Healthcare professionals' perceptions of the facilitators and barriers to implementing electronic systems for the prescribing, dispensing and administration of medicines in hospitals: a systematic review

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Received 26 May 2015
Revised 30 June 2015
Accepted 6 July 2015
Published Online First 10 August 2015

ABSTRACT

Objective To identify, critically appraise, synthesise and present the available evidence on healthcare professionals' perceptions of the facilitators and barriers to implementing electronic prescribing, dispensing and/or administration of medicines in the hospital setting.

Methods A systematic search of studies focusing on healthcare professionals' perceptions of technologies for prescribing, dispensing and administering medicines in the hospital setting was performed using MEDLINE, Cumulative Index to Nursing and Allied Health, International Pharmaceutical Abstracts, PsycARTICLES, PsycINFO, Cochrane Database of Systematic Reviews and Centre for Reviews and Dissemination. Grey literature inclusive of manual searching of core journals, relevant conference abstracts and online theses were also searched. Independent duplicate screening of titles, abstracts and full texts was performed by the authors. Data extraction and quality assessment were undertaken using standardised tools, followed by narrative synthesis.

Key findings Five papers were included in the systematic review after screening 2566 titles. Reasons for exclusion were duplicate publication; non-hospital setting; a lack of investigation of healthcare professionals' perceptions and a lack of focus on implementation processes or systems specific to electronic prescribing, dispensing or administration of medicines. Studies were conducted in the USA, Sweden and Australia. All studies used qualitative interview methods. Healthcare professionals perceived systems improved patient safety and provided better access to patients' drug histories and that team leadership and equipment availability and reliability were essential for successful implementation. Key barriers included hardware and network problems; altered work practices such as time pressure on using the system and remote ordering as a potential risk for errors; and weakened interpersonal communication between healthcare professionals and with patients.

Conclusions Few studies were identified on healthcare professionals' perceptions of the facilitators and barriers to system implementation in hospitals. Key facilitators included a perception of increased patient safety and better access to patients' drug history while key barriers involved technical problems, changes to routine work practices and weakened interpersonal communication. Investigating this area further will assist in improving patient safety and reducing medication costs by informing and strengthening implementation strategies.

To cite: Hogan-Murphy D, Tonna A, Strath A, *et al*. *Eur J Hosp Pharm* 2015;**22**:358–365.

INTRODUCTION

The WHO defines eHealth as "the combined use of electronic communication and information technology in the health sector".[1] In a multisite case study exploring the introduction of shared electronic records in England and the implementation of large-scale eHealth initiatives, Greenhalgh *et al*[2] concluded that implementation is influenced at the micro level by interpersonal factors such as individuals' attitudes and beliefs; at the meso-level by the operational aspects such as readiness and resources; and at the macro level by socio-political forces. At a macro level, many countries including Australia, Canada, the USA and the UK have been at the forefront to embed eHealth into routine healthcare.[3] However, despite political commitment and substantial investment, there has been considerable variability in the success of different eHealth implementations internationally.[4] The European Union has stated that implementing eHealth strategies "has almost everywhere proven to be much more complex and time-consuming than initially anticipated".[5]

eHealth includes electronic systems for prescribing, dispensing and administering medicines that have the potential to reduce medication errors and cost.[3] ePrescribing systems involve "the utilisation of electronic systems to facilitate and enhance the communication of a prescription or medicine order, aiding the choice, administration and supply of a medicine through knowledge and decision support and providing a robust audit trail for the entire medicines use process".[4]These systems can improve patient safety mainly from more legible medication orders, enhanced clinical decision support and richer more timely interactions among healthcare teams.[6] Widely used in many hospitals internationally, automated dispensing systems also have the potential to improve efficiency and patient safety by providing computer-controlled storage, dispensing, tracking and administration of medications.[7] These systems can enhance first-dose availability and facilitate the timely administration of medications by increasing their accessibility on wards during and after pharmacy opening hours. From a pharmacy perspective, automated dispensing systems or 'robots' have demonstrated a reduction in dispensing errors, improvement in the speed and efficiency of

the dispensing process, and space optimisation in the pharmacy department.[8]

Despite these advances in technology, many hospitals currently rely on a traditional manual medicines management system that can be both inefficient and ineffective. Written prescribing errors most frequently occur, followed by administration errors, followed by dispensing errors for hospital inpatients.[9] Preventative strategies are required such as the effective use of eHealth in the prescribing, dispensing and administration of medicines in the hospital setting.

Due to a lack of standards guiding the procurement, functional specifications, level of interoperability and expected benefits of these systems, careful consideration and agreement with key stakeholders should be employed in order to maximise patient care.[10 11] Several studies have demonstrated that the implementation process for hospital eHealth systems is important to determine overall success.[12–16] While there is no overarching framework in relation to the adoption of eHealth innovations, a number of strategies have been found to be effective for successful implementation inclusive of ascertaining end users' attitudes towards the system; effective communication between implementers and end users; strategic project management and effective leadership; and continuous evaluation and quality improvement initiatives.[3] Assessing and fostering readiness for technological innovation also appears to be particularly important for successful adoption.[17] The problem of resistance or refractory behaviours of healthcare professionals and the assumption that their attitudes to eHealth are the root problem have been highlighted as barriers to eHealth implementation.[4] Understanding these perceptions of what promotes and hinders system adoption will assist in determining successful implementation.[3 18]

While several systematic reviews have been published on outcomes such as the effects of electronic prescribing, dispensing or administration of medicines on medication errors and cost, no systematic review and few primary studies have been conducted on healthcare professionals' perceptions of system implementation in a hospital setting.[10 11 19 20] Due to the importance of assisting implementers with successful implementation at a micro, meso and macro level,[2] the objective of this systematic review was to identify, critically appraise, synthesise and present the available evidence on healthcare professionals' perceptions of the facilitators and barriers to implementing electronic prescribing, dispensing and/or administration of medicines in the hospital setting.

METHODS

Development of protocol

No pre-existing systematic reviews on this topic were identified after conducting a scoping search. A protocol for the systematic review was developed using the Centre for Reviews and Dissemination (CRD) guidance for undertaking reviews in healthcare and principles from the Cochrane Handbook for Systematic Reviews of Interventions. The protocol was registered with the International Prospective Register of Systematic Reviews (PROSPERO).[21–23] This international database aims to provide a comprehensive list of registered healthcare-related systematic reviews in order to avoid duplication and compare reported review methods with the planned protocol.[24]

Inclusion and exclusion criteria

Types of participants

Studies of doctors, nurses, pharmacists and other allied healthcare professionals involved in prescribing, dispensing and/or administration of medicines were included in the review.

Phenomena of interest

Electronic prescribing, dispensing and/or administration of medicines was the main focus of this review. This phenomenon of interest excluded other eHealth systems such as electronic medical records, unique patient identifiers, clinical decision support systems and electronic discharge prescriptions. Studies that did not focus on implementation, for example, clinical and fiscal outcomes and effects on patients and resources, were also excluded. Any hospital setting was included.

Types of studies

Only full-text papers published in English were included in the review. Summaries of the literature for the purpose of information or commentary and editorial discussions were excluded.

Literature search strategy

MEDLINE, Cumulative Index to Nursing and Allied Health, International Pharmaceutical Abstracts and PsycARTICLES (via EBSCOhost), PsycINFO, Cochrane Database of Systematic Reviews and CRD were searched. An example of the search strategy used in MEDLINE is provided in table 1. Grey literature in the form of manual searching of journals, accessing conference abstracts either by attendance or online, and online theses were also searched. The bibliographies of relevant full-text literature were screened. No date limitation was applied to the search, which was conducted until August 2013.

Search terms and study selection

A wide variety of search terms were combined within each of the three main concepts: healthcare professionals; electronic prescribing, dispensing or administration of medicines; and hospital setting (table 1). All identified articles were imported into 'Refworks' and thereafter exported to Microsoft Excel for title/abstract screening. To enhance reliability, 10% of the study titles and abstracts were reviewed by the authors independently for

Table 1 Example of search terms using MEDLINE via EBSCOhost

MEDLINE	Search terms (limit English language)
1	(MH healthcare professionals+ OR MH health care professionals+ OR MH healthcare providers+ OR MH health care providers+ OR Healthcare N8 profession* OR Health care N8 profession* OR Health profession* OR Healthcare N8 provider* OR Health care N8 provider* OR Health provider* OR MH doctors+ OR doctor* OR MH clinicians+ OR Clinician* OR MH physicians+ OR Physician* OR MH pharmacists+ OR Pharmacist* OR Chemist OR Druggist* AND Apothecary* OR hospital N8 pharmacist* OR Dietician* OR Nutritionist* OR Pharm* N8 technician* OR Chiropodist* OR Podiatrist* OR Physiotherapist* OR MH nurse+ OR (Nurse OR nurses) OR (Dentist OR dentists) OR Radiographer* OR Optometrist*)
2	(MH electronic prescribing+ OR e-prescri* AND e prescri*OR electronic transfer of prescription* OR ETP OR Electron* N8 prescri* OR E N8 prescri* OR MH electronic administration+ OR electronic administ* OR automated dispens* OR automated dispens* system* OR ((electronic administ*) AND (medic* OR drug* or tablet* OR remed* OR treat* OR dos*)) OR ((bar N5 code N5 administ*) AND (medic* OR drug* or tablet* OR remed* OR treat* OR dos*)) OR electron* N8 prescrib* OR e N8 prescrib* OR ((e N8 admin*) AND (medic* OR drug* or tablet OR remed* OR treat* OR dos*)) OR Ehealth* OR E health* OR Health information technolog* OR HIT OR Mobile technolog* OR Mobile health*)
3	(MH hospital+ OR hospital* OR secondary N3 care OR tertiary N3 care OR ward*)
4	1+2+3

relevance. Full texts were then sought for all studies appearing to meet the inclusion criteria, and a final selection of papers for data extraction and quality assessment was made independently by the authors.

Data extraction and quality assessment

As all included studies were qualitative in nature, a data extraction form for qualitative studies was developed by the primary researcher and agreed by all authors. The form was designed from a combination of extracts from the CRD's Guidance for Undertaking Reviews in Healthcare, the Joanna Briggs Institute reviewers' manual and the Cochrane Collaboration Qualitative Methods Group Supplementary Guidance for Inclusion of Qualitative Research in Cochrane Systematic Reviews of Interventions.[23–25] Studies were extracted independently using the data extraction form and scored for inclusion as either yes, no or unclear. Papers were then quality assessed as per the Critical Appraisal Skills Programme checklist for qualitative research.[26]

Data synthesis

Narrative synthesis of the results was conducted involving the collation, combination and summary of the findings using text and tables. This type of synthesis combines the results of multiple studies and relies primarily on the use of words and texts to summarise and explain the findings of the review.[27 28] The Guidance on the Conduct of Narrative Synthesis in Systematic Reviews was used as a framework that provides guidance on how narrative synthesis can be conducted in a systematic and transparent way that reduces the potential for bias.[27]

RESULTS

Literature search findings

Five studies were included in the systematic review from a potential 2566 titles that were initially screened (figure 1). Reasons for exclusion were due to inappropriate setting, inappropriate systems, lack of focus on healthcare professionals' perceptions or mainly due to the retrieval of studies not centred on implementation but focused on outcomes. Out of the final eight studies included in quality assessment and data extraction, three were excluded thereafter due to poor methodological approaches post independent analysis by the primary researcher and two members of the review team (table 2). Three studies were identified from database searches and a further two studies were identified from the bibliographies of the studies included for full text/abstract screening. Manual searching of key journals did not provide additional literature for inclusion. Studies were mainly based in the USA, one in Sweden and one in Australia.

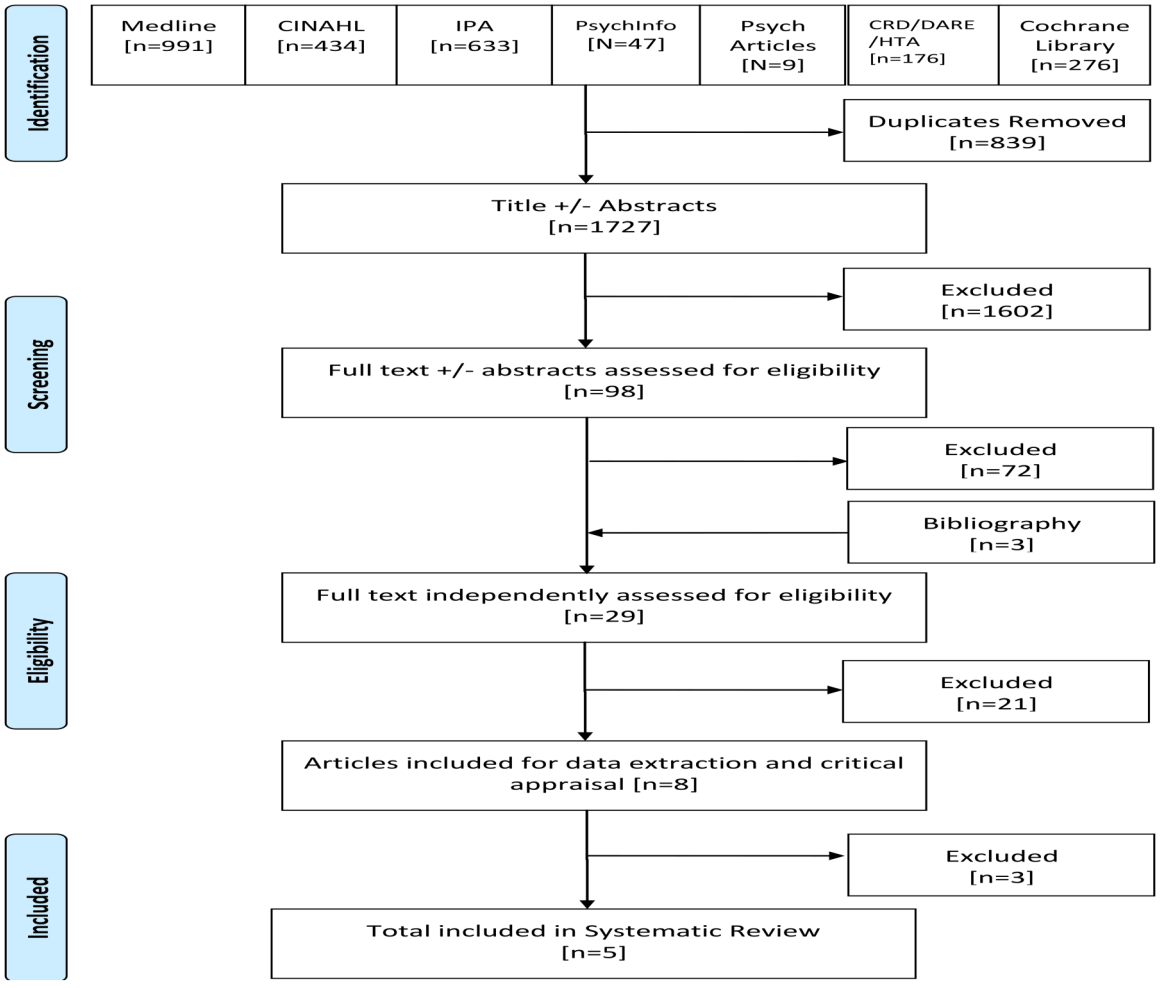

Figure 1 The Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram of literature search. CINAHL, Cumulative Index to Nursing and Allied Health; CRD, Centre for Reviews and Dissemination; DARE, Database of Abstracts of Reviews of Effects; HTA, Health Technology Assessment Database; IPA, International Pharmaceutical Abstracts.

Table 2 Description of studies included in systematic review

Author, year, country	Participants	Type of system	Context	Aims	Research methods used	Main findings
Bastholm Rahmner *et al*, 2004, Sweden[29]	21 emergency department physicians	Electronic prescribing with decision support and electronic transfer of prescriptions to pharmacies.	This pre implementation study was conducted in the largest accident & emergency department in the Nordic countries with approximately 90 000 visitors per year. Physicians hand write prescriptions and use a dictaphone for medical record documentation.	To identify physicians' perceptions of the various facilitators and barriers prior to implementing a computerised drug prescribing support system.	Semistructured individual interviews	Facilitators identified included easy access to a patient's drug history (which was not met by the new system); enhanced pharmacological knowledge from medication alerts; readily accessible information; and time efficiencies. Barriers identified included technical problems due to current problems encountered with the electronic medical record and alerts signalled too frequently; shortage of computers in the emergency department; an alteration to routine and habits resulting in diminished patient contact. Technical prerequisites formed the base for successful implementation where time was perceived as a necessary requirement to adapt to new ways of working.
Malato and Kim, 2004, USA[30]	12 nurses	Electronic medication administration record system where nurses input prescriptions into a computer that allows pharmacists review orders for appropriateness related to age, weight, diagnosis and drug compatibility. Pharmacists then enter these orders, as a patient profile, into the system and nurses directly access medications using fingerprint ID.	This initial and post implementation study was conducted in two acute care nursing units in a large 600-bed public acute hospital. Nursing staff administer approximately 300 medications per hour. A paper-based medication system had been replaced by the implementation of this system.	To examine nurses' perceptions towards implementation of a computerised medication system.	Open-ended individual interviews. Observation	Barriers identified included end user perceptions of inadequate training; negative experiences of implementation; perceived deficiencies in quality of technology; perceptions of lack of participatory design; and an ensuing circumvention of the new system.
Georgiou *et al*, 2009, Australia[31]	50 management, medical, nursing and pharmacy staff	Electronic prescribing and direct drug administration functionalities using an electronic medication chart.	This pre-implementation study was conducted in a large teaching hospital. Initial planning for the new system had been underway for >2 years at the beginning of the study's data collection. Training had not yet begun for a large majority of hospital staff. The hospital already had a CPOE system in place for the ordering of pathology and radiology tests, and diet and allied health requests. Existing medication management was performed using paper charts.	To identify the main barriers of a broad range of hospital staff to system implementation.	20 semistructured individual interviews. 6 focus groups involving a total of 30 participants	Barriers identified included alteration to work practices; software/hardware concerns; alteration to relationships/communication; requirements for education and training; inexperienced staff ability; and de-skilling. Four interrelated constructs highlighted what participants were concerned about: if it would help; if it would work; if they could cope; and if it would impair existing interactions.
Culler *et al*, 2011, USA[32]	14 nurses	Electronic medication administration record system with decision support. It displays alerts based on laboratory results; documents the dose route, and site of administration; and automatically records discretion-based variances and missed or refused administrations.	This post-implementation study was conducted in two large paediatric hospitals. Initial planning for the new system had been underway for >2 years at the beginning of the study's data collection. Training had not yet begun for the large majority of hospital staff. The hospital already had a CPOE system in place for the ordering of pathology and radiology tests, and diet and allied health requests. Existing medication management was performed using paper charts.	To describe the various facilitators and barriers by nurses to the implementation of an electronic medication administration record system at two paediatric hospitals.	Semistructured individual interviews	Facilitators included the system's ability to improve patient safety and accessibility of patient information. The most significant barrier to adoption was excessive time for logging into the system.

Continued

Table 2 Continued

Author, year, country	Participants	Type of system	Context	Aims	Research methods used	Main findings
Spetz *et al*, 2012, USA[33]	118 nurses, pharmacists, physicians, IT staff and managers	Bar-coded electronic medication administration record system.	This post-implementation study was conducted in seven of the 162 Veteran Affairs hospitals. Site selection was based on staff satisfaction survey data, staff turnover, geography and the level of care provided. A computerised patient record system was implemented over a decade from the early 1990s. The barcode medication administration system was implemented over 1 year.	To identify factors and strategies associated with successful system implementation in Veteran Affairs hospitals and how these might apply to other hospitals.	Semistructured individual interviews	Five broad themes arose as factors that affected the process and success of implementation: organisational stability and implementation team leadership; implementation timelines; equipment availability and reliability; staff training; and changes in workflow.

CPOE, computerised provider order entry.

Data extraction

Method

Table 2 provides a summary of the study authors, year and country of origin; the types of participants; the types of systems; context; the aim of the studies; the research methods used; and the main findings from each of the included studies.

Quality assessment

All of the studies were explicit in their aims/objectives and rationale for study method (table 3). Limitations for the design were stated in four of the five studies. The research design was appropriate to address the aims of the research in three of the studies and partially in two studies. The rationale for selecting the study population was provided in three studies while one study did not offer this information and it was not clear in another. All studies stated the recruitment strategy. Four of the studies partially described ethical considerations while it was unclear in one study.

Measures to enhance reliability of the data collection tool were outlined in four studies while it remained unclear in one paper. Data analysis was performed independently in three studies, solo in one study and was not stated in another paper. Limitations of the findings were discussed in three papers and conclusions were made relevant to the research question in four studies. A clear statement of findings was evident in two studies and partially in three studies. No bias or conflict of interest was likely in any study included in the systematic review.

Data synthesis

Nine main facilitators and 12 main barriers were identified from the included studies by nursing, medical and pharmacy staff to system implementation in the hospital setting (table 4). Using a narrative approach, all studies were combined for the synthesis. While more barriers than facilitators were identified, two studies focused solely on barriers with the remainder focusing on both barriers and facilitators.

Facilitators to implementation

Nine main facilitators emerged to system implementation: a perceived increase in patient safety when using the system; better access to a patient's drug history in comparison to manual systems; organisational stability and implementation team leadership; equipment availability and reliability; adequate staff training; flexible implementation timelines; improved pharmacological knowledge; time efficiency; and improved interdepartmental communication (table 4). Themes overlapped between the different implementation phases and healthcare professionals. While two studies reviewed the perceived benefits of system implementation such as increased patient safety, time efficiency and improved interdepartmental communication, one study detailed the perceived structures needed to be in place to determine successful system implementation such as organisational stability and team leadership for implementation.[29 32 33]

Barriers to implementation

Healthcare professionals faced numerous challenges with various system implementations. Twelve main themes emerged when synthesising findings from a combination of all studies relating to the various barriers perceived by healthcare professionals towards system implementation in the hospital setting (table 4). These themes included technical problems; altered work practices; weakened inter-personal communication; practice-related medication errors; poor access to computers;

Table 3 Qualitative assessment of qualitative studies

Quality assessment criteria	Rahmner and *et al*[29]	Malato and Kim[30]	Spetz *et al*[33]	Culler *et al*[32]	Georgiou *et al*[31]
Was there a clear statement of the aims of the research?	Y	Y	Y	Y	Y
Is a qualitative methodology appropriate?	Y	Y	Y	Y	Y
Was the research design appropriate to address the aims of the research?	P	Y	P	Y	Y
Was the recruitment strategy appropriate to the aims of the research?	P	Y	P	Y	Y
Were the data collected in a way that addressed the research issue?	P	P	Y	Y	Y
Has the relationship between researcher and participants and data collection been adequately considered?	P	P	N	P	P

N, no; P, partially described; Y, yes.

logistics of education and training; unsupportive management teams; implementation roll-out; cost; circumvention of the system; security; and de-skilling. Several themes that were viewed as facilitators by healthcare professionals were also perceived as barriers to system implementation inclusive of interpersonal communication, patient safety, time availability, information access and staff training.

DISCUSSION

This is the first published systematic review conducted on healthcare professionals' perceptions of the various facilitators and barriers to implementing electronic prescribing, dispensing and/or administration of medicines in the hospital setting. A very limited number of studies were identified, few of which have been carried out in Europe.[29–33]

Healthcare professionals' perceived systems improved patient safety and enhanced access to patients' drug histories and that team leadership and equipment availability and reliability were essential for successful implementation. Key barriers included hardware and network problems, changes to routine work practices, weakened interpersonal communication between healthcare professionals and with patients, and resistance to technology and training. Differences in study settings, countries and sampling may explain variations in identified facilitators and barriers. Further qualitative studies may best identify the nature of these changes.

Table 4 Facilitators and barriers to system implementation

Facilitators	Barriers
Increased patient safety: decreasing medication errors by reducing transcription errors[29]	*Technical problems:* logged out and information not saved; malfunctions and cumbersome access procedures; poorly functioning proximity badges; fear of a slow system, poor functionality and integration with pharmacy systems; cumbersome process for cosigning medications; miscoded medications, items not scanned, empty unit-dose packages delivered to wards, batteries not holding charges or recharged regularly; mobile carts large and difficult to move; network trouble and problems with patient wristbands[29–33]
Better access to a patient's drug history: comprehensive patient overview and easier to alter patients drug list[29 32]	*Altered work practices:* effect on ward rounds and remote ordering potential for errors; total patient care at risk, task allocation practice; computer illiteracy making training difficult; time pressure on using system and less time on wards; time pressure with no allocation of extra staff [30 32]
Organisational stability and implementation team leadership: teamwork and involvement of end users[33]	*Weakened interpersonal communication:* less face-to-face interaction between healthcare professionals and patients; loss of an unofficial means of communication; potential for exposing knowledge deficits and increasing conflicts[29 31]
Equipment availability and reliability: adequate access to and reliability of hardware and computer network; need to be intuitive and user-friendly[32 33]	*Practice-related medication errors:* administer medications at the incorrect time[30]
Adequate staff training: classroom training; one-on-one training; 24 h support; availability of super users[31 32]	*Poor access to computers:* long wait times; priority issues[29 30]
Flexible implementation timelines: time to gain experience; adapt to new ways of working[30 31 32]	*Logistics of education and training:* training staff prior to and during system implementation problematic due to shift work; resistance or busy schedules; healthcare professionals spending time to train others[30 32]
Improved pharmacological knowledge: via automatically generated interaction alerts and producer-independent drug information[33]	*Unsupportive management teams*: more challenging both during and after implementation[32]
Time efficiency: reduce duplication of administrative work; ease of locating chart information[31 33]	*Implementation roll-out:* time for potential stress and errors; short implementation timelines increased pressure[30 32]
Improved interdepartmental communication: information exchange between departments coupled with the ability to quickly and easily communicate with pharmacy[31]	*Cost:* cost of the system; cutting cost resulting in an inferior system[30]
	Circumvention of the system: misuse or non-use of key elements due to poor implementation management; lack of training; lack of input into the design and deficiencies in quality of technology[29]
	Security: online patient medication details more accessible and visible than paper charts[30]
	De-skilling: becoming dependent on the system[31]

Similar to findings from this systematic review, Pare and colleagues identified that the lack of 'project champions' was perceived to be an important cause of problems with the implementation of clinical information systems, followed by lack of dedication from top-level management.[16] Previous research has further documented problems with degraded communication between nurses and physicians, nurses failing to complete care duties due to excessive workload created by new systems and an increased focus on managing systems rather than patient needs.[34]

A consistent feature in study findings that focused on system pre-implementation was the unease on whether implementation would deliver the necessary hardware and the potential changes in multidisciplinary group interactions.[29 31] Doubts about the ability to cope with new technology were also identified as concerns that related to the availability of sufficient training, support and recognition of major work changes.[30 32] Adequate preparatory training was recognised as a chief concern among doctors, nurses and pharmacists and the implementation period as a time for potential stress and errors.[30 32 33]

In a descriptive questionnaire-based study by Cresswell and colleagues that primarily investigated the current implementation status of ePrescribing systems in National Health Service hospitals, lessons learnt from early implementation included the need for increased guidance in relation to implementation strategies, system choice and top-level management support to adequately resource adoption.[35] Parallel to findings in this systematic review, desired functionalities included integration with existing local systems and a more sophisticated decision support. The researchers also found that unrealistic expectations surrounding the capabilities of systems may inadvertently result in disappointment and disillusioned stakeholders.

The elucidation and understanding of healthcare professionals' perceptions of the positivity and concerns of system implementation can assist in informing, strengthening and sustaining implementation strategies. Effectiveness, ability to work with existing practices and appropriate management of systems were major constructs identified in this systematic review. As further identified in this review, it is important that implementers systematically plan for all aspects of the implementation process inclusive of staff training, support, work flow changes and communication. Success requires a high level of collaboration and negotiation across departments and between IT, end users and management, as well as a requirement to provide reassurance that staff will be supported.

Discussion of systematic review method

All types of research methods were searched with papers not in English excluded. A wide range of databases were used to search the literature. Manual searching of core journals, conference proceedings and online theses led to no studies considered for potential inclusion that raises issues around adoption of such methods in the future. No study was identified for inclusion that explored the perceptions of pharmacy staff on the barriers and facilitators towards the implementation of electronic systems for dispensing medicines in the pharmacy department. A limitation of the included qualitative studies related to a general lack of robustness with one paper assessed as poor quality, one as average quality and three as good quality. However, three researchers working independently added to the rigour of the literature inclusion and exclusion decisions. In addition, this strengthened the review process in terms of data extraction and quality rating. Structured data extraction and quality assessment forms ensured that no relevant data were missed and that important elements around study quality were properly scrutinised. A narrative synthesis of findings allowed results to be tabulated and categorised in a comprehensive manner.

CONCLUSION

A very limited number of studies were identified on healthcare professionals' perceptions of the facilitators and barriers to system implementation in hospitals. From the findings of this review, it is evident that successful system implementation will largely depend on effective leadership, the availability of high-quality systems and the development of appropriate skills and staff training for end users. Implementation planning is inherently contextual and the likelihood of successful adoption is increased if end users are educated on the necessary work changes involved. Any concerns or emotions expressed should be addressed by system designers and managers right from the onset and time should be allocated to adjust to the new ways of working. An important determinant of successful adoption is that end users are well informed of the potential benefits of the system for their own work practice. Further qualitative work on the perceived facilitators and barriers to system implementation is necessary in order to provide important information on successful system implementation for policymakers and healthcare organisations in order to increase patient safety and reduce medication costs.

Correction notice This paper has been amended since it was published Online First. Dr Pawan Rajpal was wrongly credited with authorship and has now been moved into the Acknowledgements section. Diana Hogan-Murphy was also incorrectly described as Professor in the correspondence address.

Acknowledgements The authors thank Professor Derek Stewart, Dr Vibhu Paudyal and Dr Pawan Rajpal.

Competing interests None declared.

Provenance and peer review Not commissioned; externally peer reviewed.

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