RESEARCH ARTICLE / ARTICLE DE RECHERCHE

A Study of the Impact of an Educational Intervention on Nurse Attitudes and Behaviours Toward Mobile Device and Application Use in Hospital Settings

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Abstract: Introduction: Mobile devices provide nurses with access to evidence-based information at the bedside through software applications (apps). Librarians encourage app use by purchasing licenses and promoting their features. While many high-quality nursing apps exist, there is inconsistency in published reports on whether nurses use them in patient care. The aim of this research is to describe the use of mobile devices and apps by nurses at two urban hospitals and to examine the impact of educational sessions led by hospital librarians and educators on nurse usage, attitudes, and behaviour as they relate to mobile devices and apps. **Methods:** Phase I consisted of a descriptive, cross-sectional survey of inpatient nurses to determine mobile device and app use and attitudes. Phase II involved a one-group pre- and post-test design to examine the impact of educational sessions led by librarians and hospital educators on nurse attitudes, usage, and behaviours. A post-intervention focus group captured thoughts on using mobile devices and apps at the bedside. **Results:** Results indicate that most nurses who have a personal mobile device are interested in using them to access apps at the bedside though few are currently doing so. While nurses cite many conveniences and uses, they also highlight a number of barriers associated with using mobile devices that must be addressed in order to realize the benefits in patient-centred care. **Discussion:** Hospital librarians and educators should work together to provide the education and support nurses require to realize the benefits of using devices and apps at the bedside. Larger studies are needed to determine the impact of educational sessions on patient and health provider satisfaction with mobile device and app use.

Introduction

Mobile applications (apps) and devices, such as smartphones and tablets, allow nurses to access pertinent best practice and evidence-based resources at point of care. The ability to find information using a mobile device at the bedside eliminates the time required to visit the library, log onto a computer workstation, or search a print resource. This potentially increases time for direct patient care. Despite the advantages and promotion by hospital librarians, the evidence is split on whether or not mobile devices are being used routinely in nursing practice. A 2013 study of American nurse leaders reported that although a growing number of nurses owned smartphones or tablets, these devices are rarely used in the practice of caring for patients [1]. Johansson reports in 2012 that compared to earlier studies nurses were increasingly using mobile technology in their practice but desktop computers and even paper-based guidelines were still widely used [2]. From a survey of a NHS Trust institution in London, England during 2015, Mobasheri reports that a

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This article has been peer-reviewed.

growing number of doctors and nurses own and are using mobile devises with medical apps in clinical practice. Ninety percent of doctors and 65% of nurses surveyed owned medical apps for use in their work [3]. In addition, while there is a proliferation of studies in recent years on mobile devices in healthcare, much of the research focuses on the use of mobile devices by nursing students or other healthcare providers [4-9]. Actual utilization of mobile devices by nurses is often overlooked in studies that explore the possibilities and challenges associated with their use.

Winnipeg is the largest city in the province of Manitoba with several hospitals and healthcare centres operated by the Winnipeg Regional Health Authority (WRHA) with library services provided by the University of Manitoba. A number of WRHA policies discuss the use of mobile devices by healthcare professionals. However, these policies appear vague and could be perceived as conflicting in nature at the time of the study. Clinical patient care managers who impose their own policies or personal preferences about mobile device use on their patient care units further confuse the issue for bedside nurses.

The first objective of this study was to describe the current knowledge and use of mobile devices and apps by nurses on inpatient medical and surgical units of a community hospital and a tertiary care hospital within the WRHA. Secondly, this study contributes to the evidence on mobile device use in healthcare by examining the impact of a short series of educational sessions on mobile devices and apps related to patient-centred care on nurse usage, attitudes, and behaviours. The main research questions addressed in this study were:

(1) What is the current usage of mobile devices and apps by nurses for direct patient care within the study sites?
(2) What are the attitudes of nurses at these study sites towards the use of mobile devices and apps for direct patient care?
(3) Does an educational intervention comprised of a series of short sessions on the use of mobile apps change usage of mobile devices and apps for direct patient care among nurses?
(4) Does the intervention change attitudes of nurses towards the use of mobile devices and apps for direct patient care?
(5) What are nurses' perceptions of attitudes held by colleagues, patients, and families about nurses' use of mobile devices and apps for direct patient care?

Literature Review

There is a growing body of research on the incorporation of mobile devices in nursing practice as a communication tool and as a means of supporting evidence-based practice by providing access to information resources, practice guidelines, and drug information [10-14]. Doran (2010) investigated the impact of mobile devices on nurses' access to research evidence in Ontario, Canada, and reported that the most frequently used resources accessed by nurses included drug dictionaries and medical reference sources [11]. Participants indicated they frequently accessed Google as well. Nurses felt that having access to devices changed their use of Registered Nurses Association of Ontario (RNAO) Best Practice Guidelines and that information resources assisted in their practice and improved patient care. In another study, nurses expressed the value of having clinical reference tools and drug information accessible on Personal Digital Assistants (PDAs) to their practice [12]. Mosbasheri reports more than half of nurses surveyed describe smartphones as very useful or useful. As well, mobile devices are believed to be helpful pieces of technology and used for work purposes by nurses according to Bautista in another study [3, 15].

Some researchers focused on the usefulness of integrating mobile devices in nursing education. Stroud et al. (2005) reported that students in a nurse practitioner program used drug information resources and clinical decision support resources available on a PDA [13]. More recent studies supported Stroud's (2005) early work and demonstrated how mobile devices could augment student learning on the ward, potentially reducing medication errors and improving patient safety [4, 6, 8]. As Day-Black and Merrill (2015, p. 79) wrote, "The use of the PDA and other mobile devices (Smart phone) is rapidly growing, and will be the next technology frontier for healthcare workers" [4].

Although there is a growing interest in utilizing mobile devices in nursing practice, the literature reports a variety of barriers. One concern was whether mobile device use would negatively affect their performance [16]. Many expressed fears that patients would assume they were playing games or using devices for personal use [2]. Nurses were also cognizant of potential distractions that mobile devices offer in the provision of patient-centered care [1, 2, 16, 17]. Addressing this idea of clinician distraction by mobile devices, McBride (2015, p. 2027) provided a

definition of distraction as "the interruption of a hospital clinician's primary task by the internally or externally initiated use of their smartphone" [18]. McBride and Levasseur (2015, p. 5) cautioned that registered nurses ". . . may not be able to accurately assess when it is appropriate to use them and to modify their behaviour accordingly" [16]. A recent survey of nurse leaders in the United States conducted by Hader (2013) showed that while the majority of nurses owned mobile technologies, most were prohibited from using these devices in the workplace [1].

Additional concerns by nurses included patient privacy, lack of comfort with the technology, infection control, cost, and lack of wireless connectivity [1, 10-12]. These obstacles should not be considered insurmountable given the potential mobile apps have for enhancing patient care. As healthcare administrators consider these issues in an environment where mobile technology is increasing, they need to work towards creating policies that will encompass the rights of the patient and information needs of the healthcare worker [19-21].

As mobile devices and apps grow in acceptance and use by nurses, administrators will need to develop policies that consider the integration of these technologies into patient care. Currently, most hospital policies regarding the use of mobile devices usually prohibit or limit usage [1, 15]. Bautista recommends clear policies with education on responsible use emphasizing the advantages of using mobile devices and apps for patient care [15].

Health librarians have always provided access to information and taught users how to find, evaluate, and use health information. The introduction of mobile device and app use to healthcare provides librarians with an opportunity to teach and offer services in a mobile environment. Health librarians at the University of North Carolina at Chapel Hill began in 2001 to offer services that incorporated mobile technologies, by integrating these tools into instruction, creating a web-based tutorial on Personal Digital Assistants (PDAs) for medical students and later nursing students [22]. The Dana Medical Library at the University of Vermont in 2013 offered group and individual instruction sessions, technical support and a subject guide to medical students on the use of mobile resources. Content covered in the sessions included apps available from the library, how to download and authenticate, and clinical relevance. [23]. Library services for mobile device and app use are becoming commonplace in medical libraries globally. Collaboration with health practitioners, such as the current study illustrates, is an expanding role for health librarians.

Methods

This study involved two phases that were implemented from March 2014 to December 2014. Phase I consisted of a descriptive, cross-sectional survey of inpatient nurses to determine mobile device and app use and attitudes. Phase II involved a one-group pre- and post-test design where nurses completed the same survey they completed in Phase I to determine the impact of four short educational sessions taught by librarians and hospital educators on nurses' use of mobile devices and apps as well as their attitudes and behaviours regarding the devices. A focus group consisting of Phase II volunteers was held after the trial period of use to gather in-depth thoughts on the impact of educational sessions on nurses' use of devices and apps on the wards.

Ethical approval for both phases of the study was obtained from the University of Manitoba Health Research Ethics Board and access approval was obtained from both hospitals.

Phase I

Phase I consisted of a convenience sample taken from a descriptive, cross-sectional survey of inpatient medical and surgical nurses at one community 251-bed hospital and randomly selected in-patient medical and surgical units at one 554-bed tertiary care hospital in Winnipeg. Inpatient nurses were selected for this study as the nature of their shifts allowed the opportunity to utilize the devices and apps around the clock and they would likely have a more consistent patient assignment than nurses in an outpatient setting. Units at the tertiary site were randomly selected to keep recruitment numbers at a manageable size for this study. To encourage recruitment, posters were placed on the units and emails with the survey and letter of invitation were sent to hospital listservs. As an incentive, a $100 gift card was drawn from among the people who completed the survey.

The survey was a 21-item fixed and open-ended survey developed by the researchers to capture demographic data and current usage and attitudes of nurses towards mobile devices and apps in support of direct patient care (Appendix A). Surveys were completed online using Fluid Surveys or by providing responses on hard copies of the survey that were left in

the break rooms for nurses to access. Consent forms were attached to the print copies and linked to the electronic copies of the survey.

Phase II

The Phase I survey contained information explaining Phase II and offered nurses the opportunity to volunteer for the second phase by submitting a short form with their name and contact information. Of the 54 Phase I survey participants at the community hospital, 13 volunteered to participant in Phase II. Of the 40 survey participants from the tertiary site, three volunteered to participate in Phase II. There was a total of 16 Phase II participants. To be included in Phase II, nurses had to own a mobile device with cellular data, be willing to download nursing-related apps, and attend four short educational sessions at their respective workplaces. All participants who completed Phase II received a $25 gift card.

Written, informed consent for Phase II was obtained in print at the first educational session. Installation of mobile apps and educational sessions were followed by a two-month period of device use on the units. After the two-month period of device use, Phase II participants completed a post-intervention survey using the same survey instrument administered in Phase I.

For the intervention, nurse participants attended four educational sessions facilitated by the researchers. Each session was approximately 30 minutes in length and covered one or more of the apps selected by the researchers for participants to use during the trial period. In the sessions, the facilitator discussed the relevance of each app to nursing care, features of each app, and exercises to become familiar with them. To ensure that the same material was taught at both sites, PowerPoint slides with notes and handouts were created and used as scripts by facilitators. The initial educational session oriented participants to the study and reviewed essential information such as the regional health authority's policies related to mobile device use, Personal Health Information Act, and infection control practices. Participants were not assessed for baseline knowledge prior to the intervention.

Apps were selected through careful consideration by the librarians and nurse educators involved in the project based on a number of factors. For budgetary purposes the apps had to be free (or low cost), provide nursing-related drug and medical information, and available on Android and iOS operating systems. Three of the five apps chosen were Medscape, Lab Tests Online, and Lexicomp. Licenses for the Lexicomp app were purchased for participants by the researchers. Twitter was also chosen as an information-sharing app which nurses could use to communicate with other healthcare professionals and stay current with nursing news. Participants were also given restricted access through Evernote to internal documents known as the regional health authority's drug monographs that include specific preparation and administration instructions of parenteral medications.

Following the completion of the four educational sessions, participants had a two-month period to experiment with the apps on their respective patient care units. Unit managers were informed of this study and encouraged by hospital administration to support it. Nurse participants could contact the researchers for help in using the apps at any time throughout the study.

To solicit additional feedback on the participant's experiences on the education provided in the study and the use of mobile devices and apps, the researchers employed an open-ended script of questions in an hour long audio-recorded focus group (Appendix B). The focus group discussion was led by two of the researchers who had no previous contact with these participants.

Results

Phase I

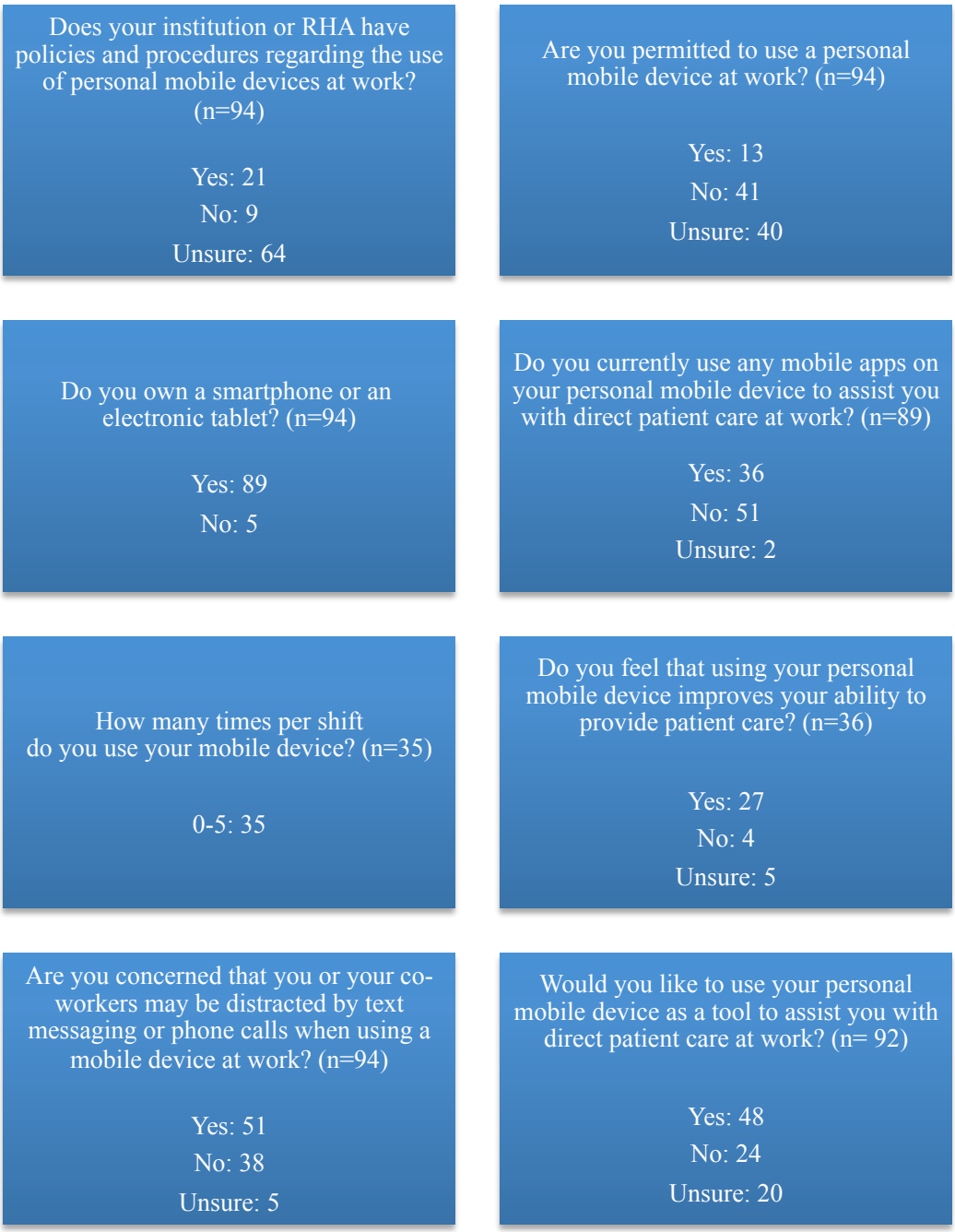
In Phase I, descriptive statistics were conducted including frequencies and means for nurse demographics and attitudes and current usage of mobile devices and apps in direct patient care. The authors examined the qualitative responses in the Phase I survey responses. Using methods described in the nursing literature [24-26], content analysis and constant comparison techniques were performed to identify, code, and categorize primary patterns in the data. A coding template was developed and tested for 95% inter-rater reliability among two authors. In instances where disagreement occurred in coding, discussion ensued until consensus was attained. The authors employed the coding template and analyses continued where similar codes were grouped into themes and subthemes.

A total of 94 of 348 eligible nurses completed the Phase I survey for a 27% response rate: 54 from the community hospital and 40 from the tertiary hospital. Although all age ranges were represented, the most frequent age range of nurse participants was 25 to 34

years (35%; 33 of 94) and 48% (45 of 94) stated that they had less than five years of nursing experience. The majority of participants (54%; 51 of 94) had a Bachelor of Nursing degree and 39% (37 of 94) held a Diploma in Nursing.

Most nurses owned a mobile device but many were uncertain if they were permitted to use it at work. The majority were unsure if there were any institutional policies regarding the use of these devices. Over half stated they had an interest in using their devices at work even though a similar number also thought that mobile devices would be a source of distraction. Less than half of study participants stated that they already used their mobile device for patient care purposes but none of the nurses used their devices more than five times in a shift (Figure 1).

Fig. 1 Phase I Survey Data



Phase I participants (n = 94) provided their qualitative responses on the use of mobile devices in the pre-intervention survey (Figure 2). Four main themes emerged from their answers:

(1) *Policy: Thoughts regarding rules and regulations within individual hospitals and the health region governing the use of mobile devices.*

Many nurses indicated they were not allowed to use mobile devices on their units because of policy or their clinical managers did not approve of device use. Others were unsure if there were policies regarding device use.

(2) *Barriers: Real or perceived barriers that prevent nurses from using mobile devices and applications at the bedside.*

Participants indicated a number of barriers that either prevented or caused nurses to feel hesitant to use their mobile devices at work including cost, potential damage or loss of personal devices, and infection control. Some participants stated they were not familiar enough with mobile devices or health-related applications to feel comfortable using them at work. As a solution to many of these concerns, some participants commented that the regional health authority or respective hospitals should provide mobile devices for work-related purposes rather than nurses using their own personal equipment.

(3) *Patient Perception: Nurses' ideas of how patients perceive mobile devices and application use in patient care.*

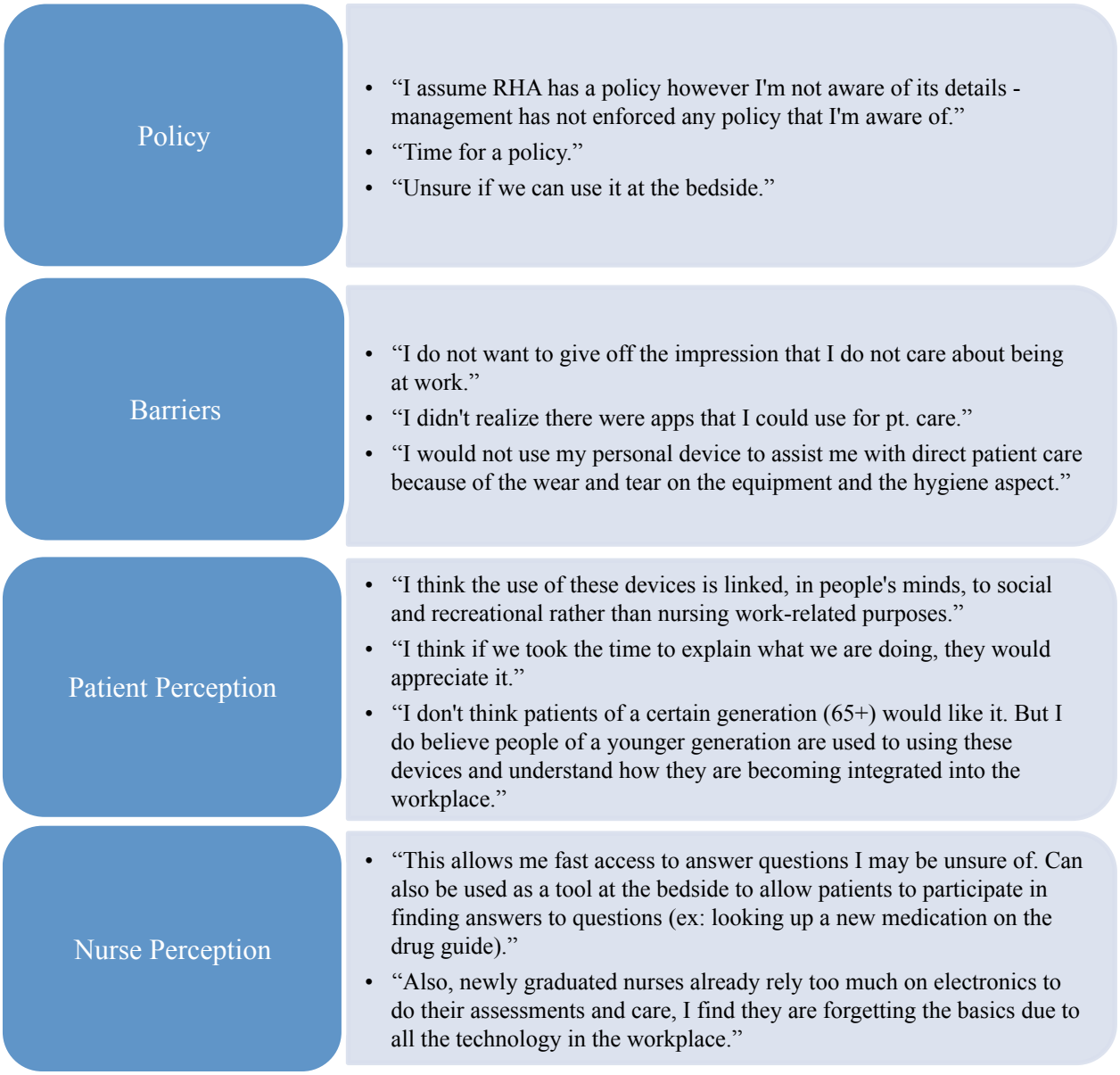
A recurring theme in the Phase I survey comments was about nurse concern for patients' thoughts and feelings regarding mobile device use at the bedside. Participants generally felt that younger patients would accept mobile devices providing that the devices were used for work purposes. Some participants pointed out that patients were familiar with mobile devices and nurse use of devices would demonstrate that the hospital is progressive in embracing technology. Others were less confident and predicted older patients would feel mobile device use was inappropriate and disrespectful. Regardless of whether patients reacted positively or negatively to device use, Phase I participants indicated that education and communication were key in garnering patient acceptance.

(4) *Nurse Perception: Nurses' thoughts and feelings about mobile devices and application use in patient care.*

Nurses' feelings about their use of devices on the units were mixed. The majority of nurses pointed out the value of using devices as a means to quick and easy access to reliable information. However, others felt that mobile devices would consume more of their time and they did not want to carry them around. Some were concerned that it would be a source of distraction and decrease their professionalism. Many nurses indicated that they were unsure of how a mobile device or app could help them due to their lack of experience in using the technology.

Participants who were already using mobile devices to assist with patient care identified a wide variety of useful apps including Micromedex, Medscape, and iTriage. However, the most frequently mentioned apps were Google and internet browsers (e.g., Safari). Many participants commented that they also used their devices as a watch, a timer, a calculator, and for looking up unit conversions. The most common usage for apps was to locate drug, disease, and diagnostic information.

Fig. 2 Sample of Phase I qualitative responses (open ended survey)



Phase II

A total of 16 participants completed the four Phase II educational sessions. Of these participants, 14 completed the survey after a two-month trial period of device use on the units. Six participants were between 45 and 54 years of age and six were between 25 and 34 years of age; one participant was between 18 and 24 years; and another participant was between 35 and 44 years. Eight nurses had a Bachelor of Nursing degree and five held a Diploma in Nursing. One person was a Licensed Practical Nurse. Fifty percent (7 of 14) of the participants had five to 15 years of nursing experience. Forty-three percent (6 of 14) had less than five years of experience and one participant had more than 15 years of experience in nursing.

Each participant's (n = 14) Phase II quantitative results were matched to their own Phase I quantitative results. The researchers examined the qualitative responses in the Phase II surveys and the focus group transcript using the same techniques as in Phase I. The first author transcribed the Phase II focus group discussion verbatim and the second author verified the transcription of the audio recording.

Our comparison of pre- and post-responses indicated, after attending the educational sessions, more nurses were aware of mobile device use policies

in the workplace (Figure 3). Most participants reported using their devices post-intervention as often as in the Phase I survey but none reported using it more than five times per shift. They were, however, more concerned about distraction due to mobile devices after the interventional and trial period of use (Figure 4). In both pre- and post-surveys, the majority of nurses wanted to use their mobile devices in patient care (Figure 5).

Fig. 3 Does your institution or the Regional Health Authority have policies and procedures regarding the use of personal smartphones or electronic tablets in the work setting?

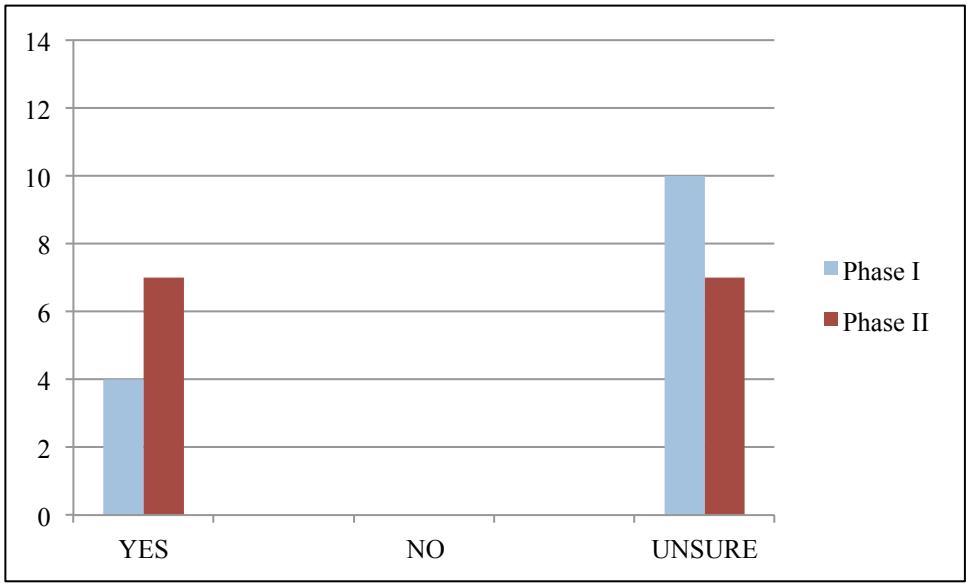


Fig. 4 Are you concerned that you or your coworkers may be distracted by personal text messaging or phone calls when using a smartphone or electronic tablet in the work setting?

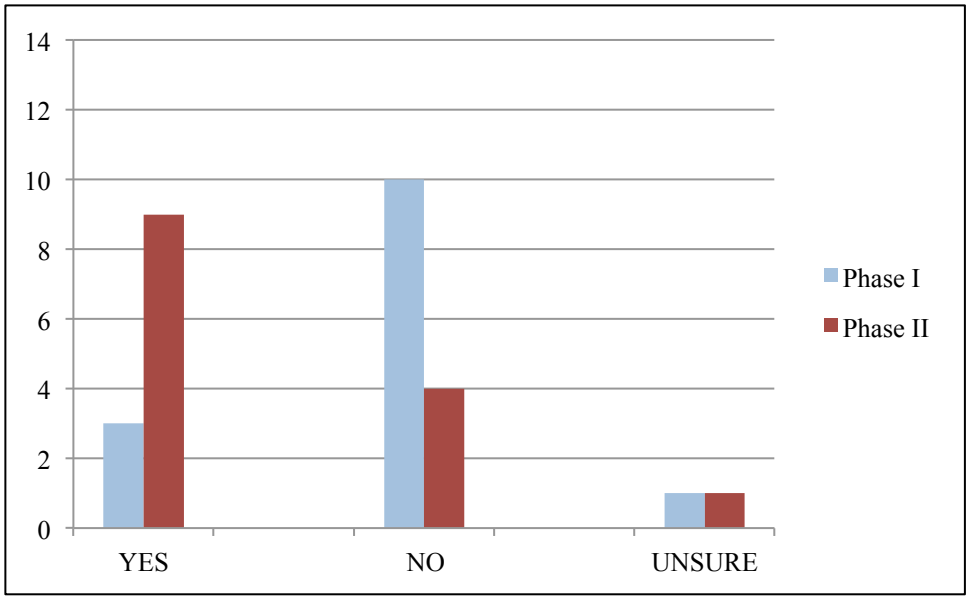
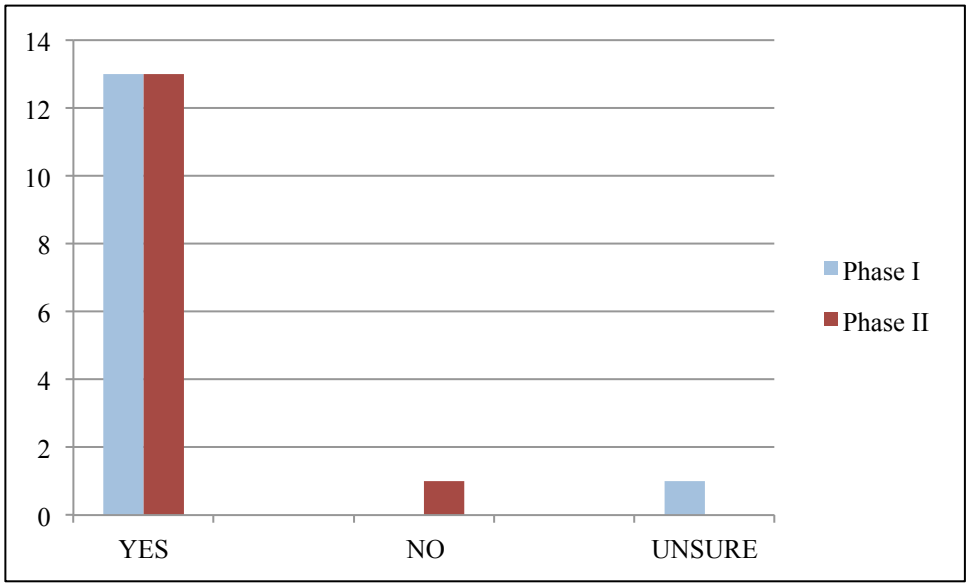


Fig. 5 Would you like to use your personal smartphone or electronic tablet as a tool to assist you with direct patient care in the work setting?



Phase II participants provided their thoughts on the use of mobile devices and apps in the post-intervention survey (n = 14) and in the focus group (n = 6) (Figure 6). Again, four main themes emerged from the data:

(1) Barriers: Real or perceived barriers nurses face using mobile devices and apps at the bedside.

As in the pre-intervention survey, barriers to device use was expressed as a common concern for participants in the post-intervention survey. Some barriers were similar to those reported by Phase I participants such as the lack of wireless internet and mobile devices were not "allowed" for use in patient care. After trying the apps on the units, some Phase II participants still felt uncomfortable due to their lack of experience in using the device in front of patients. Other participants admitted that they were distracted by personal texts and email. None of the participants commented on any fears of losing their device or infection control which were frequently cited barriers in the Phase I survey.

(2) Perceived Patient Acceptance and Non-Acceptance Factors: Factors nurses believe help to determine patients' and family members' acceptance of device and app use by nurses.

Comments from the participants focused on two main factors that could positively affect patient acceptance of device use among nurses. The first factor, education, could help patients appreciate mobile device usage by nurses when it is explained how the device helps nurses to locate information for patient care. The second factor that participants felt would impact patient acceptance of mobile device usage was patients' growing familiarity with and exposure to mobile device technology. However, participants in the post-intervention phase continued to believe that older patients would have more negative reactions toward use of mobile devices by nurses in patient care. Although no participants described any personal experience of disapproval from patients or family members, some still feared patients would think they were distracted and unprofessional if they were using devices at the bedside.

(3) Information Need, Accessibility of Information, and Convenience of Information: What nurses need in a bedside app, and benefits and convenience of having medical and drug information.

Participants described their need for apps that were easy to use, did not contain too much

Fig. 6 Sample of Phase II qualitative responses (open ended survey and focus group responses)

Barriers	• "It takes a while to sort through the app for the info I need, time can be better used." • "It can be hard to ignore messages and texts, and that's not how I want to use my time." • "I don't know if I'm allowed to and I gotta go hide in the corner - make sure nobody sees what I'm doing." • "If they had wifi in the hospital it would make a difference."
Perceived Patient Acceptance/ Nonacceptance Factors	• "If I am using my device at the bedside I explain to them what I am doing so that they don't assume I am making personal phone calls or texts." • "Most patients are quite familiar with smartphones and appreciate the resources they provide." • "I think that the more elderly patients would think it rude to use the phone in front of them."
Information Need/Accessibility of Information/Convenience in Locating Information	• "It's handy since I don't know everything." • "Ability to access quality information quickly leaves more time for bedside nursing." • "It is a lot easier and quicker to look up info on the phone than going to find it somewhere else." • "I thought it was a little in depth for what we do as nurses on a day to day basis."
Change of Behaviour and Attitude	• "People were interested in it and they were like "How did you get all that stuff?" " • "I think the general feel from management is that they want good patient care so if we take the time to find information and to teach our patients, whether it's from a desktop computer or our phones or in whatever other way, I think that there's generally a feeling of support towards that."

information beyond what was required to do their job, and provided information on drugs and medical information they could use to enhance care and answer patient questions. Apps were seen to have many benefits over print resources. Practical issues such as carrying a "heavy binder" and "fighting" with other people who needed to use the same print resource were also mentioned. Participants also described the convenience of finding detailed information quickly when using mobile devices. The use of apps allowed them to answer patient questions at the bedside and increase their time for patient care. Participants even indicated that the use of paper resources was a patient safety issue as these resources were often outdated and had missing pages of required information. For instance, some participants described their safety concerns with the IV compatibility chart which was confusing to use and had many blank boxes. One nurse referred to it as "useless". With the Lexicomp app they were able to access clear information on IV compatibilities quickly; one participant stated that Lexicomp was "essential" for this purpose. Phase II participants stated that the app they used most frequently during the intervention period was Lexicomp followed by Medscape, drug monographs (via Evernote) and LabTests Online. None of the participants indicated that they used Twitter and two participants continued to use Google in their nursing practice.

(4) Change of Behaviour and Attitude in Nurses: Change of nurse behaviour and attitude as a result of apps and or mobile device use in patient care.

Focus group participants felt that a two-month intervention period did not provide enough time to become familiar with the apps and to alter their old habits such as referring to print texts. Most participants anticipated that behavioural and attitude change would likely occur over time as more people accept and engage in mobile device use. Overall, nurses spoke positively about the educational sessions and trial period of mobile device use on the units. One person commented, "I appreciated just . . . having an educator and a librarian take some time, like, 'Ok, here's some things that can help you and that can make your job a little bit easier.' So, I'm hoping in the future maybe something like this will happen again".

Discussion

The purpose of this study was to describe the current knowledge and use of mobile devices and apps by nurses in patient care. The second aim was to examine the impact of education sessions led by hospital educators and librarians about mobile devices and apps on nurse usage, attitudes, and behaviours in patient care. Although the sample in this study was small and limited to two hospital settings, our findings revealed that most nurses had mobile devices and were interested in using them to enhance patient-centred care though few were actually doing so. This was in line with previous studies showing low use among nurses despite perceived advantages [1, 2]

While our research questions did not intend to focus on barriers to app usage, our study identified a number of factors that accounted for this lack of use including uncertainty regarding institutional policies, inexperience with using the technology, and infection control concerns.

In particular, participants were worried about potential damage to their personal devices and costs of using cellular data as wifi was unavailable in the hospitals at the time of the study. These obstacles have been discussed in previous studies of mobile device utilization by healthcare workers [1, 5, 8, 14, 27]. Nurse participants were also mindful of their image and worried that device use would decrease nurse professionalism by posing a source of distraction. Interestingly, after the educational sessions and the trial period of device use, nurse participants were more concerned about mobile devices causing distraction in the workplace. As is reflected in other research [1, 2, 14, 16, 18], a significant number of participants' comments centered around the perceptions of patients and family. Highlighted in our findings were nurse participants' concerns that older patients would feel their nurses were being rude and disrespectful– especially if patients believed that nurses were using their mobile devices for personal or entertainment purposes.

Interestingly, however, none of the participants reported any negative interactions with colleagues, patients, or family members due to their use of mobile devices during the intervention period. In fact, many participants recounted expressions of interest about mobile device usage from others. Nurse participants in Phases I and II emphasized that the acceptance of mobile device by colleagues, patients, and families would be dependent upon clear communication and education of how mobile devices and apps could be used to support patient care.

Education could assist in addressing barriers uncovered in the study results. Hospital librarians and

educators are well positioned to collaboratively offer such education as promoting best practice is a fundamental aspect of their work. As purveyors of evidence-based information, hospital librarians review and select resources including mobile apps. Teamed with hospital educators who are intimate with the particulars of nursing work and pressures, librarians can help nurses feel more comfortable with using mobile apps to their best advantage.

To address nurses' concerns as well as perceived benefits of using mobile devices in the workplace, clear policies need to be developed and communicated at all levels where management and patient care decisions are made. Nurse participants' comments in this study illustrated their uncertainty pertaining to institutional policies. Policies on mobile device and app use in healthcare settings, such as those identified by Gill, Bautista and Visvanathan, would help to normalize mobile device use and counter issues that cause concern for patients, families, nurses, and hospital administrators [15, 19, 21]. Based on the study findings, the nurse educators and librarians could advocate for enhancement and creation of policies related to the use of mobile devices in the hospital setting. Further to this, communication and associated education related to policies is often the role of nurse educators.

Although nurse participants in this and previous studies identified a number of hindering factors, they also highlighted many advantages and potential uses of mobile devices in healthcare. Our study findings corroborated previous research that mobile devices and apps enabled their ease of accessibility to evidence-based information. Garrett and Klein (2008) and Stroud et al. (2009) reported that nurses used their mobile devices for clinical decision support and drug information [12, 14]. As reported in Johansson's (2014) study, nurse participants suggested that the use of mobile devices and apps saved them time and helped them to provide improved safe care based on reliable information sources other than frequently outdated print resources [2]. Apps that provided drug and medical information, such as Lexicomp, Medscape and the WRHA Parenteral Drug Monographs were considered most useful by the nurses in this study.

While this research provided insights into the current use of mobile devices and apps among nurses as well as advantages and disadvantages to mobile device use on the units, there were limitations to this study. The sample was small and limited to nurses in direct patient care on surgical and medical units and therefore it was difficult to generalize the findings to other healthcare disciplines and patient care settings. Our Phase II participants were volunteers so there is a risk of response bias, being that they may have been more interested in the research study to begin with than others. Some participants in Phase II of this study were novice app users while other nurses used apps regularly and were even familiar with some of the apps taught in the educational sessions. There was no baseline measurement of participants' knowledge of evidence-based information prior to the intervention and so it is not known if this intervention had an impact on their knowledge of the apps. As well, as the post-test was administered after both the educational intervention and the two-month trial period it is difficult to determine which had the strongest impact on outcome. More rigorously controlled studies of nurse, patient, and family perceptions regarding use of mobile devices and apps in nursing practice are required to provide convincing evidence and insights into their respective opinions.

Conclusions

These findings were the first to demonstrate the degree of mobile device usage and interest among nurses working at the bedside in Winnipeg. Our results revealed that most nurses were familiar with mobile devices and interested in using them to provide evidence-based care. Post-intervention responses of participants were positive regarding mobile device use in direct patient care. They also reported many advantages to using mobile devices and apps over traditional means of obtaining and sharing information. Despite this interest, a number of barriers still existed that prevented bedside nurses from using their mobile devices at work. These barriers included uncertainty of regional policies, costs, and potential damage to personal mobile devices. Bedside nurses were also mindful of their patients' opinions of using mobile devices and did not want to offend patients or potentially diminish their nursing professionalism.

With evidence of strong interest by bedside nurses in using technology in their clinical work, it is incumbent upon managers and administrators in hospital settings to address potential uses and barriers of mobile device and app usage in patient care. Outcomes of further research can be used to strengthen policy in the regional health authority and improve the

communication of such policies at all levels where patient care policies are developed and decision-making happens. Additionally, future studies should focus on strategies that hospital librarians and educators could utilize to facilitate appropriate use of technology to the benefit of patient care.

Acknowledgements

This work was supported by the Grace Hospital Patient Care Research Award through the Grace Hospital Research Fund and Grace Hospital Foundation. Thank you to the nurses who took time from their busy schedules to participate in this study as well as the hospital managers and administrators who supported them in this project. Thank you to Lisa Demczuk whose comments greatly improved this manuscript. We would like to thank Dr. Elif Acar and Mr. Erfanul Hoque from the Statistical Advisory Service at the University of Manitoba for their general statistics advice and help with the statistical analysis.

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Appendix A. Survey questions

Mobile Device and Application Use in Direct Patient Care Nursing Survey

1. Which hospital are you employed at?
    - Grace Hospital
    - St. Boniface Hospital
    - Both hospitals

2. Are you a direct patient care nurse?
    - Yes
    - No

3. What area of nursing do you work in?
    - Critical care
    - Medicine program
    - Surgery program

4. What length of nursing shifts do you work?
    - 8 hour
    - 12 hour
    - A combination of 8 and 12 hour
    - Other

5. What nursing rotation(s) do you work?
    - Days only
    - Evenings only
    - Nights only
    - Days/evenings
    - Days/evenings/nights

6. What is your highest level of nursing education?
    - Licensed Practical Nursing
    - Diploma in Nursing
    - Bachelor of Nursing Degree
    - Masters of Nursing
    - PhD in Nursing
    - Degree in another discipline (please specify)

7. What is your age?
    - 18-24
    - 25-34
    - 35-44
    - 45-54
    - 55 years of older
    - Prefer not to answer

8. How many years have you been employed as a nurse?
    - Less than 5 years
    - 5-15 years
    - More than 15 years

    Comment:

9. Are you permitted to use a personal smartphone or electronic tablet in the work setting?
    - Yes
    - No
    - Unsure

    Comment:

10. Does your institution or the Winnipeg Regional Health Authority (WRHA) have policies and procedures regarding the use of personal smartphones or electronic tablets in the work setting?
    - Yes
    - No
    - Unsure

    Comment:

11. Are you concerned that you or your co-workers may be distracted by personal text messaging or phone calls when using a smartphone or electronic tablet in the work setting?
    - Yes
    - No
    - Unsure

12. Do you own a smartphone or an electronic tablet?
    - Yes
    - No

    List the mobile device(s) (including brands) you currently own: (e.g., Apple iPhone, Samsung Galaxy S4)

13. Can you access the internet with your personal smartphone or electronic tablet via wireless internet?
    - Yes
    - No
    - Unsure

    Comment:

14. Can you access the internet with your smartphone or electronic tablet without wireless internet? (i.e., via a cellular data plan)
    - Yes
    - No
    - Unsure

    Comment:

15. Do you currently use any mobile applications on your personal smartphone or electronic tablet to assist you with direct patient care in the work setting?

    - o Yes
    - o No
    - o Unsure

    Comment:

16. What mobile applications are you using to assist you with direct patient care? Please provide an answer in the box.

17. On average how many times per shift do you use mobile applications to assist with direct patient care?

    - o 0-5
    - o 6-10
    - o 11-15
    - o Greater than 15

18. Do you feel that using your personal smartphone or electronic tablet improves your ability to provide patient care?

    - o Yes
    - o No
    - o Unsure

    Please explain:

19. If you are not using your mobile device for direct patient care please explain why in the box below.

20. How do you think patients would perceive the use of smartphones or electronic tablets by nurses at the bedside? Please provide an answer in the box.

21. Would you like to use your personal smartphone or electronic tablet as a tool to assist you with direct patient care in the work setting?

    - o Yes
    - o No
    - o Unsure

    Please explain:

Thank you for completing the survey.

Appendix B. Focus group questions

Incorporation of Mobile Applications in Clinical Nursing Practice

Opening question

1. Can you tell me about why you volunteered to participate in this research project?

Intervention questions

In the following questions we are interested in hearing about your thoughts and feelings about the education sessions.

1. We had four half-hour education sessions.
    a. I am wondering if you could describe whether you would change the number of sessions?
    b. Could you say something about the length of the education sessions?
    c. Can you tell me whether there were any problems with the education sessions?
    d. Can you describe to me what you enjoyed about the education sessions?
    e. Could you tell me about how easy was it for you to attend these sessions?
        i. What do you think about holding any future sessions at different times or on different days?
2. Can you tell me whether you think two months was long enough to see if using these apps had an effect on your work?
3. Can you tell me whether you think you will continue to use these apps in the future?

Exploratory questions

1. Can you give examples of how you used the mobile applications in your work over the last two months?
2. During the course of the two months can you describe whether any patients or patient's family members commented on your use of a mobile device?
3. When you think about the apps you used what do you think about them?
    a. Could you share some suggestions for others mobile apps that you think would be more useful?
4. Could you tell me about any comments you received from colleagues regarding the use of mobile apps and devices on the unit?
5. Could you tell me how supportive your administrators/managers were towards your involvement in this project?

Ending question

Is there anything else you would you like to add regarding either the research project or use of apps in nursing?