

Evidence Check

Effectiveness of mental health electronic medical records

An **Evidence Check** rapid review brokered by the Sax Institute for the NSW Ministry of Health. November 2019.

This report was prepared by: Yvonne Zurynski, Louise A. Ellis, Huong Ly Tong, Liliana Laranjo, Robyn Clay-Williams, Luke Testa, Anne Groedahl. Australian Institute of Health Innovation, Macquarie University.

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Effectiveness of mental health electronic medical records on usability, uptake and clinical and patient safety and quality outcomes

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Executive summary

Background

Modern healthcare is becoming more complex and more reliant on integrated information systems. Successful implementation of new information technology (IT) is dependent on how easy the technology is for clinicians to use and how well it integrates with existing systems and processes of care. Although provision of care is the core task of healthcare professionals, they are also required to document the care they provide as fully and accurately as possible. Electronic Medical Records (EMRs) are expected to provide efficiencies that benefit healthcare organisations, clinicians and patients. Few published studies have evaluated the benefits of EMR as implemented in health systems, although there is some evidence suggesting improvement in accuracy and completeness of clinical documentation. The proportion of time spent by clinicians on completing documentation during patient consultations is estimated at approximately 35%, regardless of whether they use EMRs or paper systems. Indeed, research regarding the effects of EMRs on saving time for clinicians shows mixed results and suggests that time savings are likely dependent on the EMRs design and usability. For example, a 2018 pre- and post- implementation study of the same EMRs in two sites found that the time spent on documentation increased in one site and decreased in another. E-prescribing systems have been linked with improved medication safety, especially in contexts where high-functioning socio-technical systems have been established.

The Mental Health Design Working Group at NSW Ministry for Health aims to develop, implement and optimise the EMRs systems used within NSW public mental health services to support integrated and patient centred-centred care and quality health outcomes. A scope and synthesis of recent research evidence was required as one of the informing inputs to support decision making regarding next steps and priorities for the further development and redesign of the EMRs for public mental health settings in NSW. Researchers from the Australian Institute of Health Innovation at Macquarie University were contracted to undertake a rapid literature review to address the questions below.

Review questions

This review aimed to address the following specific questions:

Question 1: What is the effectiveness of implementing EMRs in terms of usability, user experience and human factors, uptake and clinician and patient safety and quality outcomes in mental health services?

Question 2: Why or why not were the EMRs effective in mental health services?

Question 3: What are the implications of the findings of this review for enhancing and designing the EMRs in NSW mental health services?

Summary of methods

We conducted a rapid literature review. The search was limited by strict inclusion and exclusion criteria. Rapid reviews limit the comprehensiveness of the search while identifying key primary papers and published reviews to address the research questions.

In consultation with the policy team and a medical librarian at Macquarie University, we developed a search strategy that covered the period January 2010 to May 2019, using the following databases: PubMed, Embase and PsycInfo. Although our literature review centred on peer-reviewed papers about clinician-facing EMRs used in mental health settings, we included literature reviews on EMRs implemented in the broader health systems. To capture implementation outcomes and processes, we used both the Proctor Framework and the Consolidated Framework for Implementation Research (CFIR), as organising frameworks to capture:

- Implementation outcomes (acceptability, adoption, appropriateness, costs, feasibility, fidelity, penetration, sustainability)
- Service outcomes (efficiency, safety, effectiveness, equity, patient-centeredness, timeliness)
- Client outcomes (satisfaction, function, symptomatology).

Evidence grading

We used a seven level Hierarchy of Evidence based on a combination of recommendations from the National Health and Medical Research Council (NHMRC), the Oxford Centre for Evidence-based Medicine Levels of Evidence and a publication by Melynyk and Fineout-Overholt (2011). Most of the papers included in our review were graded as low quality, with only two randomised controlled trials identified.

Key findings

A total of 14 primary research studies focussed on EMRs in mental health settings and eight literature reviews of EMRs implementation in the broader health system (22 studies in total) met all inclusion and exclusion criteria and underwent data extraction. Most (64%) of the studies in mental health settings originated from the USA, with fewer studies from Canada, France and the UK. No publications on implemented EMRs in the mental health settings in Australia were identified.

Question 1

The EMRs ranged from relatively simple and focussed on a single condition or presentation, to comprehensive multi-functional systems that provided business intelligence (services delivered, costs) in addition to embedded assessment tools, e-ordering of pathology, imaging and pharmacy. Notable examples included automated prompts to develop a safety plan for children and youth with suicide ideation, embedding a suicide screening tool into general ED software, and embedding the capability for e-consultation between a primary healthcare provider and a psychiatrist.

Both positive and negative implementation outcomes in terms of acceptability, adoption and appropriateness were reported. Acceptability was likely to be high when usability, reliability and responsiveness of the EMRs was also high, and when technical support was readily available. Low adoption and acceptability were related to negative perceptions and attitudes among clinicians, lack of confidence in their own IT skills, and doubts about the ability of EMRs to improve care quality. Clinicians also worried about EMRs resulting in increased workload and loss of clinical autonomy. They also expressed concerns about limited appropriateness, with EMRs mismatched to the priorities, capacity and workflows of clinicians at the frontlines of care.

The service level outcomes were not clear-cut, with both negative and positive results being reported in terms of efficiency, timeliness, and effectiveness. Inefficiencies through increasing workload associated with completing EMRs were reported, which included double handling of clinical information, EMRs misalignment with clinical workflows, and difficulties navigating the software. On the other hand, positive outcomes included more timely, complete, legible and easily accessed patient records to support clinical decision-making, especially for screening and assessment tools, and care planning. The most convincing benefits were associated with implementation of e-prescribing for medication safety and in the systematic documentation of risk factors for suicide that prompted development of management plans for suicide prevention.

Question 2

The evidence for effectiveness was limited however, a number of factors associated with successful and unsuccessful implementation and adoption of EMRs in the clinical context were identified.

- Positive implementation and service outcomes were associated with specific mental health EMRs tools that were embedded within existing EMRs systems, and when the EMRs recognised the natural workflows of clinicians and were viewed by clinicians as “appropriate” to their clinical context.
- The highest number of negative outcomes reported was related with lack of appropriateness of the EMRs to the clinical context, including a mismatch with workflows, complex navigation which limited ease of access to information important for clinical decision-making.
- EMRs were seen to interfere with the clinical consultation processes especially in the mental health setting when there is a need to engage and develop a rapport between the clinician and patient.
- Negative attitudes of clinicians to the EMRs, their self-perceived limited IT skills, perceived loss of clinical autonomy and misalignment of the EMRs with natural clinical workflows were barriers to adoption.
- Specific parts of EMRs such as e-prescribing and medication monitoring, or suicide risk assessment and development of preventative safety plans, where practical benefits were readily apparent because of the appropriateness of the EMRs in solving a particular clinical problem, were more likely to be adopted and to be efficient and effective, rather than general EMRs software.
- Clinicians reported that training in how to use EMRs, in the benefits of EMRs to their clinical practice and in IT skills would increase adoption of EMRs in routine clinical care.
- EMRs system stability, minimal downtimes and easy access to technical support would also improve attitudes towards EMRs and their adoption.

Question 3

Based on the results of our rapid review, the following recommendations should be considered by the commissioning agency when enhancing or redesigning EMRs:

- Undertake a thorough formative evaluation with all stakeholders who are likely to interact with mental health EMRs, including local managers, clinical leaders and front-line clinicians (doctors nurses, psychologists, pharmacists, etc) to ensure that the features of any future EMRs are aligned with their needs, expectations and natural workflows.
- Design mental health EMRs for easy navigation that fits in with current workflows – this means undertaking studies and consultations to understand current workflows in different contexts.
- Use a human-centred design approach, including co-design, user research and usability approaches while engaging with all stakeholders, including those working at the frontlines.
- Take the opportunity to standardise data collection where possible e.g. by defining minimum data sets, while at the same time avoiding EMRs solutions that are not easily adaptable to data collection processes by clinicians in their local contexts.
- Avoid EMR solutions that are rigid and too prescriptive, for example, EMRs that continually alert clinicians inappropriately, include too many mandatory fields, or require complex or counter-intuitive navigation pathways.
- Minimise use of decision support tools that impose “hard-stops” that cannot be overridden when justified in certain individual clinical circumstances.
- Embed a mixed methods implementation evaluation from the very beginning of implementation to ensure that important data on implementation outcomes and on service outcomes, barriers and enablers are collected from the outset to support ongoing evaluation and system improvement.
- Ensure that clinicians are supported through easily accessible training before and during implementation and ensure that they have easy access to technical support when it is needed.

Gaps in the evidence

- Few studies specific to the mental health context were identified.
- Enormous variability in the EMRs features implemented in a variety of contexts makes synthesis challenging, as does the variability in study methodologies and outcomes assessed.

- The strength of evidence was generally low, with only two studies using RCT methodology.
- The impact of EMRs on patient safety was rarely reported - only three studies examined this.
- The evidence is largely inconclusive with both positive and negative effects reported, often in the one study.
- Few studies assessed intervention feasibility, and none assessed fidelity of the intervention.

Discussion and conclusion

The above summary of evidence shows a relatively weak evidence base with a limited number of studies, especially in mental health settings, with few studies of high quality, and lack of data from Australia. This, coupled with lack of access to current evaluation results for the existing EMRs implemented in publicly funded mental health settings in NSW, further limits our ability to make firm recommendations for future implementation of EMRs. The most successful EMRs solutions in mental health that were identified in the literature review included EMRs with a specific purpose, e.g. e-pharmacy, safety planning for suicide prevention, and digitisation of assessment and screening tools that were embedded in the EMRs. The key recommendations include ensuring that the EMRs proposed as solutions are aligned with clinical contexts, workflows, and the needs of clinicians at the frontlines of clinical care, while avoiding duplication of information handling and ensuring that the EMRs solutions minimise disruption to rapport-building between patient and clinician during consultations. This will require an investment in formative evaluation, consultation and engagement through co-design.

Background

Purpose

This Evidence Check review was commissioned by the Sax Institute on behalf of the NSW Ministry of Health InforMH System Information and Analytics Branch, Mental Health Design Working Group (MHDWG). It was undertaken by the Centre for Healthcare Resilience and Implementation Science, Australian Institute of Health Innovation, Macquarie University working in collaboration with the MHDWG using a co-design approach.

The MHDWG aims to develop, implement and optimise the Electronic Medical Record (EMR) systems used within NSW public mental health services to support integrated and patient centred-centred care and quality health outcomes. A scope and synthesis of recent research evidence was required as one of the informing inputs to support decision making regarding next steps and priorities for the further development and redesign of the EMRs for public mental health settings in NSW.

Background

As modern healthcare becomes more complex, and more reliant on integrated information systems, an emerging problem is how to safely implement new technology such as EMRs.⁽¹⁻³⁾ Successful implementation of new technology is dependent on how easy that technology is for clinicians to use⁽⁴⁾ and, how well it integrates with existing systems and processes of care.⁽⁵⁾

Patient care is the primary core task of clinicians, whether in mental health or in other healthcare settings. Clinicians also have an obligation to document the care that they deliver, as fully and accurately as possible. EMRs are expected to provide benefits to healthcare organisations, clinicians and patients. Proponents supporting implementation of EMRs have predicted benefits including time saving for clinicians, and more accurate, complete, standardised and usable data to support timely and safe healthcare delivery and business process.⁽⁶⁾ However, new clinical errors associated with the implementation of EMRs are increasingly recognised and incidents associated with adverse patient outcomes have been reported.⁽⁶⁾ Furthermore, a recent literature review showed that e-prescribing software alerts to prevent drug-drug interactions or drug-condition alerts has both benefits and adverse effects.⁽⁷⁾ The proportion of time spent by clinicians completing documentation during patient consultations is estimated at approximately 35%, whether using EMRs or paper systems.^(8, 9) The effect of EMRs on saving time for clinicians is unclear. A 2018 pre- and post- implementation study in two sites found that the time spent on documentation increased in one site and decreased in another.⁽¹⁰⁾ Automation through e-prescribing has, on the other hand, resulted in improved care quality and safety, especially in clinical contexts where effective socio-technical systems have been established.⁽¹¹⁾ However, the mismatch between what “off-the-shelf” EMRs offer and what clinicians need is well recognised.⁽¹²⁾ The impacts of EMRs have seldom been systematically studied, measured and reported in the peer-reviewed literature related to mental health service delivery.

To maximise the benefits of EMRs, they need to be acceptable, usable and beneficial to the clinician end users and, they must interface smoothly with clinical workflows. Standardised EMRs are associated with many benefits, including improved accuracy and completeness of medical information, comparability of data across clinicians and sites, ease of access to patient history and embedded access to best practice guidelines, clinical calculators, decision support tools, imaging and pathology ordering have been shown to improve care quality.⁽¹³⁾ However, EMRs are also associated with lower clinician satisfaction.⁽¹⁴⁾ Clinicians have reported difficulties related to responsiveness (e.g. multiple passwords, slow EMRs response times, convoluted navigation), usability (e.g. too many alerts, too many mandatory fields before navigation to the

next section is permitted, lack of adaptability and “nimbleness”). It has also been suggested that EMRs may interfere in the development of effective relationships between healthcare professionals and patients⁽¹⁵⁾; this being particularly pertinent in the mental health setting.

The design of EMRs is a key aspect of their usability and impact.⁽¹⁶⁾ Therefore, the design features of EMRs must take account of many aspects of the healthcare setting, workflows, access to computers and software, usability and adaptability especially to the needs and preferences of end-users. Usability has three components: effectiveness (does the system do the intended job?), efficiency (is it cost-effective to use?) and user-satisfaction (does the clinician enjoy using it?). Attempting to integrate new technology such as EMRs into existing IT systems can result in mismatches, user error and frustration. Usability evaluation is a method for assessing the effectiveness, efficiency and user-satisfaction of the system prior to installation, or early in the implementation process, so that faults can be identified and rectified prior to introduction into the service.

While current regulation does not specifically require that usability evaluation be completed as a component of EMRs implementation⁽¹⁷⁻¹⁹⁾, usability has become the de facto method for demonstrating regulatory requirements for EMRs safety and effectiveness.⁽²⁰⁻²²⁾ Results of a usability assessment can be used to compare the products of different manufacturers when deciding which EMRs to purchase and can provide scientific evidence to support acceptance or rejection of the new technology. It may also provide system designers with data to aid in remedying problems. EMRs with a high level of usability are likely to have improved uptake and acceptance among clinicians and managers, and will guard against user workarounds, which have the potential to harm patients.

Methods

Aims and scope of the study

We conducted a rapid review of the peer-reviewed literature to answer the following research questions and used the synthesised evidence to summarise the implications for the design and use of EMRs in NSW mental health services.

Question 1: What is the effectiveness of implementing EMRs in terms of useability, user experience and human factors, uptake and clinician and patient safety and quality outcomes in mental health services?

Question 2: Why or why not were the EMRs effective in Mental Health Services?

Question 3: What are the implications of the findings of this review for enhancing and designing the EMRs in NSW mental health services?

Search strategy, approach and rationale

This rapid review was conducted within a very limited timeframe (one month). Our methods align with methods recommended for rapid reviews.^(23, 24) We used a systematic review approach but several steps were omitted due to the rapid nature of the current review. The search was limited by strict inclusion and exclusion criteria: date range, English language, inclusion of peer reviewed publications only, fewer databases searched. This limited the comprehensiveness of the search while identifying key primary papers and published reviews to address the research questions.

In consultation with the policy team and a medical librarian at Macquarie University, we developed a search strategy that covered the time period January 2010 to May 2019, and targeted three databases: PubMed, Embase and PsycInfo. As we were interested in literature that covered EMRs use in high income countries with similar health care systems to Australia, we included studies originating from countries that are members of the Organisation for Economic Co-operation and Development (OECD) and fall into category 1 (developed countries), as defined by the World Bank.⁽²⁵⁾ We used two related strategies to search for relevant literature.

Strategy 1 (S1): We captured published literature reviews on the use of clinician-facing EMRs in health services in high-income countries, whether they were related to the mental health setting or not. The rationale being that clinicians working in mental health may need to use general EMRs systems not specifically designed for mental health and the broad issues around usability, interface with users and workflows will be equally relevant to the mental health settings.

Strategy 2 (S2): We included clinician-facing EMRs that had been implemented specifically for mental health clinicians or in mental health delivery settings. S2 focused on published articles reporting primary data on the use, and implementation of clinician-facing EMRs in mental health settings and included published reviews, but only if they reported on mental health professionals or settings.

The search terms used in both search strategies are summarised in Table 1. After consultation with the policy team, a medical librarian and investigators at the AIHI, we agreed on search terms related to EMRs, healthcare professionals and terms related to impacts of EMRs.

Table 1. Search strategy for S2, developed in consultation with the policy team and a medical librarian

Database	Search terms (combined by AND between each column) *apply English + time restriction + reviews only		
	EMRs-related terms	Health care professionals related terms	Impact-related terms
PubMed	"Electronic Health Records"[Mesh] OR Medical Records Systems, Computerized[Mesh] OR ((health record* OR medical record* OR healthcare record* OR health care record* OR clinical record*) AND (digital OR electronic OR computerised OR computerized OR ambulatory))[Title/Abstract]	("mental health"[Title/Abstract]) OR ("psychiatric nursing"[MeSH Terms] OR psychiatric nurs*[Title/Abstract]) OR ("psychiatry"[MeSH Terms] OR psychiatry[Title/Abstract] OR psychiatrist[Title/Abstract]) OR (psychology[Title/Abstract] OR psychologist[Title/Abstract]))	uptake[Title/Abstract] OR adoption[Title/Abstract] OR usability[Title/Abstract] OR utility[Title/Abstract] OR utilisation[Title/Abstract] OR utilization[Title/Abstract] OR evaluate[Title/Abstract] OR evaluation[Title/Abstract] OR implementation[Title/Abstract] OR acceptance[Title/Abstract] OR acceptability[Title/Abstract]
Embase	electronic medical record/ or electronic health record/ or ((health record* or medical record* or healthcare record* or health care record* or clinical record*) and (digital or electronic or computerised or computerized or ambulatory)).ti,ab.	psychiatry/ or psychiatric nursing/ or (psychiatrist or psychologist or psychiatric nurs* or psychiatry or mental health).ti,ab.	(uptake or adoption or usability or utility or utilisation or utilization or evaluat* or implement* or accept*).mp.
PsycInfo	((health record* or medical record* or healthcare record* or health care record* or clinical record*) and (digital or electronic or computerised or computerized or ambulatory)).mp.	PSYCHIATRIC NURSES/ or PSYCHIATRY/ or (psychiatr* or psychologist or psychiatric nurs* or mental health).ti,ab.	(uptake or adoption or usability or utility or utilisation or utilization or evaluat* or implement* or accept*).mp.

Study selection criteria

Inclusion criteria described in Table 2 were used to screen articles identified in searches (S1 and S2).

Table 2: Inclusion and exclusion criteria

	Inclusion	Exclusion	S1*	S2**
Setting	Countries that are both (1) OECD member countries and (2) category 1 countries, as defined by The World Bank	Other countries	X	X
Timeframe	The last 10 years i.e. 1 st January 2010 – May 2019	Before 2010	X	X
Language	English only	Other languages	X	X
Population	Clinicians/ Health care professionals (e.g. doctors/ physicians, nurses)	Exclude studies focusing on: <ul style="list-style-type: none"> • Patients only • Pharmacists • Medical students 	X	X
	Mental Health clinicians (e.g. psychiatrists, mental health nurses etc.)	Other clinicians		X
Intervention	Clinician-facing Electronic Medical Records (EMRs) that have been implemented and used in health care settings. EMRs used by both clinicians and patients can be included.	<ul style="list-style-type: none"> • Patient-facing EMRs only • Studies where the EMRs was not implemented 	X	X
Comparison	Any		X	X
Outcome	Any measure related to: <ul style="list-style-type: none"> • Clinicians' experiences/perspectives/opinions of implemented EMRs that have been implemented • Uptake/adoption of EMRs • Engagement with EMRs • Measured and perceived benefits of EMRs implementation (e.g. patient safety and quality outcomes) • Human factors related to EMRs 	Studies that did not report any outcomes	X	X
Study type	• Peer reviewed primary research or evaluation studies	<ul style="list-style-type: none"> • Protocols • Opinion pieces/ editorials/ letters • Conceptual/design/development papers 		X
	• Reviews with documented search strategy only	<ul style="list-style-type: none"> • Reviews without documented search • Protocols • Opinion pieces/ editorial letters • Conceptual/ design/ development papers 	X	

*Strategy 1 (S1): Focus on published literature reviews on clinician-facing EMRs generally rather than mental health specific.

**Strategy 2 (S2) – Focus primary studies on EMRs used in mental health settings by mental health clinicians

Screening, data extraction strategy and synthesis procedures

Investigators (HLT, LT, LE, AG) independently conducted two-phase screening: (1) title and abstract screening, and (2) full-text screening. Another investigator (HLT) cross-checked 50% of the screened included and excluded articles at each phase to increase reliability and consistency of applying the inclusion and exclusion criteria.

Investigators (HLT, LL, LT, AG, LE) extracted information from the included studies into a standardised form; two investigators (LT, YZ) examined the form for consistency and cross-checked the data. The following data

were collected for each study: title, year, journal, first author, country, health care setting, research aims/questions, study design, methods, guiding theories, reported EMRs features and functional design features, useability by the health professional end-user, implementation determinants (barriers/facilitators). Outcomes and effects of implemented EMRs including patient outcomes, quality of care, and impacts on workflows, were also captured, analysed and summarised in a comprehensive synthesis led by the chief investigator (YZ), with input from other investigators (LE, LL, RC-W).

To capture implementation outcomes and process, we used both the Proctor Framework ⁽²⁶⁾ and the Consolidated Framework for Implementation Research (CFIR).⁽²⁷⁾ Proctor provides an organising framework to capture:

- Implementation outcomes (acceptability, adoption, appropriateness, costs, feasibility, fidelity, penetration, sustainability)
- Service outcomes (efficiency, safety, effectiveness, equity, patient-centeredness, timeliness)
- Client outcomes (satisfaction, function, symptomatology).

In the Proctor framework “client” refers essentially to patients or clients using services. ⁽²⁶⁾ However, to understand implementation of EMRs or any other program, the views, attitudes and characteristics of the health professionals who are the end-users of the EMRs are crucially important for uptake and embedding into routine practice. Furthermore, the adaptability of programs to local contexts which may include pre-existing or new resources, policies, organisational culture and stakeholder engagement need to be considered. Such factors are better captured under the CFIR.⁽²⁷⁾ The CFIR Framework guided the capture of:

- Intervention characteristics (intervention source, evidence strength and quality, relative advantage, adaptability, trialability, complexity, design quality and packaging, cost)
- Outer setting (patient needs and resources, cosmopolitanism, peer pressure, external policies and incentives),
- Inner setting (structural characteristics, networks and communications, culture, implementation climate, readiness for implementation)
- Knowledge and beliefs about the intervention (self-efficacy, individual stage of change, individual identification with organisation, other personal attributes of end-users)
- Process (planning, engaging, executing, reflecting and evaluating).

When applying the CFIR to the selected studies in our review, we found very few had reported on these implementation factors and we therefore focussed on the Proctor Framework only.

Extracted data were analysed for common features and summarised into tables. A narrative interpretation and synthesis of the results was developed by one investigator (YZ) with the other investigators cross-checking the results for accuracy of interpretation based on original sources.

The terminology used throughout this report is aligned with the Glossary of Usability Terms published by Human Factors International https://humanfactors.com/downloads/Glossary_of_Usability_Terms.pdf

Assessment of evidence quality

We used The Hierarchy of evidence (Table 3) which includes seven levels based on publications by the National Health and Medical Research Council (NHMRC)⁽²⁸⁾ the Oxford Centre for Evidence-based Medicine Levels of Evidence,⁽²⁹⁾ and Melnyk and Fineout-Overholt.^(30, 31)

This hierarchy was chosen because it includes additional levels that better described the types of studies identified in the literature search. Few randomised controlled trials were expected in this search and instead included literature reviews, interrupted time-series and descriptive studies (quantitative and qualitative).

Table 3. Hierarchy of evidence

Level	Description
I	Evidence obtained from a systematic review of all relevant randomised control trials
II	Evidence obtained from at least one well designed randomised control trial
III	Evidence obtained from well-designed controlled trials without randomisation
IV	Evidence obtained from well-designed cohort studies, case control studies, interrupted time series with a control group, historically controlled studies, interrupted time series without a control group or with case- series
V	Evidence obtained from systematic reviews of descriptive and qualitative studies
VI	Evidence obtained from single descriptive and qualitative studies
VII	Expert opinion from clinicians, authorities and/or reports of expert committees or based on physiology

We also used the NHMRC body of evidence matrix to summarise the evidence base, by considering five components, including evidence base, consistency, clinical impact, generalisability, and applicability, and graded each component from A to D (with A being excellent and D being poor).⁽²⁸⁾

Table 4. NHMRC body of evidence matrix

Component	A	B	C	D
	Excellent	Good	Satisfactory	Poor
Evidence base	Several level I or II studies with low risk of bias	One or two, level II studies with low risk of bias or a systematic review or multiple level III studies with low risk of bias	Level III studies with low risk of bias, or level I or II studies with moderate risk of bias	Level IV studies, or level I to III studies with high risk of bias
Consistency	All studies consistent	Most studies consistent and inconsistency may be explained	Some inconsistency reflecting genuine uncertainty around clinical question	Evidence is inconsistent
Clinical impact	Very large	Substantial	Moderate	Slight or restricted
Generalisability	Population/s studied in body of evidence are the same as the target population in question	Population/s studied in the body of evidence are similar to the target population in question	Population/s studied in body of evidence differ to target population in question, but it is clinically sensible to apply this evidence to target population	Population/s studied in body of evidence differ to target population and hard to judge whether it is sensible to generalise to target population

Applicability	Directly applicable to Australian context	Applicable to Australian context with few caveats	Probably applicable to Australian context with some caveats	Not applicable to Australian context
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Findings

The S1 strategy yielded 447 literature reviews (161 from PubMed, 276 from Embase and 10 from PsycInfo). One additional paper was identified through other sources. Seventy duplicates were removed, and after abstract screening 348 papers were rejected because they did not meet the inclusion and exclusion criteria, and 22 were rejected after full-text review (Figure 1A).

The S2 strategy yielded 1361 results relevant to mental healthcare professionals or settings (564 from PubMed, 553 from Embase and 244 from PsycInfo). Another two papers were identified from other sources. After abstract screening, 1054 were rejected because they did not meet the inclusion and exclusion criteria and 55 studies underwent full-text review (Figure 1B).

Fourteen studies on EMRs use in mental health settings were included (Figure 1B), and an additional eight systematic reviews of EMRs use in the general health system were included, (Figure 1A).

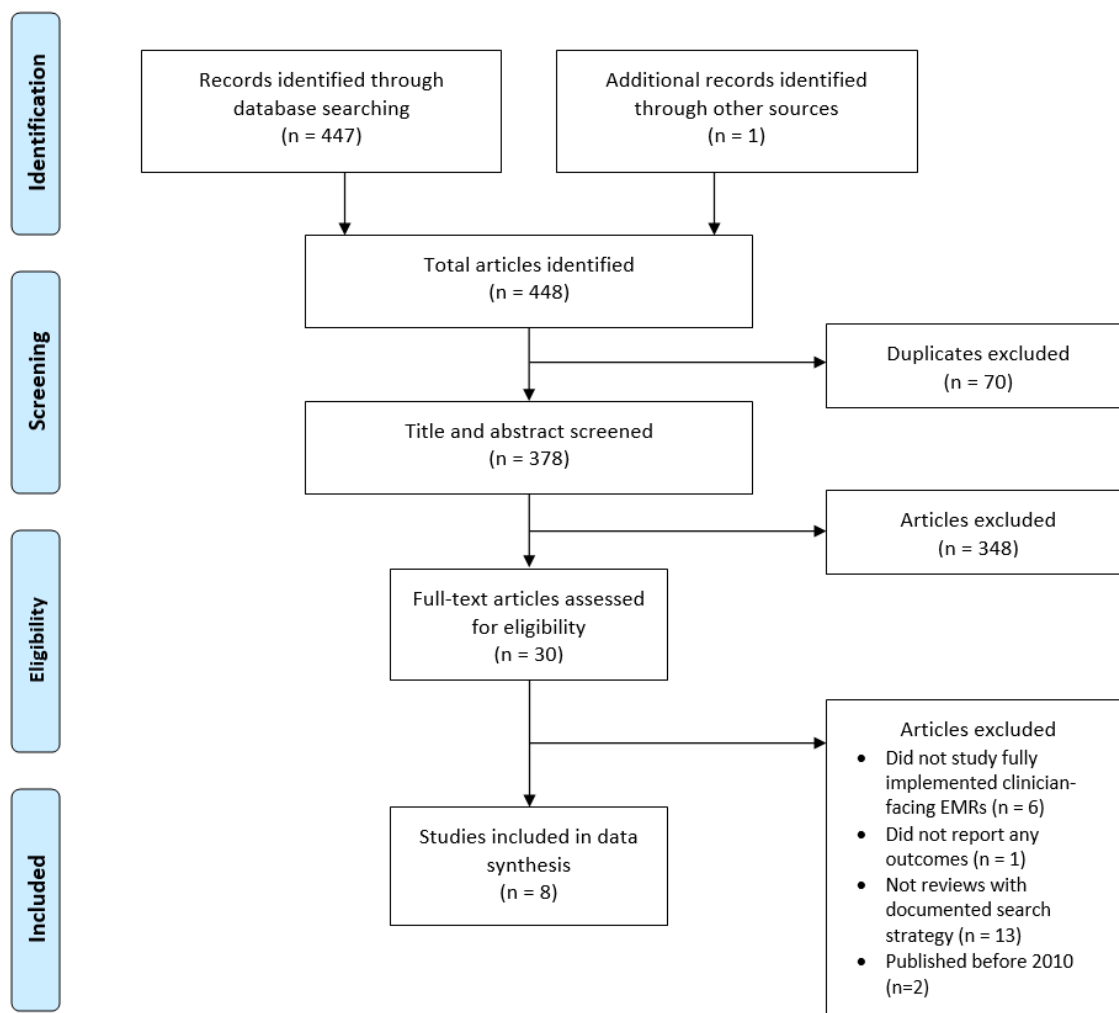


Figure 1A. Selection of studies according to inclusion and exclusion criteria – peer-reviewed literature reviews EMRs use in the general health system

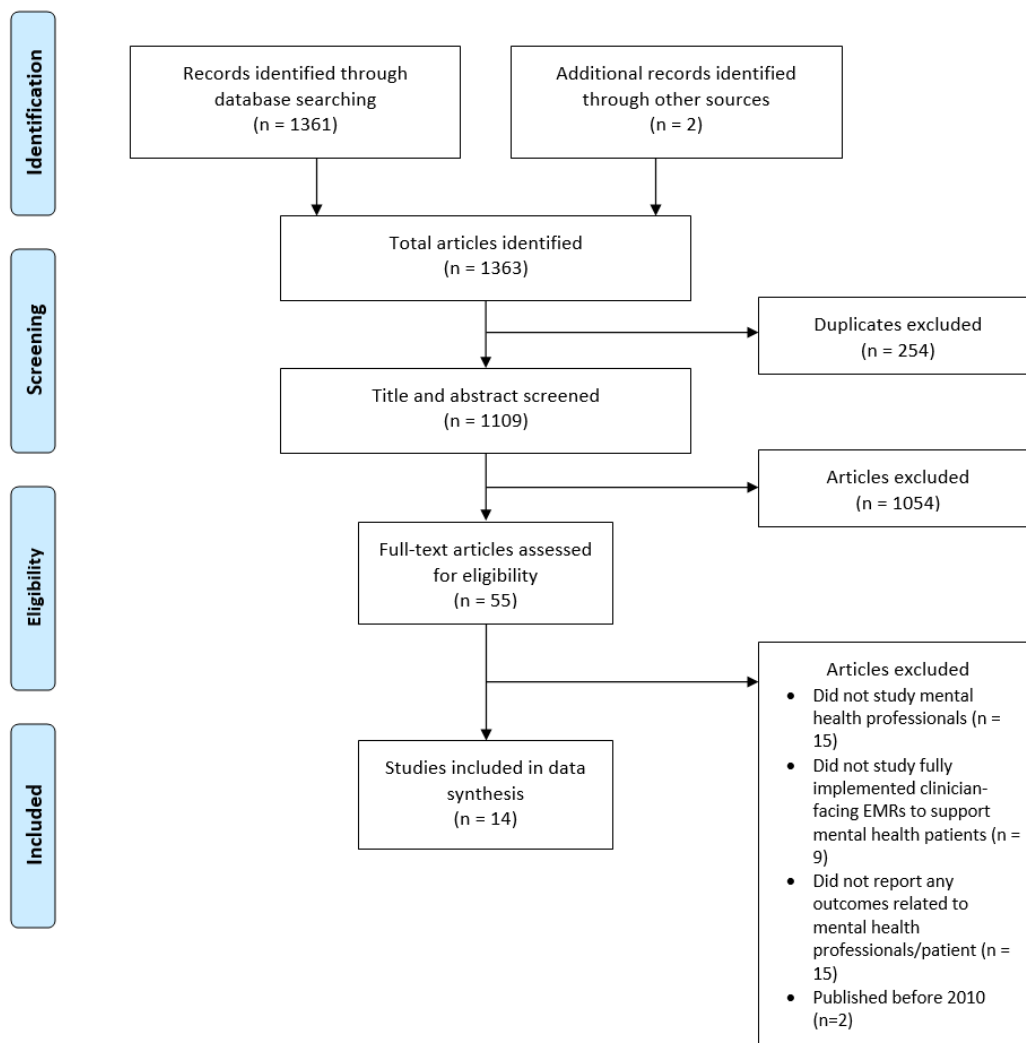


Figure 1B. Selection of studies according to inclusion and exclusion criteria – original peer-reviewed publications focussed on EMRs use in mental health settings

A total of 14 studies focussed on EMRs in mental health settings with most of these (n=9, 64%) originating in the USA, including one systematic review which focussed only on studies from the USA ⁽³²⁾. Two studies were from Canada, one from France and one from the United Kingdom (UK), and one systematic review which included publications from several countries. ⁽³³⁾ We also included eight literature reviews on EMRs use in the general health system, each of which included publications from a variety of countries, and there was one systematic review of reviews (Table 5). ⁽³⁴⁾ There was one systematic review of EMRs in the general health system which originated in Australia and that included Australian publications. There were no publications on EMRs as implemented in the mental health setting in Australia.

Table 5. Summary of included studies

Studies focussed on EMRs in mental health settings						
Study	Country	Setting	EMRs implemented	Participants	Method	Guiding theory/model
Boyer et al. (2010)	France	Psychiatric hospital	Hospital EMRs Coded data Unstructured text Scanned documents	115 health care professionals	Qualitative: semi-structured interviews	Theory of continuous quality improvement
Bruns et al. (2018)	USA	Mental health facilities	Standard fields for youth/family information Diagnoses/assessments Coordinated care plan Communication among team members Routine reporting	34 Wraparound facilitators / care coordinators	Quantitative: RCT	Not specified
Druss et al. (2013)	USA	Mental health services in general – ranging from solo practices to hospitals	EMRs and RHR in general – not specified	Not specified Also included use of EHR by people with mental illness	Literature review – claims to use Cochrane Guidelines. Do not report number of studies identified; inclusion or exclusion criteria etc. Very poor reporting of review methodology	Not specified
Golberstein et al. (2018)	USA	Primary care clinics	Mental health e-consult with psychiatry ordered by primary care Specific mental health questions asked by primary	Primary care providers (PCPs) from 45 clinics	Quantitative: RCT	Not specified

			care about patients seeing psychiatrists Payment incentive			
Huerta et al. (2015)	USA	Mental health clinic	e-prescribing tool Alerts Intra-office messaging Task assignments	35 mental healthcare professionals	Quantitative: Cross-sectional survey	Not specified
Jetelina et al. (2018)	USA	Primary Care	Integrated behavioural health (BH) into primary care through Epic EHR with referral pathways and psychological assessment, clinical and social information, goal setting, documentation and tracking; screening tools – point-and-click tools, drop-down menus, auto calculators and auto population of some fields	6 community care clinics with a mix of primary care and psychology and social work providing care to the under-insured or uninsured	Mixed: case control + structured observations and interviews with practice members	Not specified
Madden et al. (2016)	USA	Medical practice	Not specified	Health insurance plan members with depression or bipolar disorder	Quantitative: Cohort study	Not specified
Martin et al. (2018)	Canada	Psychiatric hospital	Not specified	24 nurses; patients' charts	Mixed: Interviews and review of medical records	Not specified
Reyes-Portillo et al. (2018)	USA	Child and youth psychiatry clinic	Alert in existing EMRs that triggered a safety plan when suicidal ideation, plan or attempt recorded	40 mental health clinicians	Quantitative: Case-control study	Not specified

Riahi et al. (2017)	Canada	Mental health facility	Comprehensive EMRs – Closed loop medication administration, assessment tools, D&A screening, care plan, details of restraint and seclusion, clinical practice guidelines (Schizophrenia), infection control, business intelligence	1300 facility employees	Quantitative: Case study	Kotter's change model and The Canada Health Infoway change management framework
Ser et al. (2014)	UK	Mental health hospitals	Mental Health Hospitals connectivity with the central NHS database Messaging service	33 hospital staff	Qualitative: semi-structured interviews	Not specified
Strudwick & Eyasu (2015)	Germany, England, France, Finland, USA, Sweden	Mental health / psychiatry clinical settings	Not specified	Nurses	Literature review	Not specified
Tanguturi et al. (2017)	USA	Psychiatric emergency service	Suicide risk assessment template created within existing EMRs – Columbia Suicide Severity Rating Scale	300 evaluations performed by 36 psychiatry residents	Quantitative: chart review	Not specified
Xiao & Acosta (2016)	USA	Adult outpatient psychiatric clinic	e-charting custom developed for use in the clinic, included intake notes, evaluation/assessment, progress notes and e-medication monitoring	105 charts review pre-implementation and 141 charts reviewed post-implementation	Quantitative: chart review	Not specified

Literature reviews relevant to EMRs use in the broader health system – Not specifically focussed on mental Health

Study	Country	Setting	EMRs implemented	Number of included studies	Review type	Guiding theory/model
Boonstra & Broekhuis (2010)	USA, Canada, Norway, Ireland	General health settings	Not specified (EMRs in general)	22	Systematic review	Not specified
Castillo et al. (2010)	Australia, New Zealand, USA, Canada, Germany, Denmark, France, Sweden, Hong Kong	General health settings	Not specified (EMRs in general)	68	Systematic review	Innovation-diffusion process by Rogers, Information and communication technology roles in the knowledge management processes
Gephart et al. (2015)	USA, Sweden	General health settings	Not specified (EMRs in general)	5	Systematic review	Not specified
Goldstein et al. (2014)	USA, Austria, Brazil, Canada, Switzerland	General health settings	Not specified (EMRs in general)	12	Literature review	Not specified
Goldzweig et al. (2015)	USA, France, Canada, Austria	Mostly U.S. academic medical centres.	Categorised radiology ordering EMRs interventions into 4 categories: A: Display of information e.g. cost of test, guideline	23	Systematic review	Not specified

			<p>B: Patients' clinical information linked with guidelines and recommendations</p> <p>C: Soft-stop if order contradicts guidelines etc. but could be over-ridden</p> <p>D: Hard-stop software prevented inappropriate ordering</p>			
Lau et al. (2012)	USA, UK, Canada, France, Netherlands, Australia, Austria, Belgium	General health settings	The EMRs features in these reviews varied widely, ranging from the types of information systems and technologies used, the functional capabilities involved, to the intent of these systems. Examples are the review of administrative registers, reminders, and diabetes management decision support tools	58	Canada Health Systematic review of systematic reviews	Infoway Benefits Evaluation (BE) framework.
Meißner & Schnepf (2014)	USA, Australia	Residential aged care facilities	Not Specified	7	Systematic review	Not specified
Nguyen et al. (2014)	USA, Denmark, England, Norway, Canada, Sweden, Australia,	General health settings	Included all EMRs often used in the hospital context with a medical/clinical focus as the EHR as an overall collection of a patient's health information from all sources; an Electronic Patient Record	98	Narrative review	DeLone and McLean's conceptual framework; 'Lean Thinking'

<p>Holland, Ireland, Israel, Austria, Cyprus, France, Serbia, Sweden, Japan, Korea, Kuwait, Cameroon, Uganda</p>		<p>(EPR) as a patient’s medical information from a single healthcare provider; and a Personal Health Record (PHR), containing information entered by the doctor and the patient.”</p>			
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Quality assessment of selected studies

When applying the hierarchy of evidence presented in Table 3 to the included studies that focussed on EMRs in mental health, we found that most studies were assessed at level IV or below because they consisted predominantly of cohort studies or case control studies or single descriptive or qualitative studies (Table 6). There were only two randomised controlled trials. ^(35, 36) There were two literature reviews, however, one was of poor quality as it did not report on their selection processes nor did they state how many papers were included in their final synthesis (Table 6).

All of the 8 systematic literature reviews of EMRs used in the broader health system and not just mental health settings, scored level V simply because they were systematic reviews.

Table 6. Quality of evidence assessment of included studies that focussed on EMRs in mental health

Study	Country	Setting	Method	Level of evidence
Boyer et al. (2010)	France	Psychiatric hospital	Qualitative: semi-structured interviews	VI
Bruns et al. (2018)	USA	Mental health facilities	Quantitative: RCT	II
*Druss et al. (2013)	USA	Mental health services in general	Literature review	VI
Golberstein et al. (2018)	USA	Primary care clinics	Quantitative: RCT	II
Huerta et al. (2015)	USA	Mental health clinic	Quantitative: Cross-sectional survey	VI
Madden et al. (2016)	USA	Medical practice	Quantitative: Cohort study	IV
Martin et al. (2018)	Canada	Psychiatric hospital	Mixed: Interviews and review of medical records	V
Reyes-Portillo et al. (2018)	USA	Child and youth psychiatry clinic	Quantitative: Case-control study	IV
Riahi et al. (2017)	Canada	Mental health facility	Quantitative: Case study	VI
Ser et al. (2014)	UK	Mental health hospitals	Qualitative: semi-structured interviews	VI
Strudwick & Eyasu (2015)	Germany, England, France, Finland, USA, Sweden	Mental health / psychiatry clinical settings	Systematic review	V
Tanguturi et al. (2017)	USA	Psychiatric emergency service	Quantitative: chart review	VI

**Although this was a systematic review the authors provided limited information about their methodology, they did not report on the selection process nor did they state how many papers were included in their final review. Therefore, quality was rated as VI rather than V.*

Only 5 of the 22 included studies used a supporting theoretical framework to organise the constructs assessed in their studies (Table 1). Most studies conducted evaluations shortly after implementation, with most of the papers based in mental health services assessing outcomes at only 12 months post implementation. However, longer periods of time are often needed to demonstrate service level impact and patient-related outcomes.

Question 1: What is the effectiveness of implemented EMRs in terms of usability, user experience and human factors, uptake and clinician and patient safety and quality outcomes in mental health services?

The features of EMRs were not reported in 3 of the 11 primary studies specific to mental health settings, and there was a wide range of features reported in the remaining 9 papers. The EMRs ranged from relatively simple and focussed on a single condition or presentation to comprehensive multi-functional systems that provided business intelligence (services delivered, costs, etc). EMRs described in these 9 studies included embedded assessment tools, e-ordering of pathology, imaging and pharmacy. Examples include automated alerts to develop safety plans for children and youth with suicide ideation⁽³⁷⁾, embedding a suicide screening tools into emergency department software⁽³⁸⁾, or embedding a pathway prompt for e-consultation between a primary healthcare provider and a psychiatrist.⁽³⁶⁾ Several studies simply described EMRs in terms of storage of clinical notes and test results to improve accuracy and completeness of information.^(32, 33, 39, 40)

The literature review by Druss et al.⁽³²⁾ did not provide any specific details, however, they included published papers that assessed any type of EMRs or EHRs including e-ordering of pathology, imaging and pharmacy.⁽³²⁾ They did not report on different aspects separately. Furthermore, although this review cites Cochrane methodology, they did not report the final number of papers identified for inclusion in the review and they did not report specific inclusion or exclusion criteria, nor did they provide a flowchart describing how they selected the included studies.⁽³²⁾

Only one of the seven general review articles provided a comprehensive description of the EMRs used among their included studies. The review by Goldzweig et al.⁽⁴¹⁾ assessed whether decision support tools embedded in the EMRs could be used to change behaviour when ordering radiological imaging. They divided the EMRs tools into information only (e.g. displaying information or guidelines), patient specific information matched with recommended guidelines (e.g. appropriateness of the imaging for particular symptoms or other indications), a soft-stop where the clinician could over-ride the software but had to provide a reason for ignoring the guidelines and a hard-stop where the software blocked the order.⁽⁴¹⁾ The other six reviews simply talked about EMRs or EHRs without further specifying the EMRs type, features and functions. Nguyen et al.⁽⁴²⁾ used an all-encompassing definition of EMRs for their literature review based on the definitions operationalized by the International Organization for Standardisation (ISO) and included all EMRs "...often used in the hospital context with a medical/clinical focus as the EHR as an overall collection of a patient's health information from all sources; an Electronic Patient Record (EPR) as a patient's medical information from a single healthcare provider; and a Personal Health Record (PHR), containing information entered by the doctor and the patient."⁽⁴²⁾

Implementation Outcomes

Using the Proctor model of implementation outcomes and using the constructs of acceptability, appropriateness, adoption, feasibility and fidelity of the EMRs as implemented, we synthesised extracted data from included studies to reflect these attributes.

The systematic reviews and the mental health specific papers were combined to support data synthesis (Table 7). Of the 22 included studies, 15 assessed implementation outcomes, with "acceptability" of EMRs being assessed most frequently.^(32, 33, 37, 39, 41-51) Only one study measured acceptability by using a validated questionnaire tool that included an acceptability sub-scale.⁽³⁵⁾ The other studies simply reported the proportion of clinicians who indicated that the EMRs was acceptable or simply stated that clinicians were satisfied with the EMRs.

Adoption was reported in another nine studies and appropriateness was reported by nine studies^(35, 39, 41, 42, 44, 47-50). Information on feasibility and fidelity of the implemented EMRs were not reported.

Acceptability of EMRs was reported both as a positive outcome for clinicians and as a negative, sometimes in the same study (Table 7). The strength of the positive results was often low, e.g. scores of 2.6-3.6 on a 5

point acceptability scale. ⁽³⁵⁾ According to the extensive systematic review by Nguyen, acceptability was likely to be high when usability and reliability were also high, and technical support was readily available. ⁽⁴²⁾ Negative outcomes with regards to acceptability of EMRs included negative perceptions and attitudes, lack of perceived IT skills, doubts about the ability of EMRs to improve quality, taking up clinical time and lack of trust in the implemented systems. Clinicians also worried about loss of autonomy, and mismatched priorities of managers/leaders compared with clinicians on the frontlines of care (Table 7).

Table 7. Implementation Outcomes (acceptability, adoption, appropriateness) of EMRs

Positive outcomes	Negative outcomes
Acceptability	
<ul style="list-style-type: none"> 70% of EMR users in a French psychiatric hospital had positive perceptions about EMRs ⁽⁵²⁾ Acceptability scores ranged from 2.6-3.6 on a 5 point scale ⁽³⁵⁾ Overall clinicians were satisfied with the EMRs ⁽⁴³⁾ Nurses acceptance of EMRs improved over time⁽³³⁾ Information was of better quality and easier to read ⁽³³⁾ Clinicians used the EMR tools but would use them more often if provided with training Nurses in mental health settings felt more respected when using EMRs ⁽⁵¹⁾ Acceptability was high when the usability and reliability of EMRs was high, and when technical support was available ⁽⁴²⁾ Many clinicians preferred EMRs over paper-based clinical documentation ⁽⁴²⁾ 	<ul style="list-style-type: none"> Doctors have negative attitudes and perceptions of EMRs ⁽⁵²⁾ Doctors express doubts about EMRs contributing to improved care quality⁽⁴⁷⁾ Clinicians worry about losing autonomy⁽⁴⁷⁾ ⁽⁵¹⁾ Some clinicians are not used to EMRs and feel they lack IT skills ⁽⁴⁵⁾ EHR take up time that could be spent looking after patients⁽⁴⁵⁾ Mismatched priorities between leaders/managers implementing EMRs and the needs of end users⁽⁴⁵⁾ Lack of trust in the EMRs system – concerns about stability and clinical workflows and processes ^(42, 45)
Adoption	
<ul style="list-style-type: none"> EHR facilitators from both sites demonstrated robust use of the system ⁽³⁵⁾ EHR were easy to learn and clinicians liked the e-prescribing and intra-office messaging ⁽⁴³⁾. Clinicians felt the EHR was a valuable tool ⁽³³⁾ The documentation and completion of clinical notes and assessments at intake and progress, and medication monitoring increased significantly after the EMRs system was implemented. Physicians in larger practices and in practices affiliated with a hospital are more likely to use EMRs⁽⁴⁷⁾ Physicians who are employed by a medical practice are more likely to use EMRs ⁽⁴⁷⁾ Computerised clinical decision-support improves appropriate use of diagnostic radiologic test ordering ⁽⁴¹⁾. 	<ul style="list-style-type: none"> User attitudes toward EMRs is critical for adoption EMRs less likely to be used by psychiatrists than other physicians⁽³²⁾ Adoption slow among psychiatrists/psychiatric practices - <50% of 440 US organisations surveyed ⁽³²⁾ EMRs adoption rate and usage has been low, although this is gradually increasing⁽⁴²⁾ Delayed or retrospective entering of data; doctors leaving data entry to administrative staff⁽⁴⁵⁾ Clinicians felt that EMRs did not capture all necessary information and therefore could not solely rely upon it ⁽³³⁾ A lack of computers, downtime, ^(33, 47) Physicians reported that technical factors might be a barrier to EMRs adoption e.g. physicians’ lack of computer skills, lack of technical training

Positive outcomes	Negative outcomes
	<p>and support, complexity of the system (navigation), lack of customizability & reliability, interconnectivity/ standardization, and lack of computers/hardware present some challenges ^(47, 50)</p> <ul style="list-style-type: none"> • Owners of practices, especially small practices less likely to use EMRs ⁽⁴⁷⁾ • High start-up and maintenance costs and uncertainty about return on investment are identified barriers to adoption ^(42, 47, 50)

Appropriateness

<ul style="list-style-type: none"> • Adoption and satisfaction was higher in organisations/practices where the EMRs is designed as “fit for purpose” ^(42, 47) 	<ul style="list-style-type: none"> • EHR system did not integrate well with their existing work practices; unable to tailor the system locally; lack of integration with other systems; lack of understanding between leadership and front-line workers ^(45, 50) • Duplication of charting, and not “user-friendly” EHRs as being the biggest drawbacks of the technology ⁽³³⁾ • Mismatch with workflows and limited interoperability negatively influence perceived appropriateness ^(49, 50, 53) • Lack of uniform standards may lead to incompleteness of records ⁽⁵⁰⁾ • Usability and usefulness of EMRs required further improvement ⁽⁴²⁾ (i.e. the degree to which EMRs are perceived as being consistent with existing values, past experiences, and needs of end users), are also critical factors influencing adoption ⁽⁵³⁾
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Service level outcomes

The service level outcomes were also not clear-cut, with both negative and positive results being reported in terms of efficiency and timeliness, and effectiveness (Table 8). Only two studies reported on patient centredness and four reported on safety (Table 8). The main negative outcomes regarding efficiency and timeliness included: increasing workload because of additional time spent completing EMRs; double handling of clinical information collected at the bedside on paper; and misalignment with clinical workflows, sometimes leading to workarounds which may result in patient harm (Table 7). Positive outcomes included more timely, complete, legible and easily accessed patient records to support clinical decision-making, especially where screening and assessment tools were concerned and where decision support tools had been implemented in the EMRs (Table 8).

Although improved patient safety is often quoted as a positive influence of EMRs, we found only 3 studies in the mental health literature reporting on increased safety mainly due to e-prescribing and systematic detection of suicide risk and development of management plans to prevent suicide.^(38, 43, 52) In one study of radiology ordering, introduction of decision support tools where a “hard-stop” was put in place for ordering that did not conform with guidelines and the patients presentation, patients were harmed because of omitted needed tests.⁽⁴¹⁾

Table 8. Service level outcomes (efficiency, timeliness, effectiveness, patient centredness and safety)

Positive outcomes	Negative or neutral outcomes
Efficiency and timeliness	
<ul style="list-style-type: none"> • More complete and rapid (timely) access to patient information⁽⁵²⁾ ⁽⁴⁰⁾ • Use of EMRs system promotes efficiency through automated reminders and a trend towards less administrative tasks by clinicians ⁽³⁵⁾ • Improved perceptions of how easy it is to obtain a mental health consultation ⁽³⁶⁾ • The e-prescribing tool enabled easier/quicker access to patient medication information ⁽⁴³⁾ • Improvement in the quality of residents' records leads to improvement in the quality of care ⁽⁵¹⁾ • Commonly reported that completeness and accuracy of documentation increased ⁽⁴²⁾ • Improved workflows and increased time savings reported by clinicians during follow-up visits because specific tools/assessments were completed at the initial visit ⁽⁴⁴⁾ 	<p>Negative:</p> <ul style="list-style-type: none"> • Increased time spent writing on EMRs reduced the time for care, reduced productivity ^(47, 49, 50, 52) • Aspects of EHR design not suitable for mental health settings⁽⁴⁵⁾ • Users' work practices and system requirements not aligned; ⁽⁴⁵⁾ • EMRs structure not user friendly – does not align with the way consultations are undertaken⁽⁴⁵⁾ • Duplication of work for nurses – double handling – paper first at bedside, then enter into computer ⁽³³⁾ • Concerns about increased workload for clinicians – learning how to use the EMRs ⁽⁴⁷⁾ • Work-arounds implemented by nurses – lower efficiency and more time required⁽⁴⁹⁾ <p>Neutral:</p> <ul style="list-style-type: none"> • No change in time taken to access mental health services ⁽⁵⁰⁾
Effectiveness	
<ul style="list-style-type: none"> • Better coordination and cooperation between professionals ⁽⁵²⁾ • EHR documentation more complete compared to paper charts ⁽⁴⁰⁾ • Adherence to cognitive behavioural therapy for psychosis and vocational rehabilitation guidelines increased⁽⁵⁴⁾ • Adherence to metabolic monitoring increased slightly⁽⁵⁴⁾ • Small but significant differences were observed in outcome measures for clinicians in clinics where a suite of mental health screening, assessment, monitoring and referral tools were embedded within the software.⁽⁴⁴⁾ 	<p>Negative:</p> <ul style="list-style-type: none"> • Clinicians less effective because of stopping and starting consultation in between filling-in EMRs ⁽⁴⁷⁾ • Nurses had difficulty accessing information needed to make patient care decisions ⁽⁴⁹⁾ <p>Neutral:</p> <ul style="list-style-type: none"> • Little evidence of any impact (positive or negative) on overall service quality ⁽³⁵⁾ • Adherence to antipsychotic monotherapy guidelines increased initially but fell back by 12 months ⁽⁵⁴⁾ • No significant change in patient clinical outcomes when comparing clinics with EMRs those without ⁽⁴⁴⁾
Patient centredness	
None reported	<ul style="list-style-type: none"> • Presence of EMRs may conflict with the human and relational component required for quality clinical practice ^(47, 52)
Safety	
<ul style="list-style-type: none"> • EMRs resulted in increased patient safety because of more accurate documentation e.g. of suicidal ideation or risk, e-prescribing and less errors, ^(38, 43, 52) 	<p>Negative:</p> <ul style="list-style-type: none"> • Decreased ordering of appropriate tests ⁽⁴¹⁾ <p>Neutral:</p> <ul style="list-style-type: none"> • Although data are gathered on suicide ideation/risk this is done inconsistently⁽³⁸⁾

Specific client or patient reported outcomes, were mentioned in only 8 of the 22 studies. Mostly there was little or no evidence that EMRs had any effect on patient satisfaction, nor on treatment outcomes, although one study showed improved patient satisfaction with care integration and coordination,⁽⁴⁴⁾ and in another study, the number of completed safety plans increased for children and youth with suicide risk ⁽³⁷⁾.

Question 2: Why or why not were the EMRs effective in Mental Health Services?

A synthesis of the above literature showed that EMRs had both positive and negative effects, and sometimes both positive and negative effects were reported in the same study, making it difficult to draw out strong conclusions.

- Positive implementation and service outcomes were associated with specific mental health EMRs tools that were embedded within existing EMRs systems, and when the EMRs recognised the natural workflows of clinicians and were viewed by clinicians as “appropriate” to their clinical context.
- The highest number of negative outcomes reported was related with lack of appropriateness of the EMRs to the clinical context, including a mismatch with workflows, complex navigation which limited ease of access to information important for clinical decision-making.
- Several studies reported that having to complete the EMRs interfered with the consultation process and was sometimes seen as a barrier to the recognised need for relationship relationships and rapport building between the clinician and patient, especially in the mental health setting.
- Negative attitudes of clinicians to the EMRs, their self-perceived limited “IT skills”, and perceived misalignment of the EMRs with their natural clinical workflows were barriers to adoption.
- Specific part of EMRs such as e-prescribing and medication monitoring, or suicide risk assessment and development of preventative plans were seen as positive in terms of implementation outcomes and services outcomes, especially in terms of efficiency and effectiveness.
- Efficiency when expressed in terms of timeliness (i.e. the time taken to complete the medical records) when using EMRs in mental health and in general, was reported as both, negative and positive. Negative outcomes included increased workload, leaving EMRs completion for nurses, nurses having to develop work-arounds when using EMRs and nurses and doctors double handling of information – information collected at the bedside or in the consultation setting on paper that had to be entered into the EMRs after the encounter with the patient. This was compounded by limited access to computers (reported mainly by nurses)
- New EMRs or EMRs modules that were difficult to navigate, that did not align with workflows and that did not integrate with existing EMRs systems were time consuming for clinicians and were less likely to be adopted.
- Clinicians reported that training in how to use EMRs, in the benefits of EMRs to their clinical practice and in IT skills would increase adoption of EMRs in routine clinical care.
- EMRs system stability, minimal down-time and easy access to technical support would also improve attitudes towards EMRs and their adoption.
- EMRs where there was a mismatch between what the managers and “clinical leaders” felt was needed and what was actually needed at the frontlines was also associated with poor adoption.

Gaps in the evidence

- There is a paucity of peer reviewed literature on EMRs use in terms of acceptability, adoption, and appropriateness, specifically in the mental health context.
- The existing literature shows wide variability in the types of EMRs assessed, the way that data were collected and reported in identified and included studies about the implementation and service outcomes, and wide variability in the design of studies reporting on these factors.
- The quality of identified studies was generally low (Table 9), with only two randomised controlled trials, although to study implementation factors that help or hinder adoption of EMRs in the health system,

rigorously designed mixed methods implementation/evaluation studies are needed to understand in more detail the human factors and experiences of various stakeholders in addition to collecting specific quantitative data on EMRs usefulness.

- Furthermore, none of the identified studies reported on using any kind of formative evaluation or co-design approaches when developing and implementing EMRs in the clinical eco-system.
- Most studies reported outcomes in the short term (1 to 2 years for the mental health EMRs studies) and the adoption of new systems by clinicians is usually a longer-term endeavour, which requires changes in attitude and organisational culture change.

Table 9 provides the NHMRC matrix, which was requested by the Sax Institute to provide an overview of the strength of the evidence base. However, the matrix has been developed when assessing literature related to a clinical problem or intervention (diagnosis, treatment) rather than health services infrastructure, as in our review. We attempted to assign the categories in the matrix by adjusting some of the wording e.g. changing “clinical question” to “research question” to the evidence base in our review.

Table 9. NHMRC matrix to summarise the evidence base

Shaded squares represent where the evidence identified in this review falls within the matrix.

Component	A	B	C	D
	Excellent	Good	Satisfactory	Poor
*Evidence base^A	Several level I or II studies with low risk of bias	One or two level II studies with low risk of bias or a systematic review or multiple Level III studies with low risk of bias	Level III studies with low risk of bias, or level I or II studies with moderate risk of bias MOSTLY level IV or lower, although there were two rcts (level II) and several systematic reviews of high quality	Level IV studies , or level I to III studies with high risk of bias
Consistency^B	All studies consistent	Most studies consistent and inconsistency may be explained	Some inconsistency reflecting genuine uncertainty around the research question	Evidence is inconsistent
**Practice impact	Very large	Substantial	Moderate	Slight or restricted
Generalisability	Population/s studied in body of evidence are the same as the target population in question	Population/s studied in the body of evidence are similar to the target population in question	Population/s studied in body of evidence differ to target population in question but it is clinically sensible to apply this evidence to target population	Population/s studied in body of evidence differ to target population and hard to judge whether it is sensible to generalise to target population
Applicability	Directly applicable to Australian context	Applicable to Australian context with few caveats	Probably applicable to Australian context with some caveats	Not applicable to Australian context

A Level of evidence determined from the NHMRC evidence hierarchy as in Table 1.

B If there is only one study, rank this component as 'not applicable'. National Health and Medical Research Council (2009) NHMRC levels of evidence and grades for recommendations for guideline developers.

Canberra: National Health and Medical Research Council. Available from:

https://www.nhmrc.gov.au/files/nhmrc/file/guidelines/developers/nhmrc_levels_grades_evidence_120423.pdf

*We used the seven level hierarchy of evidence which includes the ability to grade studies that were descriptive and those that used qualitative methods

** We have changed this category to "practice impact" rather than clinical impact as the review is not clinically focussed

Discussion

Both negative and positive impacts of implemented EMRs were reported in the 22 studies included in this rapid review. Identified potential benefits of EMRs in mental health settings include:

- Standardised recording of patient information to improve accuracy and completeness, but the standardisation should not be so rigid that clinicians cannot record additional important information relevant to clinical decision-making.
- Ability to use standardised screening and assessment tools and early identification of risks or problems that can be treated in a more timely manner.
- Improved responsiveness, including speed of access to the information needed for clinical decision making.
- Supporting patient centred approaches – individualised systematic assessments and matching services to the needs of the patient through shared goal setting and care planning - only two papers on mental health EMRs in our review, reported on this aspect.
- Improved information-sharing among all clinical team-members involved in care through one central EMRs that contains all needed information for decision-making and has the potential for reducing unnecessary care duplication and ensuring that needed care is not missed and supporting care coordination.
- Better communication among clinical team members with some EMRs embedding clinician-to-clinician messaging and in some cases, clinician to patient messaging.

One of the two RCTs (level II evidence) showed a non-significant trend that staff were spending less time on administrative tasks, significantly less time sending reminders to families, and significantly more time reviewing patient progress and using measurement-based case strategies, when implementing an integrated model of care - “wraparound”.⁽³⁵⁾ The other RCT showed improved self-efficacy, skills and confidence among primary care clinicians who used eConsults and referrals embedded in their EMRs when providing services for depression.⁽³⁶⁾

Impacts on patient outcomes were seldom reported, except for improved medication safety because of e-prescribing, and improved, earlier safety planning for suicide prevention among people identified at increased risk of suicide. Related to this, decision support tools that enabled guidance according to standardised assessment tools to identify patients at risk were reported to be acceptable and more likely to be adopted into routine care. However, three studies reported no change in patient outcomes, with one of these reporting an initial improvement in adherence to prescribing guidelines which slipped back to pre-EMRs implementation levels at 12 months. [31,36,50]

Human Factors: End-user attitudes and characteristics influence adoption of EMRs

Negative attitudes of the end-users (clinicians) to EMRs solutions are associated with poor uptake and adoption of these solutions. The negative attitudes among clinicians, stem from their negative perceptions of the value EMRs in clinical practice and doubts about EMRs relevance to clinical workflows and patient safety.

EMRs implemented using a “top-down” approach resulted in limited adoption. For better acceptability and adoption, clinicians on the frontlines of care need to have input into the decision-making processes about the functionality and design of EMRs that they are expected to adopt. However, decision-making often occurs at the clinical leadership or management levels without the benefits of a deep understanding of the contexts and workflows at the frontlines of care. Several literature reviews included in our rapid review

highlighted the influence of organisational culture and policy as potentially complicating factors for implementation of EMRs, especially where support from stakeholders was uneven.

Clinicians' perceptions about their technical skills to use EMRs effectively is a significant barrier. Adoption and acceptability of EMRs by clinicians is more complete and more rapid when implementation includes easy access to technical support for end-users, and when clinicians are provided with meaningful training by trainers who understand both, the clinical context and the technology.

Trust among clinicians about the stability and accuracy of the EMRs was another important factor for adoption. Frequent EMRs down-time increased workloads through double handling of information as clinicians kept paper copies of key patient information as a work-around. Even without excessive down-time, there was evidence that the implementation of EMRs at times increased workloads for the end-users and interfered with the provision of care. This is particularly pertinent in the mental health setting where building rapport between patients and clinicians is essential to treatment.

Furthermore, when EMRs do not align smoothly with natural workflows there may be double handling of information, potential for error, and inefficient use of time, e.g. when information collected on paper at the bedside needs to be entered manually into the EMRs by a clinician at a later time. Easy access to EMRs with streamlined user credentialing (usernames and passwords) and easy, intuitive navigation of the software that aligns with natural workflows also improves adoption, efficiency and effectiveness of EMRs.

Decision support tools embedded in the EMRs have been shown to be effective when the recommendations embedded in software take into account individual patient characteristics and allow for rules to be overridden by clinicians when reasons are provided. EMRs decision support tools that rigidly apply a "hard-stop" have been shown to have unintended consequences including patients missing out on needed tests resulting in delayed diagnosis and associated disease progression.

Literature quality: implications for interpretation

The quality of evidence was generally poor and there was a lack of evaluation, implementation and outcomes data related to mental health EMRs as implemented in the Australian context, with most studies originating in the USA where the private fee-for-service model of healthcare delivery dominates. This limits the applicability of the current rapid literature review in supporting strong recommendations for the development of EMRs for publicly funded mental health services. On the other hand, knowledge of this gap in evidence, provides an opportunity for NSWHealth to address it by working with research investigators to evaluate the implementation process and outcomes of future EMRs implemented in publicly funded mental health settings in NSW. In-built evaluation from the very beginnings of implementation to maximise outcomes by identifying problems or negative effects early and enabling adjustment of the EMRs intervention according to ongoing feedback. This will also enable identification of any unintended consequences of implementing new EMRs interventions, including identification of missed care, care duplication or the adoption of "work-arounds" by clinicians which could potentially harm patients. A concrete example of a work-around includes the ability to by-pass the EMRs when recording patient medications, which could potentially lead to dose duplication and associated harms.

Applicability and recommendations

Given the quality and variability of the current evidence and the identified factors that helped or hindered adoption by frontline clinicians we have developed the following recommendations for the commissioning agency:

- Undertake a thorough formative evaluation with all stakeholders who are likely to interact with mental health EMRs, including local managers, clinical leaders and front-line clinicians (doctors nurses, psychologists, pharmacists, etc.) to ensure that the features of any future EMRs are aligned with their needs, expectations and natural workflows.
- Design mental health EMRs for easy navigation that fits in with current workflows – this means undertaking studies and consultations to understand current workflows in different contexts.
- Use a human-centred design approach, including co-design, user research and usability approaches while engaging with all stakeholders, including those working at the frontlines.
- Take the opportunity to standardise data collection where possible e.g. by defining minimum data sets, while at the same time avoiding EMRs solutions that are not easily adaptable to data collection processes by clinicians in their local contexts.
- Avoid EMRs solutions that are rigid and too prescriptive, for example, EMRs that continually alert clinicians inappropriately, inclusion of too many mandatory fields, or requires complex or counter-intuitive navigation pathways).
- Minimise use of decision support tools that impose “hard-stops” that cannot be overridden when justified in certain individual clinical circumstances.
- Embed a mixed methods implementation evaluation from the very beginning of implementation to ensure that important data on implementation outcomes and on service outcomes, barriers and enablers are collected from the outset to support ongoing evaluation and system improvement.
- Ensure that clinicians are supported through easily accessible training before and during implementation of new EMRs and ensure that they have easy access to technical support when it is needed.

Conclusion

The current summary of evidence shows a relatively weak evidence base. Evidence is limited by the small number of studies, especially in mental health settings, few studies of high quality, and a lack of data from Australia. This, coupled with lack of access to current evaluation results for the existing EMRs implemented in publicly funded mental health settings in NSW, further limits our ability to make firm recommendations for future implementation of EMRs.

The most successful EMRs solutions in mental health that were identified in the literature review included EMRs with a specific purpose e.g. e-pharmacy, safety planning for suicide prevention, and digitisation of assessment and screening tools that were embedded in the EMRs. The key recommendations include ensuring that the EMRs proposed as solutions are aligned with clinical contexts, workflows, and needs of clinicians at the frontlines of clinical care, while avoiding duplication of information handling and ensuring that the EMRs solutions minimise disruption to rapport-building between patient and clinician during consultations. This will require an investment in formative evaluation, consultation with all stakeholders to develop a deep understanding of work as done within local contexts, and engagement through co-design.

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Appendices

Appendix 1. Data extraction table for 14 studies focussed on EMRs used in mental health settings and 8 systematic reviews of the literature of EMR use in the broader healthcare context.

Positive (+), negative (-) or no effect (0)

eMR Mental Health Studies										
No.	Study	Country	Setting	Participants	Method	Guiding theory/model	EMR features	Implementation outcomes assessed	Service outcomes assessed	Client/clinician outcomes assessed
1	Boyer et al. (2010)	France	Psychiatric hospital	115 health care professionals	Qualitative: semi-structured interviews	Theory of continuous quality improvement	EMR was introduced in all the departments of psychiatry, but its use was not mandatory. The EMR could be used by all of the professionals working in the hospital. EMR includes both unstructured free text, coded data and scanned images for paper-based documents.	<i>Acceptability:</i> 70% EMR users perceived EMR positively (+)	<i>Effectiveness:</i> Better coordination and cooperation between professionals (+) <i>Efficiency:</i> More complete and rapid access to patient information (+) Increased time spent writing on EMR reduced the time for care (-). <i>Patient-centeredness:</i> Presence of EMR may conflict with the human and relational component needed for quality clinical practice (-) <i>Safety:</i> Increase in patient safety (+) <i>Timeliness:</i> Time savings (e.g. Find information about the patient) (+)	Not assessed

2	Bruns et al. (2018)	USA	Mental health facilities	34 Wraparound facilitators	Quantitative: RCT	Not specified	Key functions of the EHR included standard fields such as youth and family information, diagnoses, assessment data, and progress notes. In addition, there was the maintenance of a coordinated plan of care, progress measurement on strategies and services, communication among team members, and reporting on services, expenditures, and outcomes.	<p><i>Acceptability:</i> Scores on the acceptability subscale ranged from 2.6-3.6 out of 5 (+)</p> <p><i>Adoption:</i> EHR facilitators from both sites demonstrated robust use of the system (+)</p> <p><i>Appropriateness:</i> Scores on the appropriateness subscale ranged from 2.9-3.4 out of 5 (+)</p> <p><i>Feasibility:</i> The System Usability Scale average score was 54.72 (i.e. considered low) (-)</p> <p><i>Fidelity:</i> Little evidence of impact (0)</p>	<p><i>Effectiveness:</i> Little evidence of any impact (positive or negative) on overall service quality (0)</p> <p><i>Efficiency:</i> Use of EHR system promotes efficiency (+)</p>	<p><i>Client:</i> Little evidence of impact on client satisfaction (0)</p>
3	Druss et al. (2013)	USA	Mental health services in general – ranging from solo	Not specified	Literature review – claims to use Cochrane Guidelines.	Not specified	Not specified – this is a review EMR, EHR systems in general – including papers on	<p><i>Adoption:</i> eMRs less likely to be used by psychiatrists than other physicians (-). Survey of 440 US</p>	Not assessed	<p><i>Clinician:</i> One study reported that psychiatrists are less inclined</p>

			practices to hospitals Also included use of EHR by people with mental illness		They do not report the number of studies identified, inclusion or exclusion criteria etc. Very poor reporting of review methodology	Organization of Care Group” (poor quality – methods not reported in any detail)		organisations found less than half had implemented eMRs (-)		towards using technological applications than other physicians (-)
4	Golberstein et al. (2018)	USA	Primary care clinics	Primary care providers (PCPs) from 45 clinics	Quantitative: RCT	Not specified	Two key components: the mental health eConsult capability via the EHR system, and the financial incentive for psychiatrists to participate. PCPs have the option within the EHR of ordering an eConsult on behalf of their patients, which allows the PCP to ask specific questions about a particular patient's care.	Not assessed	<i>Efficiency:</i> Improved perceptions of how easy it is to obtain a mental health consultation (+) <i>Timeliness:</i> Did not affect how quickly mental health services could be accessed (0).	<i>Clinicians:</i> Improved perceptions that PCPs had the help and support they needed for diagnosing mental disorders (+), making treatment decisions (+), and changing treatment regimens (+). However, weak evidence that eConsults affected PCPs'

										perceived self-efficacy (0) or self-assessed skill (0) in dealing with patients' depression.
5	Huerta et al. (2015)	USA	Mental health clinic	35 mental healthcare professionals	Quantitative: Cross-sectional survey	Not specified	Alerts, e-prescribing, intra-office messaging and tasking	<p><i>Acceptability:</i> Overall satisfaction with the EHR (+)</p> <p><i>Feasibility:</i> Overall participants found the EHR easy to learn and they liked the e-prescribing and intra-office messaging (+).</p>	<p><i>Efficiency:</i> The e-prescribing tool enabled easier access to patient information (+)</p> <p><i>Safety:</i> Participants reported that the e-prescribing tool was fast, easy and error-free; enhanced safety (+)</p> <p><i>Timeliness:</i> The e-prescribing tool ultimately saved time through allowing easier access to patient information (+)</p>	None specified
6	Jetelina et al. (2018)	USA	Integrated behavioural health (BH) into primary care	12 clinics: 6 intervention (4377 patients) and 6 control clinics (3628 patients). <i>Intervention:</i> 2 clinics used all features and functions of	Mixed: case control + structured observations and interviews with practice members	Not specified	The authors developed a suite of user-centered tools (the BH e-Suite) to address the information needs of BH clinicians practicing in integrated primary care practices. The BH e-Suite enables integrated care delivery by organising	<p><i>Acceptability:</i> Clinicians working in clinics that fully or partially implemented the BH e-Suite reported that the tool was acceptable and easy to use. Clinics that fully or</p>	<p><i>Efficiency:</i> Clinicians reported the tool added 1 to 2 minutes to the initial visit but saved a significant amount of time during follow-up visits by automatically populating the history of the presenting illness and patient instructions at subsequent visits (+)</p> <p><i>Effectiveness:</i></p>	<p><i>Satisfaction:</i> Patient perceptions of integration-of-care improved overall and among clinics that fully implemented the tool. Patient perceptions of communicatio</p>

				<p>the BH e-suite EHR tool (fully implemented) 2 clinics implemented some, but not all features of the tools (partially implemented) 2 clinics did not use the tools at all (did not implement)</p>			<p>the tools BHCs use into a single tab, with fast links to those tools. In addition, the authors added functionality that supports psychosocial assessment, information gathering, goal setting, documentation, monitoring, and tracking, by using a range of point-and-click functions and drop-down menus. It also included templates for commonly used screeners (eg, Patient Health Questionnaire-9 [PHQ-9]; Generalized Anxiety Disorder-7 [GAD-7]) that auto-calculate and auto-populate progress notes and show changes in scores over time.</p>	<p>partially implemented the tool found it easy to use (mean Technology Acceptance Model score, 3.75 and 3.5, respectively). (+)</p> <p><i>Adoption:</i> Among clinics that partially implemented the BH e-Suite, clinicians reported that they would use the tool more often if they were given more training in its use. (+)</p> <p>There was a significant increase between intervention and control clinics in process of care, specifically the proportion of patients screened with PHQ-9. (+)</p> <p><i>Appropriateness:</i> BH clinicians at clinics that fully</p>	<p>There was no change in intermediate clinical outcome measures (ie, PHQ-9 and GAD-7 scores). When examined by degree of implementation, significant but small differences were observed in outcome measures between intervention and control clinics.</p>	<p>n with primary care providers significantly improved only among clinics that partially implemented the tool. (+)</p>
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								implemented the tool noted that the tool simplified EHR use and welcomed it as a way to help address their health IT needs. <i>Feasibility:</i> All clinics that implemented the tool to some degree reported an increase in perceived usability from pre- (mean, 1.87) to post-intervention (mean, 3.78 (+))		
7	Madden et al. (2016)	USA	Medical practice	Health insurance plan members with depression or bipolar disorder	Quantitative: Cohort study	Not specified	Not specified	<i>Appropriateness:</i> Nearly 90% of acute psychiatric services at hospital facilities, representing more severe exacerbations of mental illness, were not captured in the EHR (-)	Not assessed	Not assessed
8	Martin et al. (2018)	Canada	Psychiatric hospital	24 nurses; patients charts	Mixed: Interviews and review	Not specified	Not specified	Not assessed	<i>Effectiveness:</i> EHR included more information compared to paper charts (+)	Not assessed

					of medical records					
9	Reyes-Portillo et al. (2018)	USA	Child and youth psychiatry clinic	40 mental health clinicians	Quantitative: Case-control study	Not specified	Alert to create a safety plan triggered whenever a clinician indicated in the categorical fields that a patient reported suicidal ideation, plan, or attempt.	Acceptability: Clinicians reported feeling neutral about the alert (0)	<p><i>Efficiency:</i> Improved perceptions of how easy it is to obtain a mental health consultation (+)</p> <p><i>Timeliness:</i> Did not affect how quickly mental health services could be accessed (0).</p>	<p><i>Clinicians:</i> 27% (n = 10) reported feeling happy with the alert</p> <p>18.9% (n = 7) felt it improved their level of care</p> <p>27% (n = 10) felt it led them to complete more safety plans (0)</p>
10	Riahi et al. (2017)	Canada	Mental health facility	1300 facility employees	Quantitative: Case study	Kotter's change model and The Canada Health Infoway change management framework	Closed Loop Medication Administration, Business Intelligence, Resident Assessment Instrument-Mental Health, Plan of Care, Restraint and Seclusion, Clinical Practice Guidelines for Schizophrenia, Infection Prevention and Control Surveillance Status Board, Drug of Abuse Screening.	Not assessed	<p><i>Effectiveness:</i> Adherence to CBT for psychosis and vocational rehabilitation guidelines increased (+); adherence to antipsychotic monotherapy guidelines increased initially but fell back by 12 months (0). Adherence to metabolic monitoring increased slightly (+)</p>	Not assessed

11	Ser et al. (2014)	UK	Mental health hospitals	33 hospital staff	Qualitative: semi-structured interviews	Not specified	Connectivity with the central NHS database and messaging service	<p><i>Acceptability:</i> EHR system taking up time with patients; perceived not to meet clinical needs; difficult transition for people not used to IT; lack of understanding between leadership and front line workers; no trust in the system/system instability (-)</p> <p><i>Adoption:</i> Delayed or retrospective entering of data; doctors leaving data entry to administrative staff (-)</p> <p><i>Appropriateness:</i> EHR system did not integrate well with their existing work practices; unable to tailor the system locally; lack of integration with other systems; lack of</p>	<p><i>Efficiency:</i> Aspects of EHR design not suitable for mental health settings; Users' work practices and system requirements not aligned; System structure for data entry not clear/user-friendly; Unsuitable for some consultations (-)</p>	<p><i>Clinician:</i> EHR system did not integrate well with their existing work practices; unable to tailor the system locally; lack of integration with other systems; lack of understanding between leadership and front line workers (-)</p>
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								understanding between leadership and front line workers (-)		
12	Strudwick & Eyasu (2015)	Germany, England, France, Finland, USA, Sweden	Mental health / psychiatry clinical settings	Nurses	Literature review	Not specified	Not specified	<p><i>Acceptability:</i> Nurses' acceptance of the technology improved over time; patient information was easier to read; Student nurses reported EHRs provided better information availability, and better quality of record keeping (+)</p> <p><i>Adoption:</i> Clinicians felt the EHR was a valuable tool, however did not feel it captured all necessary information and therefore could solely rely upon it at the time of the study. A lack of computers, downtime, duplication of</p>	Efficiency: Nurses felt there was duplication of work where information originally written on paper during a client interaction was then transferred to the eMR (-)	Clinician: Nurses' acceptance of the technology improved over time (+)

								charting, and not “user-friendly” EHRs as being the biggest drawbacks of the technology (-)		
13	Tanguturi et al. (2017)	USA	Psychiatric emergency service	300 evaluations performed by 36 psychiatry residents	Quantitative: chart review	Not specified	A standard psychiatric evaluation template was created for the EMR, which included a suicide risk assessment section. The Department of Psychiatry chose to use the components adapted from the Columbia Suicide Severity Rating Scale (C-SSRS)—risk assessment version. A total of seven subsections were used from the C-SSRS with “clickable” options for each variable (suicidal ideation/ behavior, recent negative events, treatment status, collateral information, past history, clinical status,	Not assessed	<i>Safety:</i> Documentation is somewhat adequate for necessary information including current suicidal ideation and past attempts - basic data is gathered and documented, but there is no consistent documentation of all variables (0)	Not assessed

							and protective factors).			
14	Xiao & Acosta (2016)	USA	Adult outpatient psychiatric clinic	105 charts review pre-implementation and 141 charts reviewed post-implementation	Quantitative: chart review	Not specified	e-charting program developed specifically for the site. The EMR included 1) intake evaluation note, 2) progress note and 3) medication monitoring.	<i>Adoption:</i> The documentation and completion of intake evaluation note, progression note and medication monitoring increased significantly after EMR system was implemented (+).	Not assessed	Not assessed

eMR Reviews

No.	Study	Country	Setting	Number of included studies	Review type	Guiding theory/model	EMR features	Implementation outcomes assessed	Service outcomes assessed	Client/ clinician outcomes assessed
1	Boonstra & Broekhuis (2010)	USA, Canada, Norway, Ireland	General health settings	22	Systematic review	Not specified	Not specified	<i>Acceptability:</i> Physicians have concerns regarding the use of EMRs that are based on their personal issues, knowledge, and perceptions. Their perceptions of the questionable quality	<i>Efficiency:</i> Introduction of eMRs will slow a physician's workflow, as it will likely lead to additional time being required to select, implement and learn how to use EMRs, and then to enter data into the system (-). Subsequently, productivity might increase and workload	Not assessed

							<p>improvement associated with EMRs and worries about loss of professional autonomy come within this category (-)</p> <p><i>Adoption:</i> Physicians reported that technical factors might be a barrier to EMR adoption. Specifically, lack of computer skills of the physicians, lack of technical training and support, complexity of the system, lack of customizability & reliability, interconnectivity/standardization, and lack of computers/hardware present some challenges (-)</p> <p><i>Appropriateness:</i> Organisational factors such as organisation type and size will influence the fit of the EHR. Physicians in larger practices are more likely to use</p>	<p>might increase (+)</p> <p><i>Patient-centeredness:</i> eMRs might present interference with doctor-patient relationship (-)</p> <p><i>Timeliness:</i> Using EMRs will take more time for each patient than using papers, as physicians might have to stop halfway through consultancy, to enter information/or if physicians are slow in typing and entering data (-)</p>	
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								<p>EMRs than smaller practices.</p> <p>Additionally, whether a practice is affiliated to a hospital is an important determinant.</p> <p>Physicians who are employed by a medical practice are more likely to use EMRs than those who own their practices (0)</p> <p><i>Cost:</i></p> <p>Financial reasons such as high start-up costs, high ongoing costs, uncertainty about return on investment, and lack of financial resources might be barriers to EMR adoption (-)</p>		
2	Castillo et al. (2010)	Australia, New Zealand, USA, Canada, Germany, Denmark, France, Sweden, Hong Kong	General health settings	68	Systematic review	Innovation-diffusion process by Rogers, Information and communication technology roles in the knowledge	Not specified	<p><i>Acceptability:</i></p> <p>The reviewed stated that user attitude towards EMRs is a critical factor influencing adoption of EMRs (0)</p> <p><i>Adoption:</i></p> <p>The review identified six critical adoption factors: user attitude</p>	Not assessed	Not assessed

						management processes		towards information systems, workflow impact, interoperability, technical support, communication among users, and expert support (0) <i>Appropriateness:</i> Workflow impact and interoperability (i.e. the degree to which EMRs are perceived as being consistent with existent values, past experiences, and needs of a potential adoption unit), are also critical factors influencing adoption (0)		
3	Gephart et al. (2015)	USA, Sweden	General health settings	5	Systematic review	Not specified	Not specified	<i>Appropriateness:</i> Nurses experienced changes to workflow as a result of eMR implementation, and must continually adapt to meet patients' needs in the context of the imperfect eMR system, and have difficult accessing the information they	<i>Efficiency:</i> Nurses must employ a lot of workarounds due to EMR implementation, leading to lower efficiency (-)	Not assessed

								need to make patient care decisions (-)		
4	Goldstein et al. (2014)	USA, Austria, Brazil, Canada, Switzerland	General health settings	12	Literature review	Not specified	Not specified	<p><i>Appropriateness:</i> All studies cited some level of technical limitations or concern as a barrier to adoption. Specifically, barriers included: lack of training, lack of computer skills; lack of technical support (internal or external); systems that are complex and difficult to use; breakdown of hardware/ software and lack of wireless connectivity. Many feared that an EMR system would not be suitable for their needs or would be incompatible with other systems, and they cited the lack of uniform standards as being highly problematic.</p> <p><i>Cost:</i> Six included papers cited financial costs (startup and/or</p>	<p><i>Efficiency:</i> Time was a major issue cited in six papers, either a perceived lack of time or a fear of reduced productivity (-)</p>	Not assessed

								ongoing) as a major barrier (-).		
5	Goldzweig et al. (2015)	USA, France, Canada, Austria	Mostly U.S. academic medical centres.	23	Systematic review	Not specified	In five studies, the intervention consisted only of display of information, such as the cost of tests or relevant guidelines (A interventions). Nine studies displayed patient-specific information about whether the requested study was consistent with existing guidelines or appropriateness assessments for the specific clinical indication, or something similar (B interventions). Four studies included what we characterized as a “soft stop,” meaning that for radiology orders that the CCDS rated as	<i>Appropriateness:</i> Moderate-level evidence that computerised clinical decision-support improves appropriate use of diagnostic radiologic test ordering (+). All of the D interventions studies reported moderate to large effects on appropriateness (+)	<i>Safety:</i> Four studies reported on harms associated with their interventions, including decreased ordering of appropriate tests (-)	Not assessed

							inconsistent with guidelines or inappropriate, the provider needed to enter a reason why the CCDS advice was being overridden (C interventions). Five studies included a "hard stop," meaning that providers were prevented from ordering radiologic examinations that the CCDS classified as inappropriate without obtaining approval from some external person, such as a radiologist or senior clinician (D interventions).			
6	Lau et al. (2010)	USA, UK, Canada, France, Netherlands, Australia, Austria, Belgium	General health settings	58	Systematic review of systematic reviews	Canada Health Infoway Benefits Evaluation (BE) framework	The EMR features in these reviews varied widely, ranging from the types of information systems and technologies used, the functional	Not specified	<i>Efficiency:</i> 244/575 (42.4%) of EMR metrics showed no significant effects, mostly in the areas of health outcomes, adverse event detection, and resource utilisation. For provider time efficiency, 4/12 studies reported	Not specified

						<p>capabilities involved, to the intent of these systems. Examples are the review of administrative registers, reminders, and diabetes management, respectively.</p>	<p>negative effect where EMR required more time and effort to complete the tasks.</p> <p><i>Effectiveness:</i></p> <p>The most effective EMR features were computer-based reminder systems in preventive care (100%), Computer Decision Support System reminders/alerts in medication management (80%), and disease management-orders/alerts in health conditions (80%). The EMR features that were somewhat effective included Computerised Physician Order Entry medication orders (66.1%), reminders in printed form (69.6%), and reminders combined with other interventions (66.7%). Facility-based electronic patient record (EPR) systems and administrative registers/research databases had better data quality than primary-care EPR systems (76.2% and 70.4% vs 58.3%). Note that 98/287 (34.1%) of these controlled EHR studies reported no significant effects, mostly in the area of disease management where 30/57 (52.6%) had neutral findings. 244/575 (42.4%) of EMR metrics showed no</p>
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									<p>significant effects, mostly in the areas of health outcomes, adverse event detection, and resource utilisation.</p> <p><i>Safety:</i></p> <p>The EMR metrics with positive effects are mostly under the dimension of care quality in patient safety for medication errors (63.6%), and in guideline adherence for immunization (84.6%), health screening (66.7%), tests/assessments/care (64.4%), and medications (61.8%). Under information quality, 76.4% of EMR metrics had positive effects in content accuracy, and 61.0% were positive in completeness. 244/575 (42.4%) of EMR metrics showed no significant effects, mostly in the areas of health outcomes, adverse event detection, and resource utilisation.</p>	
7	Meißner & Schnepf (2014)	USA, Australia	Residential aged care facilities	7	Systematic review	Not specified	Not specified	<p><i>Acceptability:</i></p> <p>Mixed views about using IT for documentation, ranging from feeling monitored (-) to receiving greater respect (+)</p>	<p><i>Efficiency:</i></p> <p>Improvement in the quality of residents' records leads to improvement in the quality of care (+)</p>	<p><i>Clinician:</i></p> <p>Some staff benefit from the use of IT (+), while others do not. The latter find it more difficult to enter data which results in poor</p>

										clinical documentation (-)
8	Nguyen et al. (2014)	USA, Denmark, England, Norway, Canada, Sweden, Australia, Holland, Ireland, Israel, Austria, Cyprus, France, Serbia, Sweden, Japan, Korea, Kuwait, Cameroon, Uganda	General health settings	98	Narrative review	DeLone and McLean's conceptual framework; 'Lean Thinking'	Not specified	<p><i>Acceptability:</i> Satisfaction related to a number of factors, such as usability, reliability, and support provided when problems occurred (+). Dissatisfaction was related to clinicians' negative experiences with eMR systems and their impact on work processes (-)</p> <p><i>Adoption:</i> eMR adoption rate and usage has been low, although this is gradually increasing (-)</p> <p><i>Appropriateness:</i> Usability and usefulness were commonly agreed to be critical features of eMR implementations, and despite continuous improvements, they required further</p>	<p><i>Efficiency:</i> eMR commonly believed to result in improved clinical documentation, improved clinical workflows, changes in clinicians' workload and increases their productivity in various ways (+). However, eMR also increases the time spent on documentation, results in work disruptions, adds additional tasks such as workarounds to bypass the system, as well as various other technology-related issues (-)</p>	<p><i>Clinician:</i> Poor satisfaction was noted in eight papers. Doctors felt removed from the system and feared uncertainties. Low satisfaction was related to clinicians' negative experiences with eMR systems and their impact on work processes (-)</p>

								<p>improvement (-)</p> <p><i>Cost:</i></p> <p>Twelve studies cited funding and cost as a major barrier (-)</p> <p><i>Feasibility:</i></p> <p>Both positive and negative impacts of the transition from paper-based to electronic documentation reported (+) (-). Many clinicians preferred EHR over paper-based clinical documentation (+)</p>	
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Positive (+), negative (-) or no effect (0)