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Title	Nursing students' attitudes and beliefs regarding the use of technology in patient care: A mixed-method systematic review
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Publication date	2021-07-12
Original Citation	Saab, M. M., Landers, M., Egan, S., Murphy, D. and Hegarty, J. (2021) 'Nurses and Nursing Students' Attitudes and Beliefs Regarding the Use of Technology in Patient Care: A Mixed-Method Systematic Review'. Computers, informatics, nursing: CIN, 39 (11), pp. 704-713. doi: 10.1097/CIN.0000000000000791
Type of publication	Article (peer-reviewed)
Link to publisher's version	10.1097/CIN.0000000000000791
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Download date	2026-11-04 08:07:47
Item downloaded from	https://hdl.handle.net/10468/12589



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Nurses and nursing students' attitudes and beliefs regarding the use of technology in patient care: a mixed-method systematic review

Abstract

Advancements in information technology and computer science have resulted in the development of computerized healthcare information systems. Information technology can optimize patient care through providing immediate e-education. The purpose of this mixed-method systematic review was to synthesize evidence from studies exploring nurses and nursing students' attitudes and beliefs regarding the use of technology in patient care. Electronic databases Academic Search Complete, CINAHL, MEDLINE, Education Full Text, PsycARTICLES, Psychology and Behavioral Sciences Collection, PsycINFO, and ERIC were searched. The methodological quality of the studies was assessed using the Mixed Methods Appraisal Tool. Convergent integrated synthesis was conducted. Eight studies were included. Technologies used in the reviewed studies include smartphones (n=4) and web-based information/educational resources (n=4). Overall, nurses and nursing students' attitudes and beliefs regarding the use of smartphone applications were positive. When compared to other healthcare professionals, nurses were more likely to have access to web-based resources and to appraise the importance of such resources in patient education. Nurses and nursing students are in a prime position to use technology in patient care and education. It is important therefore that nurses' positive attitudes towards technology be reinforced to increase the use and application of web-based and smartphone technologies in clinical practice.

Keywords: Nursing; patient education; smartphone; systematic review; technology

INTRODUCTION

The application of technology rich information systems is considered by service providers to be at the core of global health and a positive means of enhancing the quality of patient care.[1-3] Recent advancements in information technology and computer science have resulted in the development of computerized information systems across a wide range of healthcare delivery systems.[4] According to Kuwabara et al., technology has redefined the way patients and healthcare providers communicate and exchange information.[5] Internet-based patient support systems are now widely assumed to play a significant role in patient education initiatives.[6,7]

Nurses are often at the initial point of care and are aware of the importance of communicating with patients regarding their health status on a regular basis.[3,8] Nurses also play a key role in empowering patients with chronic conditions to enhance their self-management skills.[9] Currently, digital technologies provide great opportunities for nurses to develop patient health-related literacy skills to support the efficacious use of online health information.[10-12] Specifically, Darvish et al. are of the view that information technology can optimize the nursing management of patient care situations by providing immediate e-education regardless of time or place.[3] Therefore, accurate and easily accessible information is a pre-requisite for the provision of safe patient-centered care.[10]

Traditionally, healthcare providers have used paper-based formats such as articles, written messages, and pamphlets as means of providing health-focused information and education to patients.[5,13] However, more recently, a wide array of multimedia such as emails, group texting,[14] video, audio,[5] and interactive patient care technologies[15] are being integrated into a number of clinical practice settings. Healthcare professionals are beginning to see evidence of the potential use of such technologies in enhancing patient education.[14,16] Indeed, a survey by Moore and Jayewardene found that nurses and doctors recognized the benefits of devices such as smartphones and healthcare applications in helping improve patient access

to information, decision-making, and efficiency of care.[16] Of the nurse respondents, 58% used their smartphones in practice; this figure was 81% for doctors.[16]

Nurses and nursing students are important contributors to the healthcare workforce and thus important users of information technology in the clinical setting.[12] In a cross-sectional study, Tubaishat measured fourth year nursing students' attitudes towards the use of technology in healthcare.[12] This study highlighted the need to provide further education on technology to final year nursing students to help prepare for their future role as registered nurses.[12] Tubaishat's findings demonstrate that nursing students hold a generally positive attitude toward technology.[12]

According to Kuwabara et al., technological devices will continue to develop in their capacity to efficiently monitor, educate, and support individual patients to practice health-related behaviors.[5] Thus, Holden et al. contend that it is important to explore the perceptions of nurses towards novel technologies in order to use such technologies in clinical practice.[17] Nurses' attitudes can be a pivotal point upon which successful health-related technology implementation hinges. To this end, the aim of this mixed-method systematic review was to synthesize evidence from studies which explored nurses and nursing students' attitudes and beliefs regarding the use of technology in patient care. In particular, this systematic review aimed to answer the following questions:

i. What are the different technologies used in patient care within the included studies?
ii. What are nurses and nursing students' attitudes and beliefs regarding these technologies?
iii. What are patients and family members' attitudes and beliefs regarding these technologies?

METHODS

Design

Mixed-method systematic reviews allow for the inclusion of qualitative, quantitative, and mixed-method studies; therefore, combining the strengths of quantitative and qualitative research and accounting for design limitations.[18] This review was conducted according to the Joanna Briggs Institute Manual for Evidence Synthesis.[19] and reported using the 27-item Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist.[20]

Eligibility criteria

Study eligibility criteria were pre-determined according to the review aim and questions using the SPIDER (Sample, Phenomenon of Interest, Design, Evaluation, and Research type) framework.[21] Studies were considered for inclusion if they included nurses, nursing educators, nurse managers, and nursing students; used any empirical design; and primarily explored participants' attitudes, beliefs, feelings, and perceptions regarding the use of any technology in patient care in general and education in particular (primary outcome). Studies exploring the way nurses and nursing students use the technology and studies reporting on patient outcomes as a result of using technology (secondary outcomes) were also considered for inclusion.

Studies with healthcare professionals other than nurses and studies where findings from nurses could not be isolated were excluded. Studies which have solely evaluated participants' knowledge, awareness, and behaviors regarding the use of technology in patient care were also excluded. Literature reviews, editorials, opinion pieces, abstracts, dissertations, and theses were not considered for inclusion.

Information sources and search

A systematic search of electronic databases was conducted in Academic Search Complete, CINAHL, MEDLINE, Education Full Text, PsycARTICLES, Psychology and Behavioral

Sciences Collection, PsycINFO, and ERIC. The search was conducted on August 28, 2020 and was limited to studies published in English between January 2010 and August 2020. Of note, the 10-year limit helped source the most up-to-date evidence regarding the latest technologies used in healthcare.

Keywords were truncated to maximize retrieval, combined using Boolean operators “OR” and “AND,” and searched based on title or abstract as follows: Nurs* AND (attitude* OR percept* OR perspective* OR opinion* OR thought* OR feeling* OR belie*) AND (technolog* OR comput* OR tablet* OR “mobile phone*” OR smartphone* OR “smart phone*” OR cellphone* OR “cell* phone*” OR app* OR “virtual realit*” OR “VR” OR “augmented realit*” OR “AR” OR “artificial intelligence*” OR “AI” OR simulat* OR internet* OR web* OR electronic*) AND (“patient* educat*” OR “patient* teach*” OR “patient* inform*” OR “health* educat*” OR “health* promot*” OR “health* teach*” OR “health* behavio*”).

Study selection and data collection

Records identified from the database search were exported to Covidence, an online software package used to produce systematic reviews. Duplicates were deleted and the title and abstract of all records were screened. Following the exclusion of irrelevant records, the full texts of potentially eligible records were obtained and screened for eligibility. Two independent reviewers conducted title, abstract, and full text screenings at random. A third independent reviewer resolved all screening conflicts.

Data from the included studies were extracted by one reviewer using a standardized data extraction table,[22] which was cross-checked for accuracy by the review team. The following data were extracted from each of the included studies: reference; country; design; theoretical underpinning; sample; setting; technology used; data collection; and relevant results.

Quality appraisal

The methodological quality of the reviewed studies was assessed using the Mixed Methods Appraisal Tool (MMAT).[23] The design of the included studies guided the choice of the MMAT

quality appraisal items. In total, seven items assessed the methodological quality of cross-sectional studies, qualitative studies, and non-randomized studies. These items related to the clarity of the research question, suitability of the data collection process to the research question, sampling and sample representativeness, appropriateness of outcome measures, presentation and clarity of findings, and the presence of confounders.[23] Each item was voted on a “yes,” “no,” or “can't tell” basis. Quality appraisal was conducted by one author and cross-checked for accuracy by a second author. Voting discrepancies were resolved by consensus.

Synthesis of results

Data synthesis in mixed-method systematic reviews is conducted either sequentially (i.e., sequential exploratory synthesis) or concurrently (i.e., convergent synthesis).[18,24] In the present review, convergent integrated synthesis was conducted whereby quantitative data were “qualitized.”[19] This involved transforming statistical evidence into narrative descriptions according to the review aim. Qualitized quantitative data and qualitative data were then assembled, thematized, and pooled together based on similarity in meaning to produce a set of integrated findings. Therefore, findings in the current review were synthesized and presented according to the type of technology used in the included studies.

RESULTS

Study selection

A total of 2,417 records were identified through database searching. Following deletion of duplicates, the title and abstract of 1,169 records were screened and 1,110 irrelevant records were excluded. Full texts of the remaining 59 articles were obtained for further screening. Of those, 51 were excluded, mainly due to wrong outcomes (n=23) and wrong study design (n=14). Therefore, eight studies were included in this systematic review. The study identification, screening, and selection process is presented in Figure 1.

Study characteristics

Almost half of the studies were conducted in the United States of America (USA) (n=3) and used a cross-sectional survey design (n=3). Half of the studies (n=4) were conducted in hospitals. Three studies were underpinned by theory including elements from Jean Watson's Theory of Human Caring,[25] the Technology Acceptance Model,[26] and the Integrative Model for Explaining Behavioral Change.[27] Most studies were conducted among nurses (n=6) with some studies comprising mixed samples of nurses, nursing students, and other healthcare professionals. Sample sizes ranged between 12[28] and 130[27] participants. Technologies used in the reviewed studies include smartphones and smartphones applications (n=4) and web-based information and educational resources (n=4). The full study characteristics are presented in Table 1.

Quality appraisal

All the quantitative descriptive studies (n=5) had clear and appropriate research questions, data collection process, sampling strategies, and data analysis.[26,27,29-31] A major methodological issue, however, was the low response rate which ranged between 36%[27] and 43.3%[30] resulting in concerns around sample representativeness and the risk of nonresponse bias.

The two qualitative studies met almost all criteria of the MMAT.[28,29] However, coherence between qualitative data sources, collection, analysis, and interpretation was not clearly addressed.

The reviewed pre-post study had a clear research question and appropriate data collected methods.[25] Yet, it was unclear whether measurements were appropriate, confounders were accounted for, and whether the intervention was administered as intended. Moreover, threats to complete outcome data reporting and sample representativeness related to not reporting the total sample size as well as a low response rate pre-test (45%) and post-test (34%).[25] Quality appraisal results from the eight included studies are presented in Table 2.

Findings were synthesized and presented below according to nurses and nursing students' attitudes towards two key technologies namely (i) smartphones and (ii) web-based information. Data extraction with findings from individual studies are available in Table 3.

Attitudes and beliefs regarding smartphones

Smartphones and smartphone applications were used in four of the reviewed studies.[26,28, 31 32] This involved integrating smartphones into the call bell system[28]; sending health information securely using a smartphone application[26]; using smartphone applications to implement point-of-care[32]; and using an eHealth application to help with patient care.[31]

Overall, nurses and nursing students' attitudes and experiences of using smartphone applications were positive. For instance, the use of smartphones in the call bell system was believed to enhance time management, convenience, prioritization, patient safety, and nurse-patient relationship.[28] Similarly, the use of a smartphone application while implementing point-of-care was perceived to enhance nursing students' communication with patients, patient education skills, comfort while taking patient history, and cultural competence.[32] Nursing students also reported a greater ability to translate didactic knowledge to real-world situations as well as an increase in their level of confidence.[32]

Information security was a key discussion point in two of the reviewed studies.[26,31] Electronic health records and computerized health information systems were perceived to improve the sharing and real time access to patient information whilst maintaining security and quality decision-making in patient care and evaluation.[31] Likewise, Collins found that secure texting applications were perceived by nurses as useful, easy to use, and trustworthy.[26]

Nurse- and patient-related limitations of using a smartphone were addressed in one study.[28] For nurses, limitations pertained to poor call quality, interference, system glitches, poor battery life, and stress among nurses caused by having multiple notifications. In addition, nurses reported that smartphones were not favored by patients and family members,

particularly those who did not know how to use this technology.[28] Some nurses also mentioned that patients mistakenly believed that the smartphone was the nurse's personal cellphone and that the nurse seemed distracted as a result. [28]

Attitudes and beliefs regarding web-based information

The remaining four studies used web-based information and educational resources for patients, including a video-on-demand educational channel with updated online patient information material[25]; internet-based information for patients with cancer[27]; a web-based educational tool for people with schizophrenia spectrum psychosis[29]; and information technology-based warfarin education resources.[30]

Having clinical nurse specialists create a video-on-demand educational channel and update online patient information material yielded an increase in the perceived importance of such tools among nurses.[25] Kuosmanen et al. evaluated a password-protected web-based educational tool for people with schizophrenia spectrum psychosis which can be used in inpatient and outpatient settings.[29] It was found that service users, nurses, and nursing students perceived the content of the website as reliable and agreed that the website was user friendly and easy to navigate.

When compared to other healthcare professionals, nurses were more likely to have access to web-based resources and to appraise the importance of such resources in patient education.[27,30] For instance, in the context of cancer education, nurses were more likely than medical professionals to recognize patients' need for internet guidance, were more convinced that the use of cancer information websites gives patients a greater sense of control, reported greater self-efficacy in the use of such information, and found it important to refer patients to online information.[27] Similarly, nurses were more likely than doctors and pharmacists to have access to IT-based warfarin educational resources, provided that the information was of good quality, images relevant to warfarin therapy were used, and the information was available in multiple languages.[30]

DISCUSSION

This mixed-method systematic review focused on synthesizing evidence from studies which explored nurses and nursing students' attitudes and beliefs regarding the use of technology in patient care with a focus on patient education. From an analysis of the data, participants' attitudes and beliefs were explored in relation to two key technologies namely (i) smartphones and smartphone applications and (ii) web-based information and educational resources.

A key finding from this review showed that smartphones and smartphone applications were commonly used technologies in patient care.[26,28,31,32] Indeed, the use of smartphones in healthcare is not unusual, especially that smartphones help healthcare professionals download a wide range of health-related applications which can be readily used in patient care and education.[33] In the present review, nurses' use of smartphones in patient care can be grouped under six broad categories: communicating[28]; directing healthcare information[26]; implementing point of care[32]; securing healthcare information[32]; imparting education[32]; and helping provide quality healthcare to patients.[31] The above findings were corroborated in the study by Moore and Jayewardene whereby nurses and doctors showed that smartphones and healthcare applications assisted healthcare professionals to improve access to information, decision-making, and efficiency of care to improve access to information.[16] Indeed, an online survey of 735 nurses found that almost all participants (98%) used a smartphone in acute care settings in order to access information on medications and procedures, and over 75% indicated using smartphones to seek patient education information.[33]

In relation to nursing students, the current review highlighted the value of smartphones as learning tools for nursing students and the role of smartphone applications in enhancing students' ability to translate theoretical knowledge to the clinical setting.[32] According to Honey, knowing the technological device that nursing students use and have access to has the potential to guide the development of transformative and innovative teaching and

learning initiatives.[34] However, a key limitation that was not addressed in the reviewed studies relates to distractions caused by using smartphones for personal reasons[35,36] For instance, a survey of 234 nursing students in Spain found that smartphones were not widely used for professional purposes, with a number of students using their smartphones for personal reasons during their practicum.[35]

While the use of smartphones in clinical settings was perceived favorably by most participants, some limitations to using such technology among nurses and patients are worthy of note. For instance, nurses in the study by Burkoski et al. believed that the poor call quality, interference, system glitches, poor battery life, and stress caused by having multiple notifications were key limitations to using a smartphone in the clinical setting.[28] These challenges are not uncommon and have been reported elsewhere.[37] Interestingly, however, one study found that the use of smartphones in healthcare delivery was favored by nurses as a means to reduce work-related stress and enhance communication with colleagues and patient care.[38] Another limitation identified in our current review relates to patients not knowing how to use a smartphone and falsely believing that nurses were carrying smartphones for personal use, thus distracting them from patient care.[28] In keeping with distraction, when used for personal reasons in clinical settings, smartphones can lead to missing important patient information which negatively affects patient care and patient safety.[39] Of note, nurses and patients' positive and negative experiences with smartphones are well documented in the wider literature. For instance, a review of the effect of nurses' use of smartphones in patient care found that smartphones enhanced interprofessional communication, were perceived by nurses as easy and quick, improved time-management, and reduced work-related stress.[40] Nevertheless, smartphones distracted from work and made the nurse seem unprofessional.

One limitation that was not addressed in our current review pertains to the transmission of nosocomial pathogens.[41] Pal et al. swabbed mobile phones and hands of 386 healthcare workers and found that 316 mobile phones (81.8%) and 309 hand swab samples (80%)

showed growth of bacterial pathogens including “Coagulase-negative Staphylococcus, Staphylococcus aureus, Acinetobacter species, Escherichia coli, Klebsiella pneumoniae, Pseudomonas species and Enterococcus species” (p.1).[41]

In the current review, online educational resources such as an automated video[25]; internet-based information on cancer[27]; web-based education on schizophrenia spectrum psychosis[29]; and information technology education focusing on warfarin[30] were offered as novel opportunities for patient education in four studies. It was interesting to note that nurses were the healthcare professionals who were most likely to access and evaluate patient-related educational web-based resources when comparted to other healthcare professionals including doctors.[27,30] Thus, it was not surprising that, while nurses were more aware of patients’ requirements for internet support, they were also sensitive to the need of patients for information relating to their cancer diagnosis. This can be interpreted as nurses’ commitment to providing optimal person-centered care.[17]

In the current review, one quantitative study highlighted the sense of autonomy and self-efficacy felt by patients in being able to access and use online information.[27] Nurses have a central role to play in helping patients with chronic conditions to augment their self-management skills.[9] Accordingly, Anttila et al. called for a greater focus on web-based patient education during hospitalization to help patients self-manage their care on discharge.[6] It is important therefore, that nurses’ positive attitudes towards technology be reinforced, to increase the use and application of web-based technology in clinical practice.

Limitations

This review is not without limitations. While rigorous processes were used to screen and select studies, only eight studies were included in this systematic review. Therefore, review findings cannot be considered generalizable. The search was limited to studies published within the past 10 years. While the year limit would help highlight the latest technologies used in patient care, it might have led to omission of important records published before the

year 2010. Most of the reviewed evidence consisted of descriptive data with very little evidence relating to the effect of technological interventions on nurses' attitudes. Another key methodological issue related to the low response rate in quantitative studies, which ranged between 36%[27] and 43.3%[30]; this serves as another threat to generalizability.

CONCLUSION

There is a dearth of high-quality research investigating nurses and nursing students' attitudes towards technology. Nonetheless, the evidence gleaned from the reviewed studies makes an important contribution to understanding nurses and nursing students' views on the use of technology in patient care in general and education in particular. Overall, nurses and nursing students' attitudes towards the use of smartphones and online educational resources were positive with some studies finding that nurses used such technologies more than other healthcare professionals. This highlights the importance of reinforcing such positive practices. Limitations to using such technologies, however, must be considered. These include but are not limited to: system glitches and failures; poor battery life for smartphones; stress caused by multiple notifications; distractions; risk of infection transmission; and misbeliefs among patients regarding the reason behind nurses' use of smartphones at the bedside.

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Table and figure legends:

- **Table 1.** Study characteristics (n=8)
- **Table 2.** Quality appraisal of the included studies using the Mixed Methods Appraisal Tool (MMAT)
- **Table 3.** Data extraction and summary of findings (n=8)
- **Figure 1.** Study identification, screening, and selection process