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Nurses in Australian acute care settings: experiences with and outcomes of e-health. An integrative review

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ABSTRACT

The World Health Organization (WHO) defines e-health as the "use of information and communication technology for health" [1]. The use of e-health, including electronic medical records (EMR), is a growing trend. This integrative review of the literature examines nurses' experiences of e-health in Australian acute care settings. A search of the literature identified 21 papers for inclusion in this review. Two discernable themes in the literature are apparent. Research to date largely focuses on nurses' experiences of e-health, including its usefulness in their work. Findings indicate that nurses' attitudes to e-health and computer usage are positive, however there are indications that nurses currently using e-health in practice are often dissatisfied with the implementation of new e-health systems in their workplace and that there are a number of barriers to its successful implementation. Secondly, a discernable gap in the literature regarding the impact of e-health, and in particular EMRs, on nursing outcomes is identified with research to date limited to findings related to nursing documentation and multi-disciplinary discharge planning. Future research that considers nurses' experiences in implementing e-health and applies focused strategies across a range of health settings, both in Australia and around the world, can influence successful adoption and implementation of e-health.

General Terms: Integrative review

Keywords: Nursing, electronic medical record, informatics, hospital information system, health information technology

1. INTRODUCTION

E-health refers to the "use of information and communication technology for health" [1], to enable and drive health system reform with the aim of improvements in efficiency, productivity, health outcomes and consumer satisfaction [2, 3]. E-health is recognized as a major health priority in many developed countries, including Australia, New Zealand, the USA, Canada, UK, Korea, Brazil, Germany and Sweden, together with the implementation of various tools to support e-health in varying stages across the globe [1, 4-7]. E-health initiatives are premised on the implementation of electronic medical record (EMR) (also known as the electronic health record or electronic patient record) with a vision for the future of a paperless healthcare system [8].

EMRs have existed in various forms for the past 30 years and its definition has evolved over time [9]. An EMR can be as simple as (computerised) information about a patient in digital/electronic format, to as complex as a fully integrated patient care record. Currently, the World Health Organization defines an EMR as "a real-time longitudinal electronic record of an individual patient's health information that can assist health professionals with decision-making and treatment" [1]. An earlier International Organization for Standardization (ISO) definition is more specific, referring to an EMR as "a repository of patient data in digital form, stored and exchanged securely, and accessible by multiple authorized users. It contains retrospective, concurrent, and prospective information and its primary purpose is to support continuing, efficient and quality integrated health care" [cited in 9]. While the WHO definition is succinct, the ISO definition is more congruent with contemporary developments in e-health.

Healthcare informatics, including nursing informatics, is a rapidly advancing and growing field. Nursing informatics is a sub-discipline of health informatics [2] that emerged in the literature in the mid-1980s [10]. It is defined as "a specialty that integrates nursing science, computer science and information science to manage and communicate data, knowledge and nursing practice" [10]. With nurses representing the largest proportion of healthcare professionals, nursing informatics is set to play an increasing role given that e-health is now widely accepted as the way forward for healthcare around the globe [3, 7, 11].

This review of the literature highlights the use of various terminologies in relation to electronic systems within a health care context. Terminologies include: information and communication technology (ICT), information technology (IT), clinical information technology (CIT), computerized patient information systems (CPIS) and health information systems (HIS). The authors acknowledge that there may be differences in each of these terminologies, however for consistency and ease of readability and in view of the WHO definition, the terminology 'e-health' (discussed above) [1] will be used in this article in reference to electronic systems within health care.

Over time, implementation of e-health has evolved from computerised task systems, to unit and hospital wide systems, to the concept of an integrated system, which includes EMRs. However, many systems implemented over the past 15 years have focused on just one aspect of patient record keeping. The challenge for the future is to establish how each of these systems can be integrated to better inform the provision of healthcare that ultimately supports and benefits patients.

In working towards the goal of a fully integrated e-health system that includes secure EMRs, it is important to take the opportunity to learn from the past in planning for a future, including the involvement of nurses in the design and implementation of e-health and its components [12-14]. The purpose of this paper is to report on a review of the literature pertaining to nurses' experiences of the implementation and use of e-health and its impact on nursing outcomes in Australian acute care settings.

2. METHODS

This integrative review was conducted in two phases using methods outlined by Evans [15] and Whittemore [16]. The first phase comprised a search of four online databases, CINAHL, MEDLINE, SCOPUS and Science Citation Index (Web of Science) for papers published between 1995 and 2010. Search terms included are outlined in Table 1. Search results were limited by combining with Nurs*. This search

yielded 19137 results. All citations were imported in to the Endnote program [EndNote X4, 17] and 7890 duplicates eliminated. The second phase of this search was conducted in Endnote using the terms 'implementation' and 'acute care'. The titles and abstracts of these citations (n=286) were manually reviewed by the researchers and categorised for ease of analysis. References were further refined based on the following inclusion criteria: written in English, available in full text, and with a focus on implementation of information technology in the context of nursing in an acute care setting. A total of 161 papers were identified. At this point a decision was made to limit the search to studies conducted in Australia and New Zealand. The search did not identify any studies conducted in New Zealand. Review of the full text articles of Australian studies (n= 33) identified 12 exclusions, resulting in a total of 21 papers for inclusion in this review. Comparative analysis of studies chosen for this review was difficult given the wide variety of study designs, study questions and methodologies used; a narrative summary [19] was therefore used to summarise studies.

Table 1: Search terms

Ehealth or e-health	Electronic or computeris(z)ed medication management
Electronic health or patient or medical record	Electronic or computeris(z)ed scheduling
Computeris(z)ed health or patient or medical record	Electronic or computeris(z)ed discharge
Electronic or computeris(z)ed clinical notes Electronic or computeris(z)ed order entry	Bedside or handheld or portable or mobile computing device or platform

3. RESULTS

A total of 21 papers were included in this review. A summary of each paper, including a brief outline of the focus of the paper, study design, main findings and a hierarchy of evidence score [20] is presented in Table 2. Twenty of the twenty-one papers are qualitative studies and the remaining paper is a commentary paper. The majority of papers (n=18) focus on nurses' attitudes and/or perceptions towards various aspects of e-health and computer usage. Three of the remaining papers focus on outcomes following implementation of e-health, while the final paper examines a tool for assessing the effects of e-health on clinicians' workflow and communication.

Table 2: List of studies included in this review

Author Year	*Topic of interest*	*Study design*	*Participants*	*Outcomes relevant to this study*	*Level of evidence*
Nurses Attitudes Perceptions					
Callen et al 2009	Effect of medical and nursing sub-cultures on clinician attitudes toward & satisfaction with CIS system implementation	Cross-sectional organizational culture inventory and user-satisfaction survey	Nurses (45 culture survey, 60 satisfaction survey) & doctors	Nursing culture was 'constructive' style while doctors was 'aggressive/ defensive' style. Nurses exhibited more positive attitudes toward the Clinical information system (CIS) compared to doctors. Satisfaction with all aspects of the system were similar.	VI
Eley et al 2009,	Nurses attitudes towards IT	Stratified random sampling - questionnaire	Nurses (4330)	67.5% agreed that a national electronic medical record (EMR) would be beneficial to healthcare (23.1% were neutral). Information technology (IT) training was identified as a barrier to implementation.	VI
Eley et al 2008,	Nurses perceived barriers to ICT/Ehealth	Stratified random sampling - questionnaire	Nurses (3680)	Largest barriers to e-health include too many work demands, not enough computers, lack of IT support, lack of IT knowledge.	VI
Fernando & Dawson 2009	Clinicians attitudes toward and use of electronic health information system privacy & security	Qualitative case-study	Nurses (8), Doctors (9), Allied Health Professionals (9)	Clinicians' attitudes and security practices were influenced negatively by lack of training, time away from patient care, usability errors, too many passwords/control, poor IT support and disruptive environments for information entry. Clinicians use security when it is contextual, ethical and timely and reliable. Otherwise clinicians may practice work around/illicit behavior.	VI
Levett-Jones et al 2009,	Students perceptions of ICT in clinical practice	Cross-sectional mixed methods	First year pre-registration nursing students	Focus groups identified anxiety towards information and communication technology (ICT), a lack of recognition of the relevance of IT to clinical practice and concerns regarding access to IT resources and support. The survey results indicated students perceived IT to be somewhat (38%) or extremely (34%) relevant to clinical practice and 26% were unsure. More than 50% were confident using a computer &/or the internet.	VI
Eley et al 2008,	Nurses confidence & experience with IT	Stratified random sampling - questionnaire	Nurses (3680)	Nurses experience & confidence in using IT is limited to basic computer applications	VI
Callen et al 2007	Effect of organizational culture on	Cross-sectional organizational culture inventory	249 doctors & nurses from 2 sites (165 culture	Constructive culture at one site where more positive attitudes were observed compared to 'aggressive/defensive' culture at the other site	VI

	attitudes towards and satisfaction with CIS	and user-satisfaction survey	survey, 189 satisfaction survey)	associated with more negative attitudes to a computerized provider order entry system.	
Edirippulige et al 2007,	Students perceptions of Ehealth	Cross-sectional survey	Second year pre-registration nursing students	76% unfamiliar with the term e-health while 45% & 52% were familiar with online health or EMR respectively. 23% suggested e-health would be important in practice. Other results include students' easy access and use of internet (94%), good knowledge and skill in IT (82%) and limited access to e-health education (94%).	VI
Hegney et al 2006	Nurses attitudes towards IT	Stratified random sampling - questionnaire	Nurses (4300)	Many nurses use IT in some form, mostly for accessing patient records, results & professional development. Most nurses (>90%) indicated some degree of confidence in using a computer. Barriers include lack of training, time, accessibility, security, and inadequate support.	VI
Edirippulige 2005,	Nurses perceptions of Ehealth	Cross-sectional survey	Nurses (125)	78% believe it may be possible to improve service quality through improving e-health knowledge Many barriers listed.	VI
Darbyshire 2004,	Nurses & Midwives experience & perceptions of CPIS (computerized patient information system)	Qualitative interpretive phenomenology	Nurses & Midwives (53)	Few participants found computerized patient information systems (CPIS) beneficial in their practice; benefits include reduced administrative tasks, improved legibility of notes, evidence to support nurse's work. Most participants were critical of CPIS, citing it difficult and time consuming to use. Other criticisms were lack of ability to capture essential nursing activities (inc emotional and psycho-social) and information not readily retrievable or accessible. Most participants recognized no helpful influence in identifying or improving clinical outcomes	VI
Webster et al 2003	Nurses attitudes towards and use of computers in practice (EBP)	Cross-sectional survey	Nurses (590)	Most nurses use computers at home (75%) and at work (98.5%). Nurses are generally confident in computer use, 76% have used a computer to do a literature review, and many (68%) had accessed knowledge resource. Most nurses believe that computers are of value to their practice (85%) and they improve access to information (96%). 31.5% believe that computers detract from patient care.	VI
Darbyshire 2000,	Nurses perceptions of the user-friendliness of CPIS	Qualitative - Focus groups	Nurses	Participants were generally critical of CPIS systems and highlight a lack of user friendliness with regards to accessibility (too many passwords), terminal accessibility, navigability of user interface. Improvements were suggested as more icons and graphics more help and support, prompts and reminders, printer friendly, fast and responsive computers.	VI
Darbyshire 2000	Nurses & Midwives experience with CPIS	Qualitative - Focus groups	Nurses & Midwives (53)	Focus groups revealed dissatisfaction with implementation of CPIS due to the system being imposed with no consultation and a focus on management information, not clinical information – no demonstrable benefit.	VI
Marasovic et al 1997,	Nurses attitudes towards CIS	Cross-sectional survey	Intensive care nurses (43) in one hospital	Intensive care unit nurse's attitudes toward a CIS (satisfaction, beliefs & motivation) were correlated with each other. Less experienced nurses had greater motivation.	
Axford & Carter 1996,	Impact of CIS/ computerization on nursing practice	Interviews (to develop survey tool) Survey	Registered nurses (291), computer and non computer users	Interviews identified areas of impact of computerization on nursing practice (time, cost, satisfaction, work, professional status, patient outcome). The survey identified that users (compared to non-users) have more positive views towards CIS in the areas of time, cost, satisfaction, professional status and patient outcomes. The exception was that users identified slow computer response time makes work harder.	VI
Henderson & Deane 1996	User and non-user expectations and attitudes toward a Patient Management IS	Survey	Nurses (102, 72 pre-users, 30 users)	Current users of the system have more negative attitudes towards it in all aspects (incl system accuracy, patient communication, ease of accessing data, patient care, speed of operations). The most negative attitudes were toward training in the user group.	VI
Implementation Outcomes					
Miller et al 2009	Electronic vs. traditional charting	Self report task response sheet	8 bedside nurses	Electronic charting improved nurses ability to detect changes in patient parameters	VI

Allan & Ribbons 2006	Nurse managed implementation of Electronic multidisciplinary discharge summary	Commentary only	830 bed mutli-campus health service	Implementation of new system has improved timeliness and legibility of discharge information	VI
Marasovic et al 1997	Electronic vs. paper based documentation	Comparative observational	54 ICU nurses	No significant difference in frequency of nursing activities between electronic and paper based documentation. Study limited by small sample size.	VI
Other					
Westbrook & Apmt 2009	Development of a PDA based tool to assess clinicians work patterns pre- and post implementation	Observational, study	52 nurses	The results indicate that this tool is a reliable and valid tool for assessing the effect of implementation of health IT. This tool will be applied in future studies.	VI

3.1 Attitudes/Perceptions

A key theme identified in the literature is nurses' attitudes and perceptions of computer usage and e-health. Nurses are generally confident and have a positive attitude towards both [21-24], with many nurses recognizing the benefits of e-health in service delivery [25, 26]. While most studies only included registered nurses, two studies offered the perspective of student nurses, one cohort in 2nd year [27] and the other in 1st year [28]. Although sample sizes (n=56 vs. n=971) and research designs were different between the two separate studies, similar conclusions can be drawn from the findings. In general, student nurses were confident and knowledgeable in using computers, e-health and the internet. Not all students, however, recognize the importance of e-health or information technology in healthcare practice; only 23% in one study [27] and 71% in another [28]. These findings contrast with another study that found more than 85% of registered nurses believe computers are valuable to their practice [21]. The number of years experience as a nurse also influences nurses' attitudes towards e-health. In a study by Marasovic et al. [29] less experienced nurses, were more motivated to use e-health than nurses with more years experience, irrespective of age.

Attitudes and perceptions of current users of e-health in practice are mixed. While some studies indicate positive views of nurses towards particular elements of e-health initiatives [24, 30, 31], others report that in general, nurses currently using e-health in practice have more negative views and attitudes [31-35]. Two studies by Callen [24, 31] that explore nurses' attitudes further, suggest that organizational culture can be influential in nurses' receptiveness towards e-health in the workplace. More positive attitudes were found in constructive cultures, which encourage cooperative teamwork, whereas negative attitudes towards e-health were found in aggressive/defensive cultures where there is an expectation that team members will oppose new ideas, members appear independent and competent and where there is a culture of competitiveness amongst individuals.

In the literature, many barriers to successfully implementing e-health are identified [22, 25, 26, 33-37]. Barriers include lack of knowledge about e-health [25, 26], limited or lack of training in e-health [22, 36, 37] and limited access to computers [22, 25, 26, 33]. Registered nurses commonly found accessing e-health in their work time consuming, with it creating too many demands on them during their working hours [22, 25, 26, 33]. They also found that a lack of technical support [22, 26, 37] and security issues were barriers to successful use of e-health in their practice [22, 34, 37]. When registered nurses believe that implemented e-health initiatives do not reflect the nursing process [33, 35] and when there has been a lack of consultation prior to implementation [35] nurses were resistant to change.

Two papers reported on studies that assessed outcomes relevant to nursing as a result of implementing e-health initiatives. While electronic charting (vs. traditional paper charting) was found to improve nurse's ability to detect changes in patient parameters in one of the studies [38] the other study reported no effect from electronic documentation (vs. paper based documentation) on frequency of nursing activities [39]. It is worth noting that in the latter study findings were not statistically significant. A third paper comments on the positive improvements in timeliness and legibility of discharge information as a result of the implementation of an electronic multidisciplinary discharge summary [40].

4. DISCUSSION

Two major themes were identified from this integrative review of the literature. The first theme is nurses' attitudes and perceptions of e-health and its implementation and use in healthcare. The second theme relates to the outcomes of implementing e-health on nursing practice.

4.1 Attitudes / Perceptions of e-health

The majority of studies included in this review focus on nurses' attitudes towards the use of computers, recognition of the importance of e-health and EMRs, and nurses' experiences of using e-health in clinical practice. Studies, which reported positive findings in these areas, include Axford & Carter [30], Callen et al. [24], Edirippulige [25], Eley, Soar et al. [26], Hegney et al.[22] and Webster et al.[21]. These findings are supported in the broader literature with regard to nurses in countries including Kuwait [41], China [42], Holland [43], Canada [44] the UK [45] and the US [46]. Two studies in the broader literature, which focus more specifically on the implementation of EMRs, reported respectively negative attitudes towards EMRs pre-implementation of a new e-health system [47] and positive attitudes pre-implementation compared to post-implementation [46].

Reports of nurses' experiences of using e-health in practice are mixed however, particularly in relation to its implementation. Few studies in this current review report nurses having a positive experience in relation to the implementation of e-health [24, 30, 31], as compared to the number of studies reporting nurses having a negative experience [32-35]. These mixed results are supported in the

wider literature with one review of 13 papers suggesting nurses in general have positive experiences of e-health [14], while another review of five papers reports widespread dissatisfaction with various e-health initiatives [48]. Other studies not included in the two afore-mentioned reviews also indicate both satisfaction [49] and dissatisfaction with e-health [50]. Papers identified in this current review are more strongly aligned with nurses' experiencing dissatisfaction in their experiences with e-health in the workplace. Given the findings of generally positive attitudes towards e-health prior to the implementation of initiatives in the workplace followed by nurses then reporting negative experiences, these results suggest issues with implementation processes of new initiatives.

Although the majority of literature, particularly in the Australian context, reports that nurses experience dissatisfaction with e-health after the implementation of new initiatives, there is evidence in the wider literature to suggest that these negative attitudes post implementation improve over time. Some studies show greater acceptance and more positive attitudes in the months following implementation [51-55], which reinforces the importance of effective change management during the e-health implementation process.

4.2 Outcomes of implementing e-health

The benefits of e-health, including EMRs have been documented with outcomes of improved patient safety and quality of care resulting from increased efficiency, accuracy, management, accessibility and decision-support [56]. More specifically in relation to nursing, the benefits of EMRs include improved documentation, legibility, evidenced based decision support, interdisciplinary communication and reduced duplication and medical errors, all of which result in streamlined clinical workflow leading to enhanced quality of care [57-59].

While there are many expected benefits of e-health and EMRs in general these are not always assessed in terms of their effects on nursing practice as reflected in the limited evidence found in this review. In this review, journal articles related to outcomes for nursing practice, in relation to implementing e-health, are confined to outcomes associated with electronic versus paper documentation [38-40]. Positive effects of electronic documentation on various aspects of nursing work, including improvements in completeness, quality and quantity of documentation and time for patient care are also evident in the wider literature [46, 60-63].

4.3 Relationship between attitudes and outcomes of implementation: Are the two related?

While this paper has so far separated studies reporting both nurses' attitudes towards, and experiences of, computers and e-health from papers concerned with the outcomes of implementing e-health, these two areas are not mutually exclusive. Our review of the literature suggests that there is a close relationship between the success of an implemented system, the implementation process and the feelings of affected nursing staff [14, 64]. Indeed, numerous studies included in this review identified barriers to successfully implementing e-health [22, 25, 26, 33-37].

Barriers that influence the implementing of new e-health initiatives contribute to nurses' levels of dissatisfaction reported after implementation of such initiatives. Indeed, the Australian study by Callen et al. [24, 31] indicates the importance of organizational culture in effectively implementing change such as the introduction of e-health. Barriers to the implementation of e-health identified in this study are not dissimilar to those reported in the wider literature [12, 50, 64-66]. Given the commonality of barriers to successfully implementing e-health in different circumstances and environments around the world, it is important that they be considered and addressed prior to future rollouts [67]. Whilst identified barriers do not prevent the implementation of e-health initiatives they may contribute to patterns of resistance that Timmons [50] defines as 'resistive compliance' (p.257).

5. LIMITATIONS

The paper by Westbrook and Ampt [68], included in this review, highlights one important limitation of this review, which is the difficulty of evaluating the implementation of e-health. There are many aspects of implementation that need to be considered in a comprehensive evaluation process [67], which are emphasized by the range of barriers identified in this review. Furthermore, as there is no gold standard for evaluating implementation of e-health, it is difficult to compare different studies. The need to comprehensively evaluate the implementation of nursing informatics is also highlighted in the wider literature with the publication of two reviews in this area [69, 70], one specific to nursing practice [71]. While there is a need for valid and reliable evaluation tools, they are only in the early stages of development [68, 71]. Tools currently being developed, along with others likely to be developed in the future given the emerging interest in this area, will be invaluable to the evidence base related to the implementation of e-health and EMR.

6. CONCLUSION

This integrative review highlights the need for further studies regarding the implementation of e-health, including EMRs, and their impact on nursing practice in Australia. Further evidence is required regarding nurses attitudes to e-health, and secondly to assess the effect of implementing e-health on various nursing outcomes in order to understand what works and why, with the ultimate aim of determining best practice for nursing in the Australian context. To support future goals, including the successful implementation of fully integrated e-health systems, it is important to understand nurses' roles in the implementation process and impacts on nursing practice, particularly given that nurses represent the largest proportion of the health workforce. Insights from the literature highlight various factors that are important considerations in the process of implementing e-health, including health professional's lack of knowledge and training and a lack of access and technical support. Even though e-health, in its various guises is becoming commonplace in Australia and other developed countries, focused research in this area is limited. Future research that applies focused implementation strategies and considers nurses' roles and experiences in implementing e-health, both in Australia and around the world across all health settings, can influence successful implementation and adoption of e-health.

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