attitudes towards integrating CDA into EMR. Demographic information was collected using closed, single-response and numeric entry questions about age, gender, profession and training. Knowledge and application of CDAs were assessed using bespoke and standard single-response Likert scales, closed single-response, open-ended and prioritisation questions about awareness, frequency of use, preference, method of access, communication with patients and attitudes towards CDAs. Attitudes towards integration of CDA in EMR were assessed with standard single-response Likert scales and open-ended questions about attitudes towards integration, helpful features of integration and level of support. See Appendix S1 for the full survey.

Selection of participants

Healthcare professionals (doctors, nurse practitioners, nurses, physiotherapy practitioners and physiotherapists) who worked in the ED at either site were eligible to participate. An email invitation was distributed to ED clinical staff, which outlined the aim of the survey, specified that participation was voluntary and provided a link to the survey. Clinical leads for each profession were asked to promote the survey where possible (e.g. at clinical handovers, team meetings and education sessions, including journal club).

Data collection

The survey was administered using the web-based survey application Qualtrics (Provost, UT, USA). From March to April 2021, the survey was distributed to ED staff on three occasions, initial invitation and two reminder invitations, with each email sent 1 week apart to maximise participation. Participants were asked to complete the survey once and responses were anonymous.

Outcome measure

The survey was developed in three stages. First, a literature search was conducted to identify published surveys on healthcare professionals' use of CDAs. Items from identified surveys that were relevant to the aims of the present study were mapped to the theoretical domains framework (TDF), a collaboratively developed, theory-driven framework that helps identify and classify determinants of behaviour.[12] Questions were adapted to meet 9 of the 14 domains relevant to healthcare professionals' use of CDAs (e.g. knowledge and beliefs about capabilities). Mapping existing survey items enabled the identification of behavioural determinants to assist with understanding healthcare professionals' use of CDA in routine practice.[13] Finally, two rounds of pilot testing of the survey were completed with healthcare professionals who worked in the ED, two patients and public consumers, experts in the field and medical research colleagues to ensure comprehension, and face and content validity.[14,15]

Survey overview

The survey contained four sections on: (i) demographic information, (ii) knowledge of CDAs, (iii) how CDAs are applied and (iv) attitudes towards integrating CDA into EMRs (Appendix S1).

Selection of CDAs

The 21 CDAs were identified through several avenues, attempting to get a list of CDAs that represented a range of health conditions, but were used often in ED settings. We (i) posted tweets using the #medtwitter hashtag, such as 'Do you work in an Australian ED? What are the clinical decision rules you commonly use? #medtwitter', (ii) looked at CDAs recommended by RANZCR, the peak Australian body for radiologists (this is relevant as many decision aids are related to whether to request imaging) and (iii) discussion with members of the authorship team who work in ED. A list of 58 ED-relevant CDAs was compiled narrowing the selection to the 21 that the authorship team considered the most likely to be used.

TABLE 1. *Demographic characteristic of survey participants*

	Total, $n = 74$	Percentage
Completed entire survey	48	65
Male/female/prefer not to say	25/48/1	34/65/1
Profession/level of training		
Medical officer	34	46
Consultant	16	22
Registrar (principal house officer)	8	11
House officer (junior/senior)	9	12
Intern	1	1
Nursing	31	42
Registered nurse	30	41
Nurse educator	1	1
Physiotherapist	9	12
Extended scope physiotherapist (physiotherapist practitioner)	4	5
Physiotherapist	5	7
Years since graduating, mean (SD); range	13.4 (8.4); 2–40	
Years in ED, mean (SD); range	8.3 (7.6); 1–36	
Survey		
Accessed survey		
Weblink	72	97
QR code	2	3
Duration (mins), mean (SD); range	20 (50); 1–401	

SD, standard deviation.

Patient and public involvement and engagement

Two consumers from the GCHHS actively participated in reviewing the project proposal, developing the survey and review of the manuscript.

Data analysis

Closed response items were analysed descriptively. To identify the most known and frequently used CDAs, responses to items 'I know of this CDA and mostly/always use it in practice' and 'I know of and sometimes use it in practice' were summed. To determine the five CDAs which respondents' thought were of highest priority to integrate into EMR, each CDA prioritised by respondents was scored (1 = highest priority, 2 = second highest priority, etc) and the number of respondents who selected that CDA were summed. The total score was then divided by the number of respondents, and the CDAs with the five lowest scores (i.e. highest priority) were identified. Open responses were analysed independently by two team members (ZAM and RT) using content analysis.[16] Survey items that identified healthcare professionals' behaviours and attitudes towards the use of CDAs were coded by two team members (ZAM and SM) using a TDF coding guideline[17] and knowledge-to-action framework

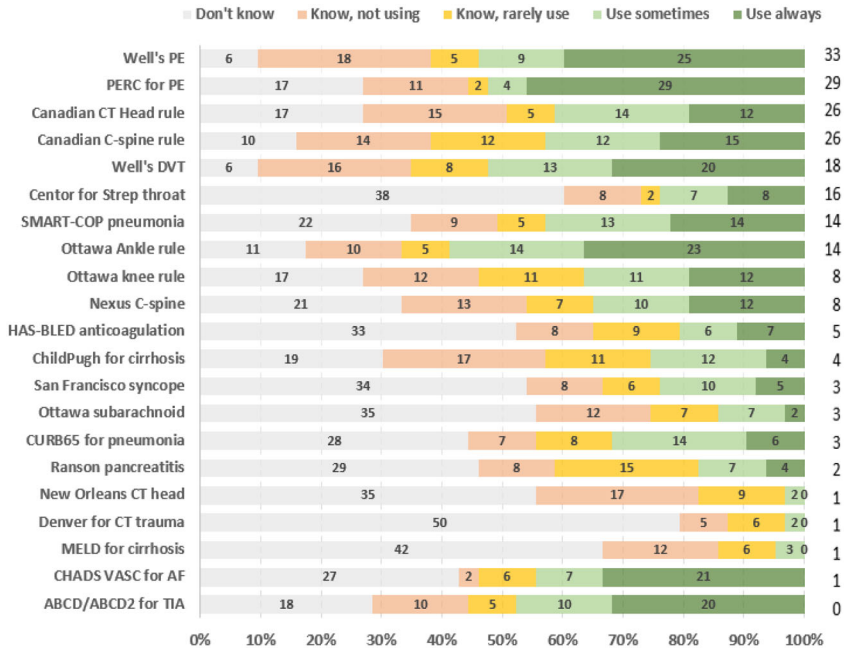

Figure 1. *Knowledge and use of 21 CDAs commonly used in the ED* (n = 63) *ranked in order of healthcare professionals' priority to integrate into EMR. ABCD/ABCD2 for TIA, clinical prediction rule to determine the risk for stroke in the days following a transient ischemic attack; C-spine, cervical spine; CDA, clinical decision aid; CJADS VASC for AF, clinical prediction rules for estimating the risk of stroke in people with non-rheumatic fibrillation; CURB65 = estimates mortality of community-acquired pneumonia to help determine inpatient* versus *outpatient treatment; DVT, deep vein thrombosis; HAS-BLED, scoring system developed to assess risk of major bleeding in people taking anticoagulants for AF; MELD, Model for End-Stage Liver disease; PERC for PE, Pulmonary Embolism Rule-out Criteria for Pulmonary Embolism; SMART-COP, tool for assessing severity of community acquired pneumonia in adults.*

principles.[18] Data were analysed in Stata/MP16.1.[19]

Results

Seventy-seven out of 635 ED healthcare professionals responded to the invitation to participate (12% response rate). However, of the 77 responses, three people did not respond to any of the survey items, leaving 74 participants for analysis. This included 34 doctors (46%), 31 nurses (42%) and nine physiotherapists (12%) (Table 1).

CDAs knowledge and use

Healthcare professionals' knowledge and self-reported use of 21 commonly used CDAs was generally low (Fig. 1). Only 4 of the 21 CDAs were reported to be used 'sometimes' or 'always' by 50% or more of respondents: the Ottawa Ankle Rule for ankle injury ($n = 37/63$, 59%), Wells' criteria for pulmonary embolism (34/63, 54%), Wells' criteria for deep vein thrombosis ($n = 33/63$, 52%) and the PERC rule for pulmonary embolism ($n = 33/63$, 52%).

CDAs not known, or known and not used, by a large proportion of respondents included, the Modified Denver Criteria for blunt cerebrovascular injury ($n = 55/63$, 87%), MELD score for cirrhosis ($n = 54$, 86%), New Orleans criteria for head CT ($n = 52/63$, 83%), Ottawa subarachnoid haemorrhage rule for headaches ($n = 47/63$, 75%) and the Centor criteria for 'strep' pharyngitis ($n = 46/63$, 73%). For the CDAs that healthcare professionals knew but did not use, the main reasons included the CDAs being outside of the professional scope of practice (38%), alternative CDAs or assessments available (33%) and the CDA not being relevant to the local ED setting ($n = 10/42$, 24%) (Table S1).

Healthcare professionals' use of CDAs at the point of care

Healthcare professionals reported that they most frequently used a phone app to recall or access CDAs in the ED. The MDCalc app was most frequently used. Other means of recall included website, memory, and consultation with a colleague (Table S2). The majority of respondents agreed or strongly agreed that using CDAs was within their scope of practice ($n = 36/48$, 75%) and that they use it to justify their clinical decisions ($n = 40/48$, 83%). However, only 22% ($n = 17/49$) respondents reported communicating the use of a CDA and findings to patients (e.g. providing information about their risk or justification for treatment decisions/investigations). One-third (33%, $n = 25/49$) reported 'sometimes' communicating this information and 9% ($n = 7/49$) reported not communicating this information to the patient. When asked about strategies or resources that would make communicating CDA findings easier, most responses related to the need for simplified information sheets to be made available that communicate and quantify key messages about risks, benefits and harms associated with investigations. Ideally, these handouts could be easily accessed and downloaded by patients (e.g. via QR code or app) and include diagrams or figures to aid healthcare professionals to communicate the often-complex information.

Theoretical domains framework

See Table 2 for results as they align to the TDF. Potential barriers impacting on the widespread use of CDAs represented three theoretical domains of knowledge, social/professional role and identity, and social influences. Reported in Table S3 are

TABLE 2. *Survey aligned and interpreted with the TDF domains* (n = *48)*

Domains†	Survey items (*n* responses)	Comments	Likert scale responses: Strongly disagree/ disagree, *n* (%)	Likert scale responses: Neutral, *n* (%)	Likert scale responses: Agree/ strongly agree, *n* (%)	Interpretation of items related to each domain of the TDF
1. Knowledge	Q8. Awareness and use of 21 common CDAs (*n* = 63)	See Figure 1 for results				• Knowledge and self-reported use for each CDA vary (Fig. 1) • Majority of respondents considered the research evidence supporting CDA
	Q20.1 I consider the research evidence supporting a CDA before using it in practice (*n* = 48)	Likert scale	0 (0)	14 (29)	34 (71)	
2. Skills	Q7. When you have used a CDA, do you use this information when communicating to the patient? (*n* = 49)	See result in text, under subheading *Healthcare professionals' use of CDAs at the point of care*				• Tendency for CDAs to be used early in the clinical assessment to guide clinical decision-making • Majority of respondents report documenting the use of a CDA • Significantly fewer respondents report communicating the use and the findings of a CDA to patients
	Q20.2 When I use a CDA, I document this in the patient notes either by name or its components (*n* = 48)	Likert scale	2 (4)	12 (25)	34 (71)	
	Q20.12 I use CDAs as a checklist at the end of my assessment to make sure I consider all relevant factors (*n* = 48)	Likert scale	3 (6)	21 (44)	24 (50)	
	Q20.13 I use CDAs early to guide my clinical assessment (*n* = 48)	Likert scale	1 (2)	14 (29)	33 (69)	
3. Social and professional role and identity	Q20.7 It is within my professional role (scope of practice) to independently apply and interpret a CDA (*n* = 48)	Likert scale	1 (2)	11 (23)	36 (75)	• The majority of respondents said that using CDA is within their scope of practice. CDAs are used to justify clinical decision made
	Q20.11 I use CDAs to justify my clinical decisions (*n* = 48)	Likert scale	1 (2)	7 (15)	40 (83)	
4. Beliefs about capability	Q20.4 I am confident in interpreting the results of the CDA (*n* = 48)	Likert scale	0 (0)	8 (17)	40 (83)	• The majority of respondents reported being confident in interpreting the results of a CDA
6. Beliefs about consequences	Q20.6 Using a CDA will decrease my vulnerability to legal action (*n* = 48)	Likert scale	1 (2)	21 (44)	26 (54)	• Respondents agreed that using a CDA would improve patient outcomes however there was less agreement/neural sentiment that use of a CDA would impact a healthcare professional's
	Q20.8 The potential harms of using CDA outweigh potential benefits (*n* = 48)	Likert scale	5 (10)	38 (79)	5 (10)	

(*Continues*)

TABLE 2. *Continued*

Domains†	Survey items (*n* responses)	Comments	Likert scale responses: Strongly disagree/ disagree, *n* (%)	Likert scale responses: Neutral, *n* (%)	Likert scale responses: Agree/ strongly agree, *n* (%)	Interpretation of items related to each domain of the TDF
	Q20.9 Using a CDA will improve patient outcomes (e.g. not miss a serious condition or cause unnecessary adverse events) ($n = 48$)	Likert scale	0 (0)	11 (23)	37 (77)	vulnerability to legal action, harms outweighed the benefit and will lead to decreased healthcare utilisation
	Q20.14 Using CDA will decrease healthcare utilisation and healthcare costs ($n = 48$)	Likert scale	0 (0)	20 (42)	23 (58)	
8. Intention	Q20.10 I would like to increase my use of CDAs ($n = 48$)	Likert scale	0 (0)	14 (29)	34 (71)	• The majority of respondents would like to increase their use of CDAs
10. Memory, attention and decision processes	CDA aware of but do not use	Open question, see Table S1				• Main reason for not using a CDA is that it is out of their professional scope of practice
	Q14. Indicate how often you use the following to recall or access clinical decision aids when in the clinical setting? ($n = 48$)	See Table S2 for results				• Respondents rarely relied on their recall of CDAs alone and frequently accessed the CDA using phone apps or online
11. Environmental context and resources	Q20.3 I use CDA even when I have little time, for example, busy caseload ($n = 48$)	Likert scale	2 (4)	13 (27)	33 (69)	• CDA appears part of routine practice even when busy and experiencing time pressures
12. Social influences	Q20.5 People who are important to me professionally think that CDA should be used to inform practice ($n = 48$)	Likert scale	0 (0)	14 (29)	34 (71)	• Professional influence is important in supporting the use of CDA. The majority of participants were neutral in the impact of patient's preferences/ expectations on their ordering patterns
	Q20.15 I follow the CDA regardless of patient's expectation of receiving a test/investigation ($n = 48$)	Likert scale	4 (8)	32 (67)	12 (25)	

†Only relevant domains of the TDF were included in the current survey. The following domains were omitted: 5. Optimism; 7. Reinforcement; 9. Goals; 13. Emotions and 14. Behavioural regulation. CDA, clinical decision aid; Q, question; TDF, theoretical domains framework.

TABLE 3. *Healthcare professionals reasons for prioritising the CDA selected for integration into EMR (n = 42 responses, responses could be coded to more than one theme)*

Response	Number of responses coded to each theme	%
Common ED presentation	19	35
Context: frequently used CDA in department, hospital and health service pressure	16	30
Patient benefit treatment/management (reduce practice variation, risk of AE, reduce imaging/length of stay, frequently missed)	16	30
Familiarity/knowledge/confidence	11	20
Evidence informed decision-making	10	19
CDA characteristics: difficulty to remember and calculate, good sensitivity/specificity	9	17
Efficiency/time	3	6

AE, adverse event; CDA, clinical decision aid; EMR, electronic medical record.

barriers and facilitators that can be used to inform the design of future clinical decision support systems (CDSS) that integrate CDAs into the EMR.

Healthcare professionals' support and preferences for integrating CDAs into the EMR

Of the CDAs that respondents knew about and used, five were identified by healthcare professionals as a priority to incorporate into the EMR: Wells' criteria for pulmonary embolism, PERC rule for pulmonary embolism, Canadian c-spine rule, Canadian CT head rule and Wells' criteria for deep vein thrombosis. The reasons these CDAs were prioritised by healthcare professionals for potential integration into EMR are reported in Table 3 and included the condition being a common ED presentation (35%), benefits to patients (e.g. reduce imaging, and practice variation, 30%) and the context (e.g. CDA being frequently used in the ED, 30%).

Overall, 83% ($n = 40/48$) of respondents supported the integration of CDAs into EMR (Table S4). A majority (77%) of healthcare professionals agreed/strongly agreed that integrating CDAs into the EMR would make them stop and consider the reason for ordering an investigation and 88% reported that this would help to remind them what CDAs were available and potentially appropriate for their patient. Respondents disagreed that integration of CDAs into EMR would be too time consuming (strongly disagree/disagree, $n = 24/48$ [50%]; neutral, $n = 20/24$ [42%]) or make them feel disempowered (strongly disagree/disagree, $n = 37/48$ [77%]). Healthcare professionals reported that CDAs would be most helpful if they were integrated into the EMR and provided clinical decision support during patient assessment (65%), at the point of referral (65%) or at triage (24%) (Table S5). Design features that healthcare professionals would find helpful are reported in Table 4. Key themes from open-ended responses included that any clinical decision support should not be a mandatory feature that requires additional 'clicks'; centralised and embedded resources such as weblinks or MDCalc would improve efficiency (e.g. no need to search for individual CDAs), and the ability to access and use evidence-based tools at the point of care.

Discussion

The present study provides a theory-informed investigation of CDA used in two large, Australian EDs and identifies several factors that can inform the future development, and facilitate the integration of, CDAs into the local EMR. Healthcare professionals' knowledge and self-reported use of 21 validated CDAs were found to vary significantly. Only 4 of the 21 CDAs were reported to be used 'sometimes' or 'always' by 50% or more of respondents: the Ottawa Ankle Rule for ankle injury, Wells' criteria for pulmonary embolism, Wells' criteria for deep vein thrombosis and the PERC rule for pulmonary embolism. Of the nine TDF domains evaluated, knowledge, social and professional role and identity, and social influences were identified to impact on the widespread uptake and use of CDAs evaluated. Several avenues of future research and EMR integration were identified.

The GCUH and affiliated institutions have a strong research focus. This may explain why, contrary to previous studies, a majority of healthcare professionals reported considering the evidence prior to using a CDA. Despite the small sample, the findings of the present study and perspectives of healthcare professionals closely reflect previous work, which has highlighted the design features, behavioural and organisational factors known to influence use of CDA and CDSS. 'The 10 commandments for CDA' and later articles highlight that system features (e.g. CDSS integration with existing EMR systems), clinician–system interaction features (e.g. usability and workflow considerations), communication and content features (e.g. how knowledge is assembled and organised for cognitive support) and auxiliary features (e.g. end-user engagement in the development, feedback, implementation

TABLE 4. *Potential design features of EMR integration and their perceived helpfulness* (n = *48)*

Statement	Not at all helpful/slightly helpful, *n* (%)	Moderately helpful, *n* (%)	Very helpful/extremely helpful, *n* (%)
MDCalc integrated into iEMR	8 (17)	10 (21)	30 (63)
Support documentation (e.g. template that could be imported into clinical notes)	9 (19)	14 (29)	25 (52)
CDA-specific questions at the point of referral for investigations	17 (35)	10 (21)	21 (44)
Link to websites or app where details of CDAs can be found	12 (25)	18 (38)	18 (38)
Automatic provision of decision support, for example, pop-up alert notifying you that CDA(s) are available for relevant patient presentations	16 (33)	26 (54)	17 (35)
CDAs incorporated into Powerplan or Careplan	23 (48)	13 (27)	12 (25)
Pop-up alert if referral/investigation order is in violation of a CDA	24 (50)	14 (29)	10 (21)
Request justification when ordering investigations, for example, blood tests or imaging	24 (50)	18 (38)	6 (13)

Careplan and Powerplan, Queensland specific templates for electronic decision rules; CDA, clinical decision aid; iEMR, integrated electronic medical record; MDCalc, Medical Calculators (www.mdcalc.com).

framework including evaluation) are all important factors that need to be considered when designing and implementing CDSS.[20–23]

Strengths of the present study include the broad, evidence and theory-informed investigation of CDAs. Developing the survey within a theoretical framework provides the opportunity to align future solutions and implementation approaches with behaviour change theory and strategies.[24] Last, this survey also captured the perspectives of medical officers, nurses and physiotherapists, all for whom the use of specific CDAs is within scope of practice. This inclusive approach to determining the knowledge and use of CDAs has been seldom used, with previous studies often evaluating CDA by individual disciplines.[9–11] Capturing multiple perspectives has both strengths and limitations. It is inherently a strength, as it creates opportunities to embed CDSS that is relevant to common patient presentations and has the potential to encourage staff to work within their full scope of practice.

The primary limitation of the present study was the small response rate (12%) and sample size, which may impact the generalisability of results. Although this response rate is significantly lower compared to previous surveys on CDAs, it does align with more contemporary surveys that have been conducted during the COVID-19 pandemic.[25] This response rate may reflect the clinical workload, increased stress and uncertainty healthcare staff were experiencing during the survey period. All healthcare staff (i.e. full-time and part-time) who worked in the EDs were invited to respond. It is possible that a proportion felt that CDAs were relevant only to key clinical decision-makers (e.g. medical staff, nurse practitioners and extended practice allied health practitioners) and did not think the survey applied to them. We believe that the responding sample is likely to be representative of those healthcare professionals who think this level of decision-making falls within their scope of professional practice and are engaged in evidence-based decision-making. Although subgroup analysis would have provided insights into which CDAs were used or not used by doctors, nurses and physiotherapists, the numbers were too small for meaningful data. We acknowledge that physiotherapists may not need to use all 20 CDAs in their usual practices which would have impacted on the results.

Overall, respondents supported integrating CDAs into the EMR and improving their use of valid and reliable clinical decision tools. Respondents also recognised the need for high quality, evidence-based patient resources, to support ED care and to improve decision-making communication when patients are transferred to the ward or home where primary care takes over. However, this survey only studied healthcare professionals' self-reported knowledge and use of CDAs, so must be supplemented with assessments of actual CDA usage. To successfully integrate CDAs into the EMR, engaging end-users is critical to the development of

strategies and their acceptance into practice.[12] This includes interacting with, and understanding the needs of, healthcare professionals who work in the ED, patients and carers, and others such as radiographers, ward staff for admitted patients, and GPs. Although many CDAs can be safely implemented by nurses and physiotherapists, the extent of use is likely to be determined by the context and operating structures within each ED. The number of presentations to the ED is increasing and ensuring that non-physician staff work within their full scope of practice has the potential to relieve the pressure on medical officers while also assisting with timely patient management.

Consistent integration of the use of selected, valid CDAs into ED workflow processes has the potential to achieve the 'quadruple aim' of enhancing patients' experience, improving population health, reducing healthcare costs and improving the work life of healthcare providers. The findings of the present study provide valuable insights into the use of CDAs in ED that will inform future research to explore integration of selected CDAs into the EMR to facilitate workflow processes. Although the findings of the present study provide a valuable first step in understanding which CDAs are used and the factors influencing their use, further investigations are required to ensure that any CDSS developed improves the delivery of targeted care and gets the right information, to the right people (including patients and consumers), in the right format, through the right channel, at the right time.

Conclusion

CDAs are used variably by healthcare professionals and are inconsistently applied in the clinical encounter. To improve the appropriate usage of CDAs will require a better understanding of which CDAs healthcare professionals are, and are not, currently using and why, plus their preferences for integration into the clinical workflow, such as integration into EMRs.

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Competing interests

GK is a section editor for *Emergency Medicine Australasia*.

Data availability statement

Data available on request from the authors.

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Appendix S1. Supporting Appendix.
Table S1. Reasons healthcare professionals provided for not routinely using CDA that they were aware of ($n = 42$ responses, responses could be coded to more than one theme).
Table S2. How CDAs are recalled or accessed by healthcare professionals within the clinical setting ($n = 50$).
Table S3. Barriers and facilitators that can inform the design of future CDSS that integrate CDA into the EMR.
Table S4. Healthcare professional's level of support for integrating CDAs into EMR.
Table S5. Point at which integration of CDAs into EMR would be most helpful (respondents could select more than one response).