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Nurses' Perception of Mobile Communication in an Acute Care Setting

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A Major Paper Presented

by

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Abstract

Communication is at the center of providing health with care. Good communication between nurses, patients, and among members of the health care team is paramount in delivering patient-centered care. The literature has demonstrated that mobile communication devices can improve quality and efficiency of communication among clinicians, mobilize information, improve clinical workflow, improve response time, and provide cost savings. The research has also revealed unintended consequences such as interruptions in care, increase in errors, caregiver distractions, and reductions in workflow processes. There is currently limited evidence in the literature regarding the perceptions of nurses regarding the use and satisfaction of mobile communication devices. This study examined a convenience sample of nurses (n=64) working in an acute care setting. Donabedian's process, structure, and outcome model was used to guide this exploratory research. Registered Nurses (RNs) participated in a self-reported one-time survey on perceptions of the use of wireless mobile communication devices. The survey consisted of a 34 response Likert questionnaire which included questions about the mobile devices' impact on communication, the personal impact the device had on nurses, the perceptions of training and implementation, the devices' involvement in patient safety, and the overall impact of using the device. The results suggest an increase in the speed and reliability of communication with the use of a mobile communication device, improved response time to patient issues, and improved communication. However, nurses responded unfavorably regarding the impact on patient safety. Trends in data demonstrated nurses with less experience scoring more favorably than nurses with more experience. Most nurses responded unfavorably to the overall impact these devices had.

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I want to thank my wife and daughters for their overwhelming sacrifice through the years of my graduate school studies. I would like to recognize the unfailing support of my parents and in-laws for making this dream a reality.

Table of Contents

NURSES' PERCEPTION OF MOBILE COMMUNICATION IN AN ACUTE CARE SETTING

Background/Statement of the Problem

Utilizing mobile communication is thought to bring superior care and shown to improve quality and efficiency of communication among clinicians (Wu, et al. 2012). Soto, Chu, Goldman, Rampil, and Ruskin (2006) demonstrated a reduction in communication delay as well as reduced patient injury with mobile communication. One study concluded that nursing time away from patients was reduced by 94% when mobile communications were implemented at the bedside (Whitlow, et al., 2014).

With an acutely ill inpatient population, and the need for clinicians to remain mobile, mobile communication devices can improve nursing care, communication efficiency, and patient safety (Whitlow, Drake, Tullman, Hoke, & Barth, 2014). Mobile communication devices are provided to inpatient nursing staff to improve response time addressing patient needs and improve the quality and safety of patient care. By using mobile communication devices Gamlen, Clancy, Moengen, and Rauen (2012), discovered operating room savings in addition to increased surgical cases directly related to time savings once the devices were in use.

Current literature is available on the perception of mobile communication devices, such as iPhones, by healthcare providers. In a qualitative study by Farrell (2016), nurse perception of the utilization of iPhones in the acute care setting were found to improve communication between nursing staff without having to leave the bedside of a critically ill patient. However, there is a lack of research specific to the Ascom Myco® mobile communication device currently in use at a 247-bed community teaching hospital. Ascom

Myco®, short for “my companion”, mobile communication devices can reduce alarm fatigue, mobilize information, and improve clinical workflow per the manufacturer (Ascom Wireless Solutions, 2014). The most important capability of the device is that it can be integrated with existing hospital systems including call light infrastructure. The phone can link a nurse directly with an assigned patient, decreasing delay in response to patient needs, eliminating alerts to the unit and reducing overall noise level on the unit. The mobile communication device can be linked to patient specific monitors, such as cardiac rhythm monitors and oxygen sensors, alerting the nurse immediately of potential change in patient condition. Staff may receive or dial calls within the institution in addition to accepting patient calls from pillow speaker devices (Ascom Wireless Solutions, 2014).

Despite movements towards widespread use of mobile communication devices, intended to improve communication, some research has revealed unintended consequences such as interruption in care, associated medication errors and a negative impact on quality patient care (Klemets, Evjemo, & Kristiansen, 2012). Caregiver distractions from the use of mobile communication devices were named on the top ten technology hazards for 2013 (ECRI Institute, 2012). In an article by Gill, Kamath, and Gill (2012) the use of mobile devices by clinical staff was correlated with a 12.7% increase in errors per occurrence. Mobile communication devices may inadvertently cause inefficiency and reductions in workflow processes. Inefficiency in care by wasted clinician time is thought to cost twelve billion dollars a year (as cited in Lo, Wu, Morra, Lee, & Reeves, 2012, p. 277).

There is limited data available on mobile communication and its' impact on patient care as perceived by registered nurses as opposed to provider-nurse communication satisfaction. A study examining nursing staff perceptions of wireless email found staff did experience faster communication and perceived increased patient safety (O'Connor, Friedrich, Scales, & Adhikari, 2009). Patient and caregiver communication is of top importance and necessary for a patient-centered approach to healthcare (McCabe, 2004). The purpose of this study is to explore nurses' perception of mobile communication in an acute care setting.

Next, the relevant literature will be presented.

Literature Review

The search was completed utilizing PubMed, the Cumulative Index to Nursing and Allied Health (CINAHL), and Medline. The literature was searched from 2005-2016 including the keywords effective communication, history of mobile devices, mobile device efficiency, nursing workflow, benefits and risks of mobile devices, and nursing perceptions of mobile devices.

Effective Communication

Communication is defined as "an act or process of transmitting information about ideas, objective information, attitudes, or emotions" (Merriam Webster, 2016). Effective communication in healthcare has been defined as "communication that conveys or evokes an understanding" (Saunders, 2004). Furthermore, it has been defined as the creation of a meaningful patient-provider relationship where the actual exchange puts patients in the center of their care (Deese, 2015; Morgan, 2013).

In research by Abbott, Rogers & Freeth, (2012) eight hospitals including both emergency rooms and delivery units in England were studied. The authors identified key components of a safety culture being effective communication and good situation awareness. Communication style was observed for thirty-five hours per institution. Situational awareness has been defined by Wright, Taekman, and Endsley (2004) as an "individual's awareness of the elements within the environment within a volume of time and space" (Wright, et al., 2004, p. i66). The authors emphasize that response to emergency and workflow processes improve with better situational awareness. Courteous assertiveness, active listening, and a reduced noise level were three components the authors defined as effective communication (Abbott, Rogers & Freeth, 2012). The author

chose two hospitals from the larger study of sixteen hospitals for their variability in quality of care. Observations made by researchers found that one hospital lacked the organizational climate, teamwork, and safety culture that the second hospital exhibited. Three audit measures linked to safety culture included the number of emergency cesareans, normal deliveries, and meconium stained-liquor births (Freeth, et al., 2012). Meconium stained liquor is the presence of meconium during labor and may or may not be a sign of low oxygen content in the fetus (Liu, et al., 2005). One hospital took care of women in labor only, while the second took care of women both prenatally and at time of delivery. Abbott, et al. (2012) explained the importance of situational awareness and the extent to which it was necessary for an effective team approach to healthcare. Findings at one of the two institutions revealed low situational awareness was linked to discourteous behavior like shouting or interruptive language. The second hospital demonstrated softer, calming behaviors, which were associated with increased trust between clinicians, a higher situational awareness, and thus a better culture of safety. This resulted in better emergency care and workflow response by inpatient chart audits. Interestingly, the first hospital examined here, although more situationally aware had decreased routine care results by chart audit compared with the second hospital, considered less situationally aware.

In a qualitative study by Morgan (2013), seven video-recorded consultations examined communication patterns between general practitioners and their patients. As a sub-study, providers were approached for post consultation interviews with the researcher. Fourteen patients were approached with seven patients agreeing to participate in the interviews. All interviews were analyzed and revealed communication mismatches

in three of the seven patient interviews. Communication mismatch is defined by the author as a single instance of miscommunication between patient and provider. Two interviews were intensely analyzed as case studies as they included "detailed insight into the sources and outcomes of different kinds of miscommunication" (Morgan, 2013, p. 124). The author found communication mismatches to be multifaceted and complex. In case one, the urgency of follow-up was the source of miscommunication. The provider believed the patient understood the need for immediate follow-up assessment; however, the patient believed he could wait. The second case revealed a misunderstanding regarding prescribed therapy. In this case both patient and physician realized a mistake while discussing current medication regimen. The author suggests the incidence of miscommunication to be frequent with the potential for major adverse consequences and that at times neither physician nor patient realizes the miscommunication event. Recommendations from the study include strategies to improve physician/patient communication such as shared care plans for chronic conditions to reduce miscommunication. In addition, the author advocates visit summarization, repetition of information, and creating future encounters for the patient as potential strategies to decrease misunderstandings in patient-physician communication (Morgan, 2013).

In a 2013 study at an Australian University, fifteen nurses with a background in education participated in an exploratory study to identify traits of an effective communicator. Participants viewed videos of simulated patient encounters in focus groups as background to discussions about effective communication. The nurses were asked what they thought was effective or not effective in the simulated encounters. Participants' response to the videos identified the need for the patient to be involved in

their care, and that communication methods should be specific to the patient. Patient perception of effective communication has been linked to the degree of involvement the patient has in their plan of care. The importance of eye contact was identified as important in patient perceptions of effective nurse / patient communication. Standing while a patient was lying down was identified as an impediment to effective communication, perceived the nurse's lack of time for the patient (O'Hagan, et al., 2013).

A Canadian quality improvement project by Johnson, Carta, and Throndson (2015) described the exchange of patient information between nurses during shift-to-shift hand-off. Semi-structured interviews of thirty-nine staff nurses on one surgical, two medical, and one women's health unit were included. The authors identified through the interviews inconsistent documentation, improper care plans, variation in current hand-off patterns, and randomness of nurse assignments as emerging themes over a three-month period. The Canadian hospital accreditation agency mandated consistent standard hand-off procedures within it's institutions which provided stimulus for this quality improvement project. Since the accrediting body was directing a more streamlined information transfer, nurses working in the surgical unit decided to utilize a common hand-off tool to meet this new mandate and implemented the Situation, Background, Assessment, and Recommendation (SBAR) tool for consistency of information exchanges. In addition, the unit implemented a buddy system to provide uninterrupted time for documentation. This buddy system functioned by allowing nurses to document while other nurses took care of their patients. The SBAR tool is becoming a standard communication tool utilized by healthcare organizations in patient hand-off. The use of SBAR is designed to communicate detailed information and plan of care in a concise and

uniform manner. Following SBAR implementation nurses reported better efficiency in patient reporting and enhanced quality of information being shared (Johnson, et al., 2015).

History of Mobile Devices

The first mobile devices can be seen in the battlefields of World War I in 1917. The 1950's saw pagers introduced to physicians in hospitals for the first time (Popular Science Monthly, 1951). Communication channels and outlets changed little over the years until 1973 when the first mobile phone was invented. The year 1984 saw the first car phone, and 1989, the first battery operated cellphone. The design of the cellphone varied over the years, but the functionality remained identical. In 1997 the first smart phone, albeit antiquated by todays' standards, allowed the user to access email, internet and retrieve faxes. In 2002 the first mobile device with a camera and instant messaging functioning was developed. The iPhone was released in 2007 which represented a major change in mobile communication standards (The Washington Post, 2014).

In a 2012 systematic review of 18 articles published between 1996 to 2010, Wu, et.al. (2012) explored mobile communication effects within hospitals. Studies from North American institutions included primarily physicians and nurses. However, approximately one-third of the studies included administrative assistants, information technology staff, pharmacists, respiratory therapists, advance practice nurses, phlebotomists, and operating room technicians. Five studies looked at the Vocera® device, which is a hands-free mobile communicator. Findings from the five studies demonstrated improved access, and reliability in non-urgent communication. Improvements in response time to patient issues, time-savings for nurses, and general perception of improved communication quality was

also described. The Vocera® studies also described the need for a supporting infrastructure and organizational commitment to proper implementation. Staff interviews revealed problems in voice recognition and ease of use including the actual size or layout of the keys on the device. Training was identified as a very important indicator in successful implementation of Vocera® including the functionality of the device and operability. Confidentiality and privacy concerns were also identified. Two studies included in the review looked at mobile phones and found decreased landline use and improved response time with a reduction in miscommunication between operating room staff and floor nurses. Finally, smartphones, with enhanced capabilities were examined in four studies. Smartphones were associated with improved speed of email communication, better efficiency in having the ability to call in urgent situations, and safer care. Findings also indicated a positive physician outlook and a reduction in redundant calls to doctors from nurses. The results suggest work was made easier and the efficiency of communication increased between clinicians. One of the four studies implemented AwareMedia to assist in operating room workflow. This system is capable of staff tracking, monitoring the general activity within operating rooms. The AwareMedia program included hand-held AwarePhones. These phones, given to 15 clinicians including physicians, operating room technicians, and nurses in operating rooms, allowed staff to view current operating schedules and provided mobile messaging and calling. Likert-scale questionnaires to explore perceptions of efficiency and impact on staff satisfaction were given to physician's nurses, and other unspecified personnel after a three-month period of use. Results from 34 out of 43 surveys cited improved

communication with this system, though 33% identified questionable impact to patient treatment (Hansen & Bardram, 2007).

Mobile Device Efficiency

The efficiency of mobile technology can be associated with the speed and frequency of communication. A descriptive article by Rennecker and Godwin (2005) examined mobile technology and whether its use induces or reduces interruption in workflow. The authors found that mobile devices can increase efficiency but also reduce attention to tasks that are being undertaken. The authors explored the interesting dynamic of information providers and information receivers. The results demonstrated through illustration that advanced communication methods have both the ability to organize and disorganize workflow. The idea of disruption or the creation of an interruption was determined by the individual seeking or receiving information. The person seeking information may inadvertently create an interruption for the individual they contact depending on the form of communication they use. Similarly, the receiver of information can choose to continue their current work while getting to the request for information at a later date. Either way interruption in workflow can occur but is linked to the mode of communication and whether the receiver or sender of information perceives the message as a break in their current task.

Cost is also examined as a component of mobile device efficiency. Return on investment after introduction of mobile devices can be quantified by measures such as decreased length of stay and a reduction in medical errors. A study looking at differences in cost before and after implementing mobile technology in an operating room (OR) was undertaken at a small Midwestern institution using Vocera® as the interventional device.

Data was collected by logging communication events every fifteen minutes throughout a two-week period. After implementing the mobile device, surgical cases increased from 18.4 to 19.7 per day and labor expense per case decreased from $555 to $524 (Gamlen, et al., 2012, p. 354). The study also found that less time was spent locating physicians or ancillary staff and less time spent on physically locating a land line telephone. By utilizing the Vocera® mobile device, over a seven-month period in the OR, projections indicated there would be a total of over $100,000 in savings within a seven-month timeframe for labor cost while saving 43,000 minutes of OR time in the same time period (Gamlen, et al., 2012).

Several articles describe the importance of device efficiency in community health nursing primarily, focusing on the geographic barriers to caring for patients. An article by Blake (2013) provides evidence that adopting mobile communication devices improves practice. The Queens Nursing Institute (QNI) received funding for small-scale technological upgrades on the premise that mobile technology would improve care for their patients in the community. Community nurses could view email, access patient information, and shared calendars, which contributed to efficient communication (Blake, 2013).

A 2013 pilot study in Great Britain described the impact of mobile technology in community health centers and found increased productivity with the introduction of mobile devices. The Department of Health engaged the National Health Service Community Trusts to evaluate the effect of mobile communication. A Benefits collection tool to measure cost savings, perceived gains in productivity, and efficiency was used to evaluate the effect of mobile devices on daily practice. Eleven community health centers

were included in phase one of the trial with limited mobile device distribution. Six community health centers were included in phase two with additional mobile devices distributed to additional staff within the trusts. Data regarding reducing unnecessary visits, unnecessary travel, and reduced admissions in phase one was collected from 377 clinicians and included 1,000 comments from clinicians and patients. Phase two included 387 clinicians and 500 comments (Department of Health, 2013a). Overall the authors identified outcomes of improved access to communication, increased employee safety due to the wireless device, and enhanced clinician to patient engagement. Objectively, the authors found increased productivity with increased contact availability, an 83-93% increase, and before increased efficiency by reducing travel time by 33%, and £16707 saved per clinician from inappropriate admissions (Department of Health, 2013a). The authors highlight the importance of connectivity and needed improvements in technical infrastructure. The authors also discuss the importance of staff training in new technologies and ongoing support from information technology (IT) departments. Training employees on new technology is essential while the lack thereof can cause a negative perception of new technology (Department of Health, 2013a). Functionality of the device, including connectivity, is another important factor discussed and was a common challenge in this study.

A quality improvement project by Unluturk, Ozcanhan, and Dalkilic (2015) describes a communication protocol utilizing nurse wireless location systems (NWLS). The authors described the mobile device-linked nurse call system as an innovation to reduce response time between nurse and patient, limit redundancy in care, and improve patient care. The NWLS uses digital enhanced cordless technology (DECT) and can call

back the patient if the nurse cannot take the call right away to determine the severity or nature of the call. DECT is the technology that all mobile phones operate on and makes it possible for NWLS to integrate smoothly. The authors state that patient satisfaction is linked to response time of providers. They describe multiple factors that delay response time; the time it takes for the call to reach the computer server, the time it takes for the computer to find the corresponding nurse, the time it takes the system to call the nurse, and the time it takes the nurse to answer the call. The call can further be delayed if the first nurse assigned by the computer fails to answer. The computer software then would need to find the second nurse assigned to the patient and proceed through the same steps outlined above. The solution to the issue to decrease response time for patients was to engineer a computer algorithm to shorten the number of rings and prioritize secondary users. Thus, another nurse on the unit would be called if the primary nurse was unavailable for the patient who initiated the call. The authors asserted that the interventions reduced patient call times and redundancy in calls. Future work identified by the authors includes additional technological equipment such as radiofrequency identification (RFID) tags to further improve response times (Unluturk, et al. 2015).

In an opinion article in the Journal of the American Medical Association, Khanna, Wachter, and Blum (2016), discuss the potential of mobile technology to improve efficiency. but caution that it may also impede efficiency. This article presents future technologies and offers them as a solution to historical failures to electronic medical record databases. The authors draw attention to the healthcare industry's push towards electronic documentation and hospital staff's distastefulness with the technology as an example of impedance for efficiency. The authors also discuss smartphone paging

applications (SPA) as an adjunct to electronic medical records. These applications put physician orders in a queue, only to be released when appropriate measures are met. As an example, suppose a patient goes to surgery; a physician can place orders that activate once the patient gets back to the unit such as diet or fluid resuscitation. These technological advancements are accessible by mobile phones and an important feature of future communication between provider and nurse. The authors emphasize the importance of adapting electronic health records into nurse workflow and suggest to readers to take full advantage of the technology (Khanna, et al., 2016).

Nursing Workflow and Technology

Utilization of mobile communication can influence nurse's mobility throughout a shift, their perceptions regarding new technology implementation, and workflow adaptation. A study conducted in a Washington, D.C. teaching hospital evaluated the impact of Vocera® on inpatient communication and workflow processes. Vocera® is a hand held mobile communication device usually worn around the neck or attached to the uniform that enables the user to make and receive calls hands-free. It also enables the user to make calls using voice commands (Breslin, Greskovich, & Turisco, 2004). The researchers examined the cost-benefit after introduction of the mobile device, focusing on labor cost, and improvements in patient care. Surveys were developed to assess nurses' perceptions of Vocera® post-implementation. In addition, four days of observations were documented on all three shifts with 24 nurses, and 5 unit secretaries being observed (Breslin, et al., 2004). The authors noted a five-times faster communication time with Vocera® than other communication methods. (Breslin, et al., 2004) Of the nurses who were observed and surveyed, 72.9% of nurses thought Vocera® improved workflow

efficiency. Nurses also thought that Vocera® improved the quality of care, 65% of nurses reporting improved quality versus 15% on non-Vocera® units. The respondents also reported time savings of thirty minutes per eight-hour shift (Breslin, et al., 2004).

Inefficient workflow can significantly impact attitudes toward practice. A 2011 survey to explore nursing attitudes and perceptions after implementation of a clinical information system on workflow used the Information, Systems and Expectations Scale (I-SEE), a 7-point Likert tool. The survey was administered pre-training, post-training, and six months after implementation of the electronic health record. A descriptive analysis of 1,395 nurses' attitudes indicated less time available for direct patient care and worsening experience with documentation at each survey administration (Ward, Vartak, Schwichtenberg, & Wakefield, 2011). Expectations of the clinical information system were high, then diminished as the six-month post survey was distributed. The survey also reported better adaptation by more recently licensed nurses and nurses with previous exposure to electronic documentation. The authors conclude that the implementation of an electronic documentation system reduced the time available for patients by increasing the time required to document, but overall was considered successful, citing staff satisfaction with technical support, and ease of use. Pre-and post-implementation training with new electronic systems improves perceptions toward electronic health systems (Ward, et al., 2011).

Mobility for nurses is a necessity. By evaluating patterns of mobility, Cornell, Clancy, and Vardaman (2013) sought to assess the complex process of nursing efficiency. An observational study of nurses on four inpatient units documented nursing tools, tasks, and location. They found that in 35% of the observations nurses were in one place for no

more than fifteen seconds and in only 2% of observations were nurses in one location for more than one minute, forty-seconds to two minutes (Cornell, et al., 2013). The authors concluded that nurses have a complex workflow pattern often with necessary reprioritizations. The next article examines new technology where the authors hypothesize from previous literature that it may not benefit nursing workflow.

In a 2010 study by the same authors, additional data on workflow and the effect of introducing an electronic medical record (EMR) was collected. The authors surveyed nurses at two hospitals following an EMR implementation. By using nursing activity lists, Cornell, Riordan, and Herrin-Grittith (2010) found that computer use increased 15.7% to 29.1% at hospital A, 15% to 18.9% at hospital B, and communication between patients remained unchanged. The study demonstrates that while implementation of technological advancements is often thought of as solutions to workflow inefficiency, data suggested that the installation of an EMR did not necessarily improve workflow, as nurses were still seen spending intermittent time charting in bulk (Cornell et al., 2010).

Nursing workflow is often sporadic and interspersed with interruptions and/or distractions. Hopkinson and Mowinski-Jennings (2013) in a systematic review found that interruptions in mental processes decrease cognitive function, producing errors. The authors examined 31 publications on workflow interruptions in an acute care environment. The studies examined medication-administration related interruptions, non-nursing activities, and gaps in communication in the inpatient environment. In one study, Paxton et al. (1996), defined an interruption as “anything that disturbs the continuity of the nurse’s work when already engaged in a task or caused a distraction during a consultation with a patient” (Paxton, et al., 1996 p. 33). Eighty-one percent of the articles

commonly used distraction to define an interruption (Hopkinson & Mowinski-Jennings, 2013). In most of the studies interruptions were linked to patient safety issues such as medication errors, and interruptions delaying patient care.

A study by Westbrook, Woods, Rob, Dunsumir, and Day (2010) in two Australian hospitals included 98 nurses and 4,271 administered medications and the impact of interruptions on observed errors. Researchers observed nurses' medication administration through the busiest part of the day. Each medication administration was observed for procedures related to dispensing the drugs to the patient. An interruption was defined as anything that caused the nurse to stop medication administration duties to attend to a peripheral event. Interruptions were observed to occur 53.1% of the time when administering medications. As interruptions increased, the error rate increased linearly. Interruption sources thought to be highest are due to "equipment alarms, other nurses, patients, family members, and physicians" (Westbrook, et al., 2010, p. 689). Clinical errors included wrong administration time, wrong IV rate programmed, wrong dose, wrong volume administered, wrong formulation, wrong additive, wrong route, wrong drug, wrong strength, extra dose, administering an unordered medication, administering an incorrect diluent with correct drug, and administrations including more than one of these errors. Without interruptions, the rate of procedural failure was 69.6%, which increased with each interruption to a procedural failure rate of 92.2% attributed to four or more interruptions. Procedural failures include failures reading medication labels, failing to read patient identification, leaving medications in unsecured areas, failing to record administration, not using aseptic technique, failing to check vital signs before administration, and failure of a two-nurse check on preparation, administration, pump

setting, and medication record of high risk medications. The authors also demonstrated that for one patient, the clinical error rate increases from 39% without interruptions to 61% with five or more interruptions during medication administration (Westbrook, et al., 2010).

An observational study by Kalisch and Abersold (2010) observed 36 nurses from two hospitals for four-hour periods. The researchers sought to determine the type of interruptions nurses' experience, what consisted of multi-tasking for a registered nurse, and the errors that arose because of multi-tasking and interruptions. Nurses were observed for communication interactions. An interruption was defined as an external event, while multi-tasking was defined as "two or more over-lapping tasks at one time". "An error is defined as an inadvertent event that may or may not cause patient harm" (Kalisch & Aebersold, 2010, p.128). Interruptions in this study consisted of those external events lasting more than ten seconds, which separated the nurse from her original task. Errors included hand hygiene lapses, patient misidentification, improper personal protective equipment, medication administration issues, and performing interventions on the wrong patient. Out of 3,441 events, 1,354 were categorized as interruptions, and 200 as errors. Kalisch and Aebersold (2010) found that out of all nurses observed, the error rate remained at 1.5 per hour and that 21-45% of interruptions were self-initiated or self-induced (Kalisch & Aebersold, 2010). The authors recommended potential solutions to prevent interruptions including being more aware that they exist, having nurses preparing medications wear a red vest, and placing a red line between the medication preparation area and the rest of the unit, designating this a no pass zone (Kalisch & Aebersold, 2010).

Benefits and Risks of Mobile Devices

Introducing mobile communication in an acute setting is thought to benefit patients and induce a more comprehensive workflow process for nurses. Other sources demonstrate risk to patient care associated with mobile communication. A 2007 qualitative observational study of 5 physicians included informal discussions and semi-structured interviews focused on creating a more manageable mobile communication interface. The authors studied pager and wireless phone use in an oncology department. The study was conducted in three phases including participatory observations, physician interview, and subsequent round of participatory observations. Participatory observations included communications between physicians and nurses that researchers listened in on. These communications were looked at for the type of communicate device utilized and what it was used for during that episodic occurrence. The authors identified that there was a mix between department role-based mobile devices and personal cell phones in use at the time of the study. The physicians in this department were in a transition to wireless devices during the study. Scholl, Hasvold, Henriksen, and Ellingsen (2007a) reported that the consensus among physicians was an increased fear of interruption when using a mobile device compared with a pager. After this study, the authors conducted another study to explore ways to better manage physician communication (Botsis, Solvoll, Scholl, Hasvold, and Hartvigsen 2007b). The authors sought to develop a communication device prototype and predict procedures and methods. The device was developed to pick up surrounding cell signals and intelligently route calls to the correct individual based on their role within the hospital. The single device could act both as a pager and a mobile phone. Through a context-aware system physician would be able to set the device to busy

mode in certain situations like in surgical procedures or if they are with a patient. A contextually aware mobile device can locate the user and accept or reject a call. Since the mobile device has a wireless tag, the system knows where the physician is and if available to retrieve a call at that time. The risk of wireless interference is reported and shielding may be necessary for life-saving equipment to avoid stray signals. The authors report that implanted cardiac devices do not interfere with wireless devices (Botsis, et al., 2007).

A study by Van Lieshout, et al, (2007) found that smartphones within 3cm of critical care equipment caused interference. Electromagnetic interference (EMI) was evaluated on critical care equipment. The authors tested mobile phones against 61 pieces of medical equipment. Forty-three percent of the devices tested were affected by the mobile phone, 33% of which were deemed hazardous. Some of these hazardous incidents resulted in a ventilator turning off and on intermittently, a syringe pump delivery device stopping, and an external pacemaker inhibited. The authors conclude that mobile devices should continue to be restricted at one meter from critical care equipment (Van Lieshout, et al., 2007).

A systematic review by the Canadian Agency for Drugs and Technologies in health (2014) identifies several evidence-based findings on wireless technology within healthcare settings. Interference data included many different transmission technologies in addition to Bluetooth, alpha pagers, Wi-Fi, in hospital cordless phones using wireless local access network (WLAN), ultra-high frequency radios, and mobile phones. Interference occurred in 44% of sixteen devices tested and included screen issues, false alarms, complete shutdown, and changes in device recordings. One study identified two

out of forty-five devices affected including a feeding pump and external defibrillator were affected in a manner consistent with dire clinical consequence. Another study found eight out of thirty-two devices affected by electromagnetic interference including an anesthesia monitor, and EKG machine. Variable distances producing interference were reported including one, two, and three feet from medical equipment. The authors recommend hospital policies to set safe distances from sensitive hospital electronic equipment for wireless technology. Consideration of potential interaction between mobile communication devices and medical equipment should be assessed prior to implementation (Canadian Agency for Drugs and Technologies in Health, 2014).

Mobile communications can improve communication in the inpatient healthcare environment. Dunphy, Finlay, Lemaire, MacNairn, and Wallace (2011) studied effects of mobile devices as perceived by nurses. The study examined implementation of Vocera® and nurses' perceptions of the device one month after implementation. The researchers interviewed seven nurses using open ended questions to obtain the nurses' perception of the mobile communication device in relation to their daily activities. Respondents indicated fewer interruptions and improved ability to carry out quality patient care. However, respondents reported frustrations with connectivity and utility of the device in some cases. Interviewees indicated there is potential for improved communication with mobile devices but cautioned institutions implementing similar technologies to create policies surrounding patient confidentiality and general use of the device.

Wu et al. (2011) studied communication with blackberry devices of 34 medical residents on an internal medicine unit. The researchers found efficiency was increased since 42% of the messages received by the residents did not require a response (Wu, et al.

201l). However, increased disruption was reported. In one forty-minute teaching session, resident physicians were interrupted seven times, five of which were direct phone calls (Wu, et al., 2011). Another identified risk was that mobile devices hindered interprofessional interactions. Nurses perceived less time was available for educational interactions with residents and less face-to-face opportunities for discussion of patient care. The study also found a disparity in what is defined as an urgent call. Residents read email communication and if not considered urgent they often would not reply. Nurses' felt that requests sent by email did not reflect the urgency that a phone call did, reporting that when sending email messages to physicians they received an email response only 50% of the time (Wu, et al., 2011). Physicians reported mobile phone interruptions during patient-physician interactions had negative impacts on their sense of professionalism. Residents reported that they were often contacted for minor concerns both by email and by direct phone calls from nurses.

Solvoll, Gironi, and Hartvigsen (2013) conducted a study using Ascom® devices with the ability to re-route or block phone calls depending on the employee's location within the hospital, schedule, and job title. Six physicians reported ease of use and the benefit of having control over receiving or rejecting calls based on geographical location. This device automatically discovers the location of the provider and determines whether they can accept or reject calls, especially when the individual enters or leaves critical care areas (Solvoll, Gironi, & Hartvigsen, 2013). Benefits of this system are determined to be improved communication and workflow.

Perceptions of Mobile Devices

Attitudes and perceptions surrounding mobile communication and related devices are linked to their area of use, manufacturer, and the message channel the device is used for. Hansen and Bardram (2007) reported on a pilot study of mobile phones in the operating room (OR) where iHospital® was introduced. Fifteen mobile phones were introduced in three operating suites during the nine-month pilot study. After the pilot project was completed, surveys were obtained from 34 nurses, 9 physicians and operating room technicians Perceptions of 67% of clinicians was positive related to efficiency of mobile devices one year after implementation in the operating suite. Traffic in and out of the operating room decreased by 58% (Hansen & Bardram, 2007). Respondents reported that patients received better care, foot traffic in the OR was reduced, and fewer interruptions in care were observed.

In a six-month study of 125 ICU staff in Ontario, O'Connor, et al. (2009) reported increased speed and reliability of communication with implementation of wireless email messaging. The number of email transmissions was recorded over five out of six months' post-implementation, in addition to five months beyond the study's termination. A 29-question survey utilizing a 7-point Likert scale was administered to four physicians and 121 nurses and other personnel including respiratory therapists, pharmacists, social workers, unit secretaries, and unit managers. The survey was developed using structured interviews with intensive care unit (ICU) staff in addition to a search of the literature. Findings were improved clinician collaboration, decreased interruption in care, and improvements in patient safety. Seven nurses reported that when they used their device for patient-related email, staff and visitors assumed it was for

personal use. Six nurses felt that emailing physicians reduced face to face interactions. (O'Connor, et al., 2009).

A 2010 study by Haroon, Yesin, Eckel, and Walker surveyed sixty junior physicians about their pattern of mobile phone usage to determine the impact of mobile phones in practice. Ninety-two percent responded that mobile phones resulted in faster communication than other methods of communication. (Haroon, et al., 2010).

Lo, et al. (2012) conducted a study on the use of Blackberry smartphone devices was conducted on an internal medicine unit at two hospitals with 31 participants from medicine, nursing, pharmacy, social work, and occupational therapy. The results suggest that nursing staff found the smartphone to be beneficial since the device could be used for email or telephone. Nurses' reported increased email communication since physicians could triage emails by urgency. Physicians and nurses found the utility of a Blackberry less intrusive and a more direct method of communication compared to paging. Disagreement was found between nurses and physicians in definition of an urgent situation and when to utilize the calling feature instead of email (Lo, et al., 2012).

A 2013 online survey study of forty-three nurses examined attitudes toward mobile devices and internet in practice. The survey, conducted by Monash University in Australia, distributed the survey to 71 facilities throughout the country. The survey consisted of closed-ended demographic and open-ended clinical practice questions followed by Likert scale questions about the usage of mobile apps at work. Eight out of ten statements related to mobile devices favorability, while two out of ten pertained to confidentiality concerns and patient perception or belief that staff used the phone for non-medical use. (Koehler, Vujovic, & McMenamin, 2013). The study found nursing

perceptions to be more favorable when accessing internet based medical applications rather than mobile phone medical applications for fear of increased disruption in their workflow. Thirty-five percent of those polled felt mobile phone applications to be distracting when caring for patients, compared with 37% did not find it distracting. Fifty-four percent of individuals felt it was faster than internet based medical application searches, 23% thought it was slower. Individuals also reported on their sense of professionalism while utilizing a mobile device with patients. Fifty-three percent believed mobile devices were viewed professionally, while 23% indicated they were not. The authors found that many nurses used personal mobile devices in inpatient settings, and their use may violate privacy policies and serve as a potential breach in patient confidentiality. Findings included confidentiality concerns with 65% of individuals concerned about this risk (Koehler, et al., 2013).

A cross-sectional survey by Koivunen, Niemi, and Hupli (2014) examined 123 nurse communications between colleagues utilizing electronic devices. Nurses were electronically surveyed with open and closed-ended questions. One hundred and nineteen nurses reported using email, while only 12 reported using video conferencing. Other reported uses included mobile phone messaging, internet messaging, and medical application utilization. Nurse's reported advantages of cost savings, timeliness of care, increased satisfaction, and faster data transfer of patient information through messaging (Koivunen, et al., 2014). Some cited advantages for their own work environment to include faster communication, flexibility, and labor savings for the organization based on reduced requirement of nurse mobility. Barriers or perceived disadvantages to mobile

devices were like other findings including privacy, technical requirements, diminishing the social aspect of communication (Koivunen, et al., 2014; Wu, et al., 2015).

Next, the theoretical framework will be discussed.

Theoretical Framework

The theoretical framework for this descriptive study is Donabedian's quality of care model. Donabedian's model organizes quality of care into assessments based on instrumentality, the process of medical care, and patient outcomes themselves. Components of quality care are many and often multifactorial. The author notes that previous literature is narrow and does not encompass all the nuances of what a quality assessment should include (Donabedian, 1966). Structure is noted to include material resources, human resources, and organizational structure. Process of care was described as how the patient sought health care, and how a provider decided on a diagnosis or treatment method. Lastly outcomes were defined as the effects of care on the health status of patients and population (Donabedian, 1988). Following his seminal article, he again reassessed the state of quality and noted the growing complexity in its' measures. He sought to provide focus in what determines quality and determined that at the base of quality are the care providers and their technical skill.

Figure 1. The Donabedian Model. Adapted from *Agency for Healthcare Research and Quality*, 2014. Copyright 1986 by Avedis Donabedian. Adapted with permission.

Donabedian's model focuses on three tenets including the process of care, structure, and outcomes. Mobile communication devices can increase efficiency of care, and potentially increase perceived quality of care by patients. Mobile communication has

also been linked to interruptions in care, which may hinder communication and decrease productivity, skills required.

Donabedian (1982) found that in general, practitioners seek to improve consumer care and it can be traced linearly. If there is no intervention to an ill individual, it is likely the person will develop a chronic condition or die from their sickness. The consumer of care will be affected by interventions and the process of care itself. These interventions and processes can negatively or positively influence care. Being sure that decisions in patient treatment have increased ability to provide benefit versus risk result in a higher state of health. Donabedian noted that the art of healthcare is intertwined with interpersonal communication and eluded to this relationship being required in successful technical skill (Donabedian, 1988). The model describes patient amenities pertinent to quality care including physical surroundings, noise, level, privacy, and comfort. The model highlighted the importance of the patient and their responsibility in the process of care. The model determined that quality of care felt by the community as inherently a part of an organizations' quality standards. Modern quality improvement projects often include data from medical records, which per Donabedian (1988) are incomplete and rarely include data on interpersonal communication throughout a hospital encounter. Efficiency in care can be directly correlated to higher quality and decreased medical costs, while inefficiency in care is generally linked to poorer quality (Donabedian, 1988). Increasing productivity and process flow can add to higher states of health (Donabedian, 1982).

Donabedian described the dichotomous view of what adds quality versus what adds cost. Additions to care may have only incremental advantages. He offered that

maximizing current processes have superior benefit. As this study seeks to determine clinician perception on mobile communication, it directly relates to Donabedian's question of "what goes on here", rather than "what is wrong?" in the process of care (Donabedian, 1966, p.196).

Next, the methods section will be discussed.

Method

Purpose

The purpose of this descriptive study was to examine nurses' perceptions of mobile communication use in an acute care setting.

Design

This descriptive study utilized a self-reported and one-time survey design.

Sample and Site

Participants were a convenience sample of nurses working on five inpatient units at a 247-bed northeast community teaching hospital (N=178). Surveyed units included five medical-surgical units, see table 7. These units are all housed in the same hospital and surveyed over the same timeframe. Unit 1 and 2 are cardiac-telemetry medical-surgical beds. Each unit has 16 rooms and consists of 30 beds each. Unit 3 is primarily a colorectal, medical-surgical unit. It has 7 rooms and can house 13 patients. Unit 4 is general medical-surgical and has 16 rooms, with the ability to hold 30 patients. Unit 5, the largest unit included in the study, serves as the primary orthopedic, and urological unit of the hospital. This unit has the most rooms albeit private at 36 beds. All RNs working all shifts on the study units were eligible. The researcher's unit was excluded from the sample to avoid potential bias. Four other units were excluded from the study since they were not fully integrated with mobile device and call light infrastructure by the time data collection began.

Procedures

Permission to conduct this study was sought from the chief nursing officer, the director of nursing operations, and nurse leaders involved in the Ascom Myco®

implementation at the study site. The research proposal was submitted to The Hospital's Institutional Review Board (IRB) and the Rhode Island College IRB for review.

Once approved by the IRB, prior to beginning the study, an informational session about the project was presented by this nurse researcher at the regular, twice-monthly hospital operations meeting attended by all nurse managers and assistant managers. The purpose of the descriptive study and methodology was shared with attendees, as well as the planned time-line for the study and the plan to share results with leadership and the study units. Managers unable to attend the meeting were contacted in person by this researcher.

Ascom Myco® was adopted by the Miriam in 2015 and implementation began in December 2015. All staff on the study units completed Phase I training beginning December 2015 through March 2016 on the use of the Ascom Myco® mobile device for communicating with other members of the healthcare team by phone or text messaging. The mobile Ascom Myco® devices were deployed on each unit as education was completed. In phase II of the project, completed in late January 2017, a new call light system integrated the Ascom Myco® device into patient call apparatus as an additional feature of the device. See Appendix A for integration timelines, go-live dates and training sessions by unit.

An informational flyer explaining the purpose of the study and inviting staff to participate in the study by completing the Perceptions of Wireless Communication using the Ascom Myco® Mobile Device Survey (Appendix B) was posted in unit breakrooms two weeks prior to the beginning of the study. Information regarding the survey was discussed at the huddle during change of shift for the first two weeks of

the study by unit leadership.

The study survey, Appendix C, modified from O'Connor, et al., (2009) asked Registered Nurse (RN) participants to anonymously fill-out questionnaires about their perceptions of the recent implementation of mobile communication devices. The original survey included 49 questions which were not all relevant to the purpose of this study. The impact of electronic email on team effectiveness and relationships was assessed in the original survey, and additional included questions on personal user information regarding electronic devices which were both removed. The survey addresses the impact of mobile devices on unit communication, impact of mobile devices on patient care, personal impact of mobile communication, the implementation process of mobile communication, and the overall impact of mobile communication in an acute care setting (O'Connor, et al., 2009). Reliability and validity of the questionnaire was established by content experts, focus groups, interdisciplinary team members and pilot testing (O'Connor, et al., 2009). The survey consists of thirty-four questions utilizing a 7-point Likert scale. Scoring a 5, 6, or 7 indicated a favorable response, 7 indicated the highest response, 4 is neutral, and 1 specified the lowest (O'Connor, et al., 2009).

At the end of the two-week informational timeframe an envelope containing questionnaires were placed in the breakroom of each unit. An informational letter (Appendix D) was attached to the outside of the envelope. Participants' consent was implied with the submission of the survey. No identifiable personal information was requested of participants. Nurses were asked to identify how long they have been a nurse, and how long they have worked for this institution. Nurses completing the surveys had an optional tear off raffle ticket for a $50.00 restaurant gift card. The surveys were available

on the units for four weeks. Surveys from the participants were placed in a sealed box next to the survey envelope. The separated raffle tickets with the participant name and unit were placed in a separate sealed container adjacent to the completed survey box. The drawing winner was contacted via email and sent the incentive award by interoffice mail.

The questionnaires were collected by the researcher at the end of each week and kept in a locked drawer within the principal investigator's office. Collecting the surveys weekly allowed an assessment of the general interest or the need for recruitment follow-up by unit leadership. A reminder was sent out through email to unit staff weekly for four weeks. Survey results were compiled by unit to enable the researcher to analyze data by unit. Survey responses were recorded on a Microsoft excel spreadsheet. Descriptive statistics were used to analyze the results by hospital unit, years of nursing experience, years of experience at this institution, survey specific domains, and overall impact.

The risk to those included in the study was thought to be minimal. Justice was maintained since sampling was not purposeful. The study was exempt from vulnerable populations as it was a convenience sample of inpatient staff nurses that are all adult age. Completion of surveys was voluntary and anonymous. Participants were asked a series of closed-ended Likert-scale questions. Risk of exploitation is non-existent since the unit the researcher works on is absent from the sample collection. Individuals did not experience emotional distress, but the risk was discussed.

Conducting the study after full integration and training diminished either a Hawthorne effect biasing results or bias from recent technology implementation. All included inpatient units under study were fully equipped with both mobile communication devices and additional patient call light connection prior to data

collection. Submission to the hospital and Rhode Island College IRB was completed in November. The study recruitment was completed March 2017 and the survey was completed by April 2017. Results of this study will be shared with unit leadership and staff, nursing leadership and interested parties' hospital-wide in an in-service format. Results were also presented at Rhode Island College Research Symposium in December 2017.

Next, the results of the study will be presented.

Results

Of 178 nurses, the response rate was 35.96% (n=64). The returns by unit were: Unit 1, n = 8; Unit 2, n = 13; Unit 3, n = 5; Unit 4, n = 19; and Unit 5, n =19. One survey completed by a certified nursing assistant (C.N.A.) was discarded.

Table 1 below shows those surveyed regarding years of service in the institution under study and those surveyed by years as a registered nurse (RN).

Table 1

Years in the Institution and Years as a Registered Nurse (RN) (n=64)

	<1 Year	1 to 5 years	6 to ≤10 years	>10 years
Years at Institution	6.25%	43.75%	28.13%	20.31%
Years as an RN	4.69%	43.75%	28.13%	21.88%

Nurses employed by this institution between 1-5 years and those working as registered nurses between 1-5 years comprised most respondents. There were fewer respondents who were employed less than one year as an RN than those responding with over ten years of nursing experience.

Table 2 represents data by survey domain without segregation to specific units under study. The impact of communication domain included questions regarding the speed, access, the reliability, and effort on behalf of staff while using the Ascom® mobile communication device. Nursing staff then answered questions regarding their perception of the Ascom® mobile device in improving patient care, improving patient safety, and whether using the device increased patient attainment of care. Next, nurses answered questions regarding the personal impact from use of the wireless devices. The personal

impact survey questions asked about job satisfaction, clinical communication skill, whether nurses felt these devices enabled them to take better care of their patients, whether the device improved their overall technical skill, and the impact the mobile device has on frustration during their work day. Nurses were then asked if using the device more often made them find the device more useful. Their thoughts on the utility of the device, their perspective on training, and mindfulness of the device were attained. At the completion of the survey nurses were asked one question, "I would like to keep using the Ascom Myco® mobile device on my unit". This question composed the only question in the overall impact domain.

Table 2

Combined Data On the Impact of the Ascom® Wireless Communication Device

Responses	Communication	Patient Care	Personal	Implementation	Overall
Favorable	46.13%	32.28%	24.76%	36.11%	31.75%
Unfavorable	25.15%	34.92%	48.57%	36.11%	49.21%
Neutral	25.89%	31.22%	22.54%	24.21%	14.29%
Did not Answer	2.82%	1.59%	4.13%	3.57%	4.76%

Overall, surveyed nursing staff reported favorably in their perceived impact the wireless device had on communication. The survey also explored an additional subset of information pertaining to the nurses' perception of the mobile devices' helpfulness in communicating with ancillary staff. Nurses graded ancillary and supplemental staff from 1-10 in increasing helpfulness when using the mobile device to contact them. Nurses indicated that the mobile devices helped somewhat in contacting charge nurses, other staff nurses, and physicians. The device had the least amount of help in contacting

clinical educators, respiratory therapists, and social workers. The most help the devices provided to nurses were when attempting to contact pharmacy. Unit collections indicated an unfavorable outlook in the perceptions of patient care. Most nurses responded unfavorably towards the impact the device has on their personal work life. With the devices' implementation nurse's responses' revealed equality between those who answered favorably or unfavorably. Overall impact of the devices indicated almost half of the nurses being not in favor of continuing to utilize the mobile device on their unit. The other half was composed of those in favor, and those who remained neutral.

Table 3 represents the survey domains discussed above but separated by specific units to ascertain patterns of responses linked to unit variances.

Table 3

Unit Specific Impact of the Ascom® Wireless Communication Device (n=64)

Responses	Unit	Communication	Patient Care	Personal	Implementation	Overall
Favorable	1	49.45%	57.14%	34.29%	46.43%	42.86%
Unfavorable		25.27%	23.81%	42.86%	28.57%	57.14%
Neutral		23.08%	19.05%	22.86%	25.00%	0.00%
Did not Answer		2.20%	0.00%	0.00%	0.00%	0.00%
Favorable	2	37.28%	12.82%	9.23%	23.08%	7.69%
Unfavorable		28.40%	38.46%	61.54%	53.85%	61.54%
Neutral		30.77%	48.72%	18.46%	13.46%	15.38%
Did not Answer		3.55%	0.00%	10.77%	9.62%	15.38%
Favorable	3	50.00%	33.33%	36.00%	45.00%	60.00%
Unfavorable		17.19%	20.00%	36.00%	20.00%	20.00%
Neutral		29.69%	46.67%	28.00%	35.00%	20.00%
Did not Answer		3.13%	0.00%	0.00%	0.00%	0.00%
Favorable	4	43.44%	22.81%	13.68%	22.37%	15.79%
Unfavorable		31.56%	43.86%	56.84%	38.16%	63.16%
Neutral		22.95%	28.07%	24.21%	34.21%	15.79%
Did not Answer		2.05%	5.26%	5.26%	5.26%	5.26%
Favorable	5	52.63%	45.61%	40.00%	52.63%	52.63%
Unfavorable		18.62%	31.58%	36.89%	28.95%	31.58%
Neutral		25.51%	22.81%	22.11%	18.42%	15.79%
Did not Answer		3.24%	0.00%	1.05%	0.00%	0.00%

Data by unit enumerates variability in responses. All units remained homogeneous in their feelings towards the benefit of mobile devices in communication. Patient care was valued differently with some units finding benefit, while others did not. Unit 2 and 3 responded with a higher neutral response rather than finding the mobile devices in patient care as a positive or negative tool. Personal impact to nurses had high unfavorability across the units measured. Units were split on implementation and training with half the units responding favorably and the other with unfavorable responses. Responses suggest Unit 3 and 5 would like to continue using these devices, while the other units responded unfavorably towards their overall impact and future use.

Table 4 represents perceptions based on the number of years nurses have been employed at the institution under study.

Table 4

Nurses perceptions of the Ascom® Wireless Communication Device by Hospital Experience

Responses	Cohort	Communication	Patient Care	Personal	Implementation	Overall
Favorable	< 1 Year	58.73%	46.67%	36.00%	45.00%	40.00%
Unfavorable		28.57%	26.67%	36.00%	35.00%	60.00%
Neutral		20.63%	26.67%	28.00%	20.00%	0.00%
Favorable	1-5 Years	57.51%	47.62%	38.13%	51.35%	44.40%
Unfavorable		18.41%	30.95%	39.57%	27.93%	37.04%
Neutral		24.08%	21.43%	22.30%	20.72%	18.52%
Favorable	6-≤10 Years	36.45%	25.49%	20.00%	23.08%	29.41%
Unfavorable		31.78%	31.37%	51.25%	43.08%	58.82%
Neutral		31.78%	43.14%	28.75%	33.85%	11.76%
Favorable	>10 Years	25.45%	2.78%	3.33%	21.28%	0.00%
Unfavorable		47.27%	55.56%	80.00%	53.19%	81.82%
Neutral		27.27%	41.67%	16.67%	25.53%	18.18%

Data by institutional experience reveals equivalent information regarding communication compared to data by units. Patient care was viewed favorable by the two cohorts with less amount of time in the hospital, compared to those with more institutional experience. The impact to nurses on a personal level was answered unfavorably throughout all cohorts. Implementation and training indicated a favorable outcome with those having fewer years at the hospital compared with their veteran counterparts. All but one cohort, those nurses with one to five years at this institution, indicated they would no longer desire to use the devices on their units. Table 5 will illustrate the data analyzed by experience as an RN.

Table 5

Nurses Perceptions of the Ascom® Wireless Communication Device by RN Experience

Responses	Cohort	Communication	Patient Care	Personal	Implementation	Overall
Favorable	< 1 Year	79.17%	100%	90.00%	75.00%	100%
Unfavorable		4.17%	0.00%	0.00%	25.00%	0.00%
Neutral		16.67%	0.00%	10.00%	0.00%	0.00%
Favorable	1-5 Years	54.90%	33.33%	43.88%	27.68%	42.86%
Unfavorable		20.45%	38.10%	28.06%	47.32%	39.29%
Neutral		24.65%	28.57%	28.06%	25.00%	17.86%
Favorable	6-≤10 Years	35.40%	29.63%	24.71%	25.00%	23.53%
Unfavorable		31.86%	33.33%	51.76%	44.12%	64.71%
Neutral		32.74%	37.04%	23.53%	30.88%	11.76%
Favorable	>10 Years	33.33%	16.67%	17.40%	29.63%	15.38%
Unfavorable		42.33%	47.62%	68.57%	50.00%	69.23%
Neutral		24.34%	35.71%	14.29%	20.37%	15.38%

Data by nursing experience showed positive responses towards communication in all but the cohort with over ten years of nursing experience. Most nurses responded

unfavorably towards the impact the devices had on patient care except for those with less than one year as a registered nurse. The personal impact of these devices showed the nurses with less experience responding favorably, while those with more years as a nurse answering unfavorably. Implementation and training were found favorable to the cohort with less than one year of nursing experience. Most nurses responded in discomfort using the mobile device. Fifty percent of nurses responded that they would prefer not using the devices on their units. The two cohorts having less experience would like to continue using the mobile device in the future.

Further data was collected on the number of shifts nurses took to feel comfortable using the Ascom® mobile device. Data was analyzed by all units, institutional years they have been employed, and years as a registered nurse. The purpose of analyzing this subset of data was to describe the potential differences in comfort compared with either nursing experience, or experience at the institution under study. Looking at the data by hospital experience compared to RN experience did not reveal a dichotomous outcome. Despite differences in nurses' perceptions within the survey domain in these cohorts, the comfortability with device utilization remained between one to five shifts. Those individuals with more experience as an RN had an increased number of respondents not answering this question then their more novice counterparts.

Next, the research summary and conclusion will be discussed.

Summary and Conclusions

Impact on Communication

Combined hospital data illustrated that more individuals felt the mobile devices increased the speed and reliability of communication with the mobile device. Breslin et al. (2004) similarly found increased communication and increases in workflow efficiency utilizing mobile communication devices. Per question analysis demonstrated not all individuals responded equally or favorably on each question within this category. Although a quantitative study, some individuals wrote comments on their survey despite there being no area for free text. One individual wrote that the device causes her "to walk in circles around the unit to look for staff". Older call-light systems had the ability to locate nurses by use of a transponder worn on every staffs' badge. The researchers' institution under study had these prior to the upgrade and Ascom® device transition. This comment was written by a nurse who chose Likert responses indicating the Ascom® device made communication less reliable, that it required more effort to communicate, and that the device had not improved access to members of the health care team. Nurses with less experience as a registered nurse, in addition to those with limited hospital exposure, scored favorably towards communicating with the device. This may suggest that these nurses may be younger in age and more adaptable to recent technology, like smartphones, which in theory allows them to handle the device faster with subjective feelings of increased communicative speed. In contrast, those nurses with more experience in the institution under study, or those with more practical experience as a registered nurse, were less favorable towards communication using these devices. These differences may be due to age and as such less able to utilize these devices with the same

speed as their millennial counterparts. Despite differences in response by years of experience or years employed by the institution, like Wu, et al. (2012), improved response time to patient issues and improved communication was realized with these devices. A similar study reported improved communication with mobile communication devices between surgeons, anesthesiologists, nurses, and operating room technicians (Hansen & Bardram, 2007). Data collected on usefulness of the devices with specific ancillary staff within the hospital led to a multitude of responses. There was more usefulness reported from staff contacting pharmacy than any other ancillary department. In this regard, the mobile devices have an opportunity to increase productivity as staff are not required to leave the patient's bedside in making a call. Increased patient safety may also be realized as nurses are able to contact pharmacy at the time of administration thereby reducing adverse drug events. Although each staff nurse is given an Ascom® mobile device to use throughout their shift, data supports its' relative disuse in contacting other departments or personnel at this time.

Impact on Patient Safety

Nurses were asked if they thought patient safety, their care, and speed of their care were improved with these devices. Although specific units scored differently, combined units indicated an unfavorable outcome utilizing these mobile devices. Some comments on collected surveys included that the devices "increased bathroom wait time for the patient, and pain medication response from the nurse". One individual wrote that noise levels were increased as the phone "constantly rings while in other patient's rooms and thus induces alarm fatigue". Another nurse commented that she easily "omits messages and experiences dropped calls" which impacts patient care. Similarly,

Westbrook et al. (2010) found that patient safety and care diminished as these modern technologies were implemented (Westbrook, et al. 2010). According to nurse respondents, Ascom® mobile devices could cause the same interruption in care, thereby reducing the safety climate within this institution. Kalisch & Aebersold (2010) similarly found a correlation between an interruption and persistent negative outcomes for the patient. Nurses with less than one year of practical experience perceived a benefit in mobile communication and patient care. All other surveyed nurses with over one year of practical experience responded unfavorably to this domain. It is unclear why nurses' felt patient safety and care was compromised using these devices. Despite feeling unfavorable towards the device on patient care, no near misses or adverse events were reported on the surveys.

Personal Impact

An ongoing trend in the data collection suggested that the newer nurses generally rated more favorably as compared to nurses with less years' experience. Data stratified by years as a registered nurse showed the Ascom® mobile device improving job satisfaction, enhancing communication skills, and decreasing the frustration nurses' have in their daily workflow. Nurses' with more experience as a clinician rated more unfavorably regarding the personal impact. Surprisingly, nurses' with more or less years at this institution responded similarly about how they felt personally about the mobile devices. Nurses on all units responded unfavorably as a whole toward the personal impact of these devices. One unit had equal amounts of people rating their personal impact favorably or unfavorably. One of these units was small, housing only 13 beds, while the other was quite large with 36 beds. A smaller unit may be impactful as nurses may have less

frustration than those on a larger unit with more ground to cover in each shift. O'Connor et. al. (2009) found that nurses reported mobile devices reduced face to face contact and gave the impression to visitors that they were using this device for personal use. Koehler et al. (2013) added that some nurses felt mobile devices were a breach of confidentiality and 23% of those stated they were viewed as unprofessional. In contrast, Koivunen, et al. (2014) reported that mobile devices positively impacted job satisfaction and improved communication skills.

Implementation

For many professional and clinical staff, the act of training defines a predictable indicator to success in the initiation of a new product or intervention. As a recent technology, the survey meant to address the ease of use and training process for nursing staff at this institution. Newer nurses, as in other domains, responded more favorably than their veteran counterparts. One can propose that newer nurses as a group are generally more current with modern technology than those nurses who had been employed for multiple years. Nurses with less than a year at the institution, regardless of their licensed work history, also responded favorably with the implementation of these devices. Nurses with more time in the hospital, whether this was composed of clinical or non-clinical employment, responded unfavorably about the training they received and how easy the device was to use. Nurses new at this institution may be more accustomed to differing technologies and would have been through extensive hospital orientation which may have set them up for a better experience with this communication tool. Nurses with more time in this hospital may have been comfortable using the paging system and overhead call bell lights reminiscent of 20th century patient care. Data combined from all units

point to equality between those who responded positively and those who did not. Individual units were split on this category. Staff were also asked how many shifts it took them to be comfortable with the device. Most individuals surveyed took between 1-5 shifts to feel comfortable with the device. There did not seem to be an advantage or disadvantage to being in the hospital longer or being a nurse for a larger amount of time. The cohort of nurses with 6-≤10 years of nursing experience had the greatest number of individuals not responding to this question. As a potential selection, nurses could respond that they were "still not comfortable" with the device. One can wonder if they did not see this as an option, or if they did not remember the timeframe in which they adapted to using the technology.

Limitations

Several limitations were identified in this study. Implementation and installation of the Ascom® mobile communication devices and Hill-Rom® systems were done at different intervals and on different units at separate times. The trainings on device utilization took place at separate times. It is possible that not all nurses attended the training. Some nurses reported connection issues and others reported frequently reported dropped calls, both confounding variables on what the researcher perceived as successful implementation. Hansen & Bardram (2007) found that training was identified as a very important indicator in successful implementation of mobile device technology including the functionality of the device and operability. Similarly, a pilot study in Great Britain commented on implementation and highlighted the importance of a working infrastructure, staff training, and that its' omission can allow staff to perceive mobile devices negatively (Department of Health, 2013a). Training done prior to and shortly

after implementing new mobile device technology is suggested to be one way to improve nurse perceptions (Ward, et al., 2011).

Freeth et al. (2012) indicated differences in situational awareness, a phenomenon of time and space, and a proponent in effective communication, as a potential limitation in their data collection. Unit differences may enable separate workflow processes to develop and effect nurses' response to the Ascom® mobile device (Freeth, et al.). A longitudinal study may be better equipped to study the intricacies of the units including workflow, staffing dynamics, and team situation awareness, a necessary component of what Mackintosh, Berridge, & Freeth (2009) deemed as an effective team.

A limitation to the study, abstaining from unit evaluation, may have altered the findings between one unit and another. Another unknown factor is unit geography and if this impacted how nurses perceived their own personal impacts from this device. Motion data or numerical trends from a pedometer may have been useful in correlating nurses on a larger unit and their Likert responses to this domain. Another limitation, the omission of age from the data set, may have been useful in comparing implementation, and ease of use with generational existence. Data collected prior to the study on go-live and training dates (Appendix A) delineates alterations in timing between units. This had the potential to give some staff more time with the device, thereby making them more likely to feel comfortable with its functionality. Surveying the staff on all units, despite them all having different amounts of time with the device, could have had an impact on their responses to the survey.

Overall Impact

The total impact of this new communication method was evaluated on each unit. All nurses but the cohort that had been at the institution for 1-5 years responded unfavorably to this question. One individual commented that “phones are helpful, just not these phones”. In contrast, newer nurses felt they would like to keep using the devices, despite their more veteran counterpart’s feelings. Almost half of all units surveyed aside from years of experience or time they have been in this institution responded negatively. Interestingly, the two units that were the least alike in size responded favorably towards their overall impact.

Recommendations and Implications for Advanced Nursing Practice

Having completed the data analysis for all inpatient units under study it is immediately aware that immense variability and intricacies exist between units. Assessment after implementation of the Ascom® mobile device has led to a mixed interpretation of usefulness and functionality in caring for patients. An initial discussion with nurses to elicit their perceptions toward mobile communication may have been of benefit prior to unit wide installation. The involvement of nurses in preliminary planning sessions is essential and could have enhanced their acceptance of the device. Those nurses who are recent graduates or those who have been in the institution for less time responded favorably to the overall impact of the device. On future hospital upgrades and accompanying implementation, it is possible that designing trainings to meet the need of the users would result in more favorable feedback.

Other literature directs attention to facilitators of change or unit champions being crucial in the successful adaptation of a new product or process (Mateo & Forman, 2014). Advanced practice nurses (APRN) have an opportunity to be champions and leaders in communication, patient safety, and device implementation. Supporting leadership in taking ownership of these roles operationally during this time may have achieved a more favorable response from nurses surveyed. Advanced practice nurses could establish the foundation for a change in practice. Proposing a change in operational policy surrounding capital planning and staff involvement may be one way to gain positive nursing perceptions. Nurses with more time in the hospital were unfavorable about the devices' impact to them personally. This may have been an effect of many technological transitions throughout their career, or perhaps their general aversion to change. Another

interesting dynamic is that nurses could become comfortable over time and are less likely to respond favorably to new projects or technological advancements when they do not find a personal stimulus for change. An intervention shaped at consistent education, training and evaluation, may have positively influenced these nurses' survey responses.

Each domain surveyed by nurses with more time in the hospital seemed to produce equivalent less than desirable reactions. Evaluating cost to predict the impact of these devices may have been another useful endeavor. Do the mobile devices impact time spent with patients? Do they shorten the amount of time nurses spend on communication with physicians on crucial assessments? Does the Ascom® mobile device confer added patient safety or benefitted outcomes as compared to some other device? Future studies should aim to assess the device as it relates to patients' length of stay and the measurement of time savings for the nurse at the bedside. These devices have the potential to immediately identify risks to patients, prevent falls, and induce a rise in patient satisfaction. By avoiding patient risk and chance for increased morbidity, the devices have the potential to affect future cost savings, and reimbursement from Medicare in the future (Mateo & Forman, 2014).

Exploring nursing perceptions on mobile communication within an acute care setting has deepened an understanding of individual user complexity and the effect nurses' experience has on integrating recent technology. In practice, this study could positively influence communication. Nurses' can contact physicians or advanced practitioners directly which may reduce the time a patient is waiting for critical intervention. Increasing non-nursing staffs' utilization of this device may be one way to close gaps in communication and stimulate a more favorable response to device utility.

These devices may also increase patient satisfaction by reducing noisy overhead paging and staff intrusion during patient care. This study may lead future qualitative examinations of patient care and the phenomena that exist with mobile communication tools. More research is required on a grander scale to extrapolate findings to all care areas, but this review can provide a working template to guide other institutions wishing to implement mobile communication devices on their units.

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Appendix A

Education & Integration Timelines

Table A1[1]

Ascom Myco® Education and Go-Live timetable

Unit	# of Phones	Education	Go-Live
A	19	12/1/15-12/3/15	12/7/2015
B	14	12/1/15-12/3/15	12/7/2015
C	14	12/1/15-12/3/15	12/7/2015
D	8	12/1/15-12/3/15	12/7/2015
E	12	12/1/15-12/3/15	12/7/2015
F	13	12/1/15-12/3/15	12/7/2015
G	44	12/1/15-12/3/15	12/7/2015
H	15	3/23/16-3/24/16	3/29/2016
I	14	3/23/16-3/24/16	3/29/2016

Table A2[1]

Hill-Rom® Education, Installation, and integration to Ascom Myco® wireless device timetable

Unit	# of Rooms	# of Beds	Education	Target Install Date	Ascom® Integration
A	23	25	9/20/2016	10/28/2016	12/28/2016
B	16	30	1/26/2016	1/29/2016	2/22/2016
C	16	30	1/26/2016	2/5/2016	2/22/2016
D	7	13	5/31/16-6/1/16	6/3/2016	6/7/2016
E	16	32	8/16/16-8/17/16	9/2/2016	10/27/2016
F	18	36	8/16/16-8/17/16	9/30/2016	10/20/2016
G	36	36	6/28/16-6/29/16	7/14/2016	7/27/2016
H	16	16	3/07/17-03/08/17	3/7/17-3/20/17	5/3/2017
I	9	9	3/07/17-03/08/17	3/21/17-3/31/17	5/3/2017

[1]Values presented are valid beginning 01/12/2018

Appendix B

Informational Flyer

IRB Approval:	12/28/2016
IRB Accepted:	12/28/2016

Calling all Registered Nurses!

You are asked to consider participating in a study looking at nursing perceptions of mobile communication in the inpatient setting.

This is an *anonymous one-time* questionnaire that all inpatient nurses located on 4East, 4West, 3West, 3North, and 3B are eligible to take between December 2016 to January 2017.

Surveys will be in each respective unit breakrooms in a manila folder with an attached informational letter discussing the study's purpose and objectives.

Surveys will be collected at one-week intervals and stored in a central location.

An optional raffle ticket for a gift card to Siena Restaurant will be available for your time and given out at surveys end.

Thank you for your support!

Cynthia Padula, Ph.D.
Principal Investigator
The Miriam Hospital

Appendix C[1]

Perceptions of Wireless Communication using the Ascom Myco® Mobile Device

1) Today I have been floated to this unit. If yes, Please **STOP** filling out this survey, if **NO,** please continue.

2) I have been an RN for _____years, months, days

3) I have been working for this hospital for_____ years, months, days

Impact on Communication on your unit

4) Ascom Myco® has made communication:

Slower			**No change**			**Faster**
1	2	3	4	5	6	7

5) The Ascom Myco® device has made communication more reliable (more likely to get a response to a message):

Less Reliable			**Neutral**		**More Reliable**	
1	2	3	4	5	6	7

6) Using the Ascom Myco® device for communication has required:

More Effort			**No change**			**Less Effort**
1	2	3	4	5	6	7

7) The Ascom Myco® device has improved my access to members of the health care team:

Strongly Disagree			**Neutral**		**Strongly Agree**	
1	2	3	4	5	6	7

8) The Ascom Myco® device has improved the response time of physicians to routine patient care issues:

Strongly Disagree			**Neutral**		**Strongly Agree**	
1	2	3	4	5	6	7

9) The Ascom Myco® device has improved physician response times to critical time sensitive patient care issues:

Strongly Disagree			**Neutral**		**Strongly Agree**	
1	2	3	4	5	6	7

10) I am **less** likely to delay or hesitate contacting a physician regarding a concern I have about a patient using the Ascom Myco® device compared to using other methods of communication:

Strongly Disagree			**Neutral**		**Strongly Agree**	
1	2	3	4	5	6	7

11) The Ascom Myco® device has reduced the time it takes to get a response from non-physician members of the health care team (nursing, pharmacy, respiratory therapy, social work):

Strongly Disagree			**Neutral**		**Strongly Agree**	
1	2	3	4	5	6	7

12) I feel patient care would be improved if all physicians used an Ascom Myco® device:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

13) I have resorted to numerical or overhead paging because of a failure to reach unit staff using the Ascom Myco® device:

Never			**Occasionally**			**Frequently**
1	2	3	4	5	6	7

14) The content of messages sent on the Ascom Myco® device is useful:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

15) Please indicate how helpful the Ascom Myco® device is for communicating with the following hospital staff using a 1-10 scale. (1= not helpful at all; 10 = maximally helpful) NA, for not applicable.

Charge Nurse	
Clinical Educator	
Nurse	
Pharmacy	
Physician	
Respiratory Therapist	
Social Worker	

16) Does the Ascom Myco® device have any negative impact(s) on unit communication?

No If no go to question 18

Yes If yes go to question 17

17) If you answered yes to question 15 above how large is the negative impact(s) of the Ascom Myco® device?

Very Small			**Medium sized**			**Very Large**
1	2	3	4	5	6	7

18) Overall what impact has the Ascom Myco® device had on communication on the unit?

Worse			**Neutral**			**Better**
1	2	3	4	5	6	7

Impact on Patient Care

19) Ascom Myco® in the unit has improved patient care:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

20) Ascom Myco® in the unit has improved patient safety:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

21) Ascom Myco® has enabled patients to receive their care faster:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

22) Are you aware of any errors, adverse events, near misses, patient harm or poor patient outcomes that are the result of using Ascom Myco®?

No If answer is no go to question 24.

Yes If the answer is yes please to go question 23.

23) If you answered yes to the above question how many negative events are you aware of? ____

Personal Impact

24) Ascom Myco® has improved my job satisfaction:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

25) Ascom Myco® has improved my clinical communication skills:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

26) Using Ascom Myco® helps me to take better care of my patients:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

27) Using Ascom Myco® has made me more comfortable using computers and information technology for patient care:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

28) Ascom Myco® has made my job less frustrating:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

Ascom Myco®, Implementation and Use

29) How many shifts did it take for you to become comfortable using the Ascom Myco® device? _____ **Or** I am still not comfortable using Ascom Myco®

30) The more I use Ascom Myco® the more useful I find Ascom Myco®:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

31) The Ascom Myco® device is easy to use:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

32) I received sufficient training on how to use an Ascom Myco®:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

33) I find carrying and keeping track of my Ascom Myco® during my shift to be:

Very Easy			**Neutral**			**Very Difficult**
1	2	3	4	5	6	7

<u>Overall Impact</u>

34) I would like to keep using Ascom Myco® on my unit:

Strongly Disagree			**Neutral**			**Strongly Agree**
1	2	3	4	5	6	7

Appendix D

Informational Letter

IRB Approval:	12/28/2016
IRB Accepted:	12/28/2016

To 4East, 4West, 3West, 3B, and 3North staff nurses:

We hope that you have heard about a research study that is being conducted on your respective units. This letter serves as a reminder to staff and to make you aware that the surveys are available on your units. The instructions on completion accompany the survey and are identical to those below.

I am a staff nurse on SCU and Fain 3. As a Rhode Island College graduate student, I will be conducting a study with the principal investigator, Cindy Padula, Ph.D. We would like to ask you to take part in this research study called Nursing's Perceptions of Mobile Communication in an Acute Care Setting that will describe perceptions of communication through your completion of this survey.

This survey is meant to assess staff perceptions of the recently adopted mobile devices on your unit.

Your completing this survey will approximately take ten minutes of your time. This survey is the only thing we will ask of you.

There are no questions that should cause you any discomfort. Your taking part in this research survey is completely voluntary. If you do not want to complete the questionnaire you are free to choose not to fill out the survey. There is no penalty or loss of benefits if you decide not to fill out this survey.

Your completion of this survey may not benefit you personally. I am hoping these completed surveys will provide insight into nursing perceptions of mobile communication in our acute care setting. You may fill out an optional $50 gift card raffle ticket for completing the survey. The raffle ticket and survey will be kept separate and placed in adjacent receptacles upon completion.

The surveys from this study will be kept confidential. None of the information you provide will have your name or any number on it that will identify you personally. Upon completion of the survey, please place the survey into the container labeled "completed surveys" and the optional raffle ticket into the container labeled "raffle tickets". The surveys will be kept in a centrally located locked file in the principal investigators office until data collection has been completed.

If you have questions about the survey or the research study itself, please feel free to contact me by email dgardner_5476@ric.edu or by mobile telephone 401.793.1865 or the principal investigator of this study, Cynthia Padula, Ph.D. by email cpadula@lifespan.org or by phone

401.793.3617;

You may contact the graduate student's advisor Margaret Mock, Ph.D. by email mmock@ric.edu or by phone 401.456.2775; or the RIC IRB designate at IRB@ric.edu; or if you have any questions about your rights as a research subject please feel free to call the office of Research Administration manager, Janice Muratori, at 444-6897.

Thank you very much for your time!

Warm Regards,

David A Gardner Jr., BSN, RN-BC
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