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Attitudes and beliefs among anesthesia provides regarding smartphone use for intraoperative anesthetic management

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Attitudes and Beliefs among Anesthesia Providers

Regarding Smartphone Use for Intraoperative Anesthetic Management

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Abstract

Smartphone technology has evolved with the accelerated pace of technological innovation. The

literature shows that healthcare providers already utilize Smartphone technology to bridge gaps

in knowledge and provide quality care to patients. Critics are leery about Smartphone use in the

operating room (OR) because it may be a source of distraction for anesthesia providers; however,

supporters argue that their use is also recognized as a potential aid in learning. Hence, this study

was conducted to assess workplace attitudes and beliefs regarding the use of Smartphones in the

operating room and to gain better understanding of the issues surrounding Smartphone use in the

operating room in order to establish policies that promote patient safety in conjunction with

accessibility to valuable technology. Using a survey methodology, an investigator-developed

questionnaire on Smartphone use in OR was sent to the anesthesiology staff of a large, academic

medical center in Illinois. The study enrolled 28 participants who are anesthesiologist physician

attendings, CRNAs and SRNAs. The findings revealed that over 95% of study participants

believe that Smartphones in the OR are very useful for accessing medical information during

anesthesia care. The majority of participants (92.9%) indicated that they never use Smartphones

during critical times of anesthesia and 57.1% of participants do not believe that Smartphone use

should be restricted in the OR. Fisher exact test revealed that there was no statistically significant

association between the participants' beliefs and attitudes on intraoperative Smartphone use and

the participants' sociodemographic variables such as age (40 years and younger versus 41 years

and older), years of experience (1 to 10 years versus 11 years and above), or provider type

(anesthesiologist attending physicians versus nurse anesthetists). A large discrepancy was noted

between the Employee Handbook policy on Smartphone use and the beliefs, attitudes and actions

of anesthesia providers. There is a need for a policy review on Smartphone use in the OR in

order to correct any inconsistencies, remove obsolete rules, update outdated policies and build

consensus on ways to use Smartphones effectively and safely in the OR.

Keywords: Smartphones, Anesthesia, Medical Apps, Patient Safety, Hospital Policy

Attitudes and Beliefs among Anesthesia Providers Regarding Smartphone Use for Intraoperative Anesthetic Management

Introduction

Over the past 30 years, cellular phones have evolved into small wireless computers, appropriately referred to as Smartphones (Johnson et al., 2015). A 2014 Pew Research Center survey showed that 90% of American adults own a cell phone, 58% of which were smartphones (Snoots & Wands, 2016). There are a number of Smartphone applications (apps) designed for medical professionals to improve healthcare delivery (Johnson et al., 2015). Smartphones are used as medical monitoring devices and pain scoring tools, and for communication, knowledge acquisition and diagnosis of heart rhythms (Pinar et al., 2016). Many practitioners believe that Smartphone technology has a noteworthy positive impact by allowing clinicians to have diagnosis and treatment resources available at their fingertips (Johnson et al., 2015). However, there is some disagreement on this position and there appears to be a variation in attitudes and beliefs related to Smartphone use in the clinical setting (Lamarche, Park, Fraser, Rich, and MacKenzie, 2016).

Background

Problem

According to the American Association of Nurse Anesthetists (AANA), patient safety is a concern raised by anesthesia professionals surrounding the use of Smartphones in the operating room. Another concern is the difficulty in assuring accurate clinical content and validity (AANA, 2015).

Anesthesia providers early in their careers as well as students of anesthesia readily depend on Smartphone technology to bridge gaps in knowledge while providing patient care

(Lamarche et al., 2016). "The integration of mobile information technology into clinical practice can have meaningful advantages for clinicians and their patients" (AANA, 2015).

> The current NorthShore University HealthSystems Employee Handbook states, "Employees may carry a personal cellular phone or PDA, such as Blackberry or Smartphone, while on duty provided the phone is turned off and fully concealed from patients and guests. Employees may use their personal cellular devices during a time designated by their supervisor, *but may not use cellular phones while in direct or indirect contact with a patient.* Employees should use cellular devices in break rooms or other designated cell phone areas, not at their desk or within the common area of their department. Employees may not use personal camera or audio/video recording devices to capture proprietary or confidential information, including protected health information. Further, *such devices may not be used in patient care areas*, locker rooms or restrooms" (NorthShore University HealthSystem Employee Handbook, 2015).

Due to the restrictive verbiage of the employee handbook, it was important to assess workplace attitudes and beliefs regarding the use of Smartphones in the operating room in order to evaluate the appropriateness of the current policy. If necessary, it is important to establish policies that promote patient safety while allowing accessibility to educational technology.

Study Goal

The purpose of this study was to assess the anesthesia providers' attitudes and beliefs of Smartphone use for intraoperative anesthetic management to then evaluate whether the current Employee Handbook Smartphone policy is in agreement with anesthesia providers' beliefs and attitudes.

Research Questions

- What are the current attitudes and beliefs among anesthesia providers regarding use of Smartphones in the operating room?

- Is the current Employee Handbook policy regarding Smartphone use in the operating room concordant with anesthesia providers' beliefs and attitudes?

Theoretical Framework

Technology Acceptance Model (TAM) is a theoretical framework that explains how users accept and use technology (Davis, 1989). Davis (1989) found that perceived usefulness and perceived ease of use are correlated with the use of technology, and his findings led to the development of TAM (Davis, 1989). The use of Smartphones and apps in the operating room depends on how users perceive the usefulness of those devices in practice (Davis, 1989). The corresponding beliefs may determine whether anesthesia providers accept or reject the use of Smartphones in their practice, leading to information that supports or rejects the need for modifications to current Employee Handbook policy on Smartphone use in the operating room.

Literature Review

Search Methods

An extensive literature review was conducted using the CINAHL Complete database. The key words used were "(nurse anesthetist OR CRNA OR anesthesia OR operating room OR operating theatre) AND (cell phone OR cellular phone OR cellphone OR smartphone OR ipad OR computer handheld)." The search yielded a total of 40 articles. Twelve articles were directly related to the research question and were included in this study. The literature offered several studies that look at the frequency and type of use of Smartphones in the clinical setting. The impact on accurate diagnosis, treatment, and care, as well as perceptions of Smartphone use by medical professionals is also described in the literature.

Smartphone Use

A significant amount of research on healthcare technology analyzes the use of Smartphones in a variety of medical settings. Ozdalga, Ozdalga, and Ahuja (2012) state that Smartphone tools are one of the fastest growing and most impactful technological advancements in medicine. Communication, medical education, and research were among the many uses found in the study (Ozdalga et al., 2012). The research notes improved communication between healthcare providers, improved patient education, as well as improved access to medical references via Smartphone apps (Ozdalga et al., 2012).

Ositelu, Landy, Kadry, and Macario (2012) analyzed the prevalence and types of use of Smartphone technology among medical residents in seven medical subspecialties at Stanford University Hospital. Of the 76 medical residents surveyed, 97 percent owned a Smartphone. Smart devices were most commonly used for communication (as in paging of providers) and retrieval of pharmacy and medication-related information (Ositelu et al., 2012). The next most common uses were for medical reference, textbook study aid, obtaining information on evidence-based medicine or treatment algorithms, and keeping up-to-date with medical literature (Ositelu et al., 2012).

Payne, Wharrad, and Watts (2012) examined patterns of medical app use within the medical student and junior doctor populations in the United Kingdom. In the survey, 79 percent of medical students (n= 257) and 74.8 percent of junior doctors (n=131) owned a Smartphone (Payne et al., 2012). On their phones, the majority of study participants owned one to five medical related apps (Payne et al., 2012). Both groups used apps several times per day (Payne et al., 2012). Students utilized apps for disease diagnosis, medical management, and drug reference guides, whereas doctors favored clinical calculators (Payne et al., 2012). Payne et al. (2012)

noted that both groups endorse the development of more technology to support their education and clinical practice.

Johnson et al. (2015) studied the frequency of Smartphone use and its appropriateness in the clinical setting by anonymously surveying physicians and medical students about their use of Smartphones during clinical practice. Questions from the Johnson et al. (2015) survey inquired about checking voice mail, making personal calls, responding to work related text messages, and using work related apps. "Other than while on break, respondents were more likely to report Smartphone use for work-related purposes than for personal or non-work related purposes" (Johnson et al., 2015, p. 4).

Medical Decision-Making

Medical residents are likely to own and use a Smartphone when delivering patient care, and this technology serves as an integral part of healthcare delivery (Ositelu et al., 2012). Mosa, Yoo, and Sheets (2012) conducted a systematic review of literature to identify research that discussed design, development, evaluation, or use of Smartphone-based software for healthcare professionals, medical or nursing students, and patients. Mosa et al. (2012) found that among all the healthcare apps found in the literature, disease diagnosis, drug reference, and medical calculator apps were reported as the most useful. These apps have a great potential to improve and facilitate medical and nursing education and should be incorporated into professional training (Mosa et al., 2012).

Mixed Attitudes

Despite the prevalent use, Smartphone technology is not yet normalized in medical clinical areas (Lamarche et al., 2016). Lamarche et al. (2016) reported that student nurse practitioners point out generational and experiential factors in cellphone use in the clinical

setting. "Preceptors and colleagues experienced in mobile application use were more open to access during clinical time with patients, and able to coach new users" (Lamarche et al., 2016, p. 130). Inconsistent healthcare policy and lack of understanding of the usefulness of smartphone apps are the main barriers to progress of this technological trend in the clinical arena (Lamarche et al., 2016).

According to Boruff and Storie (2014), mobile devices such as the iPhone, iPad, other Smartphones and tablet computers are increasingly becoming the main tool for accessing clinical information for the younger generations of medical professionals and healthcare students. Their survey of 1,210 medical professionals and students indicated widespread use of smartphones and tablets in various clinical settings by students, residents, and faculty members at four Canadian hospitals (Boruff & Storie, 2014). Of note, students in active clinical training were found to use healthcare apps the most frequently among all clinicians surveyed (Boruff & Storie, 2014).

Another study by Robinson et al. (2013) acknowledged that the potential of Smartphone use as an educational tool is gaining recognition in professional healthcare circles. Third, fourth, and fifth year medical students at the University of Birmingham, UK, were sent a sixteen-point questionnaire designed to assess how Smartphones were used for educational purposes (Robinson et al., 2013). According to Robinson et al. (2013), survey results showed that 84 percent of respondents (n=303) believed Smartphones "would be either useful or very useful in their medical education" (2013, p. 3). Under the "further comments" section of the survey, several disadvantages emerged including the notion that Smartphone use in the clinical setting could be viewed as unprofessional (Robinson et al., 2013). In addition, some students were concerned that an "over-reliance on Smartphones may lead to limited knowledge and poorer clinical judgment in comparison to traditional methods of learning" (Robinson et al., 2013, p. 3).

Potential for Distraction

It is commonly accepted that multi-tasking, maintaining situational awareness, and managing distractions are all part of administering safe anesthesia (Jorm & O'Sullivan, 2012). Jorm and O'Sullivan (2012) reviewed the anesthetic literature on workflow interruptions, vigilance, and multi-tasking, and concluded that all anesthesia providers need to be mindful of the limits to the human attention span. Moreover, they found that there is no evidence supporting a blanket ban on Smartphones in the operating room at this time, although students with less experience should avoid additional distractions of Smartphones (Jorm & O'Sullivan, 2012).

Common distractions related to cellphone use in the operating room include medication errors, reduced personalization of patient care, violation of confidentiality, and transmission of nosocomial infections (Schulte, Roberts, Birch, & Lisco, 2016). Research by Schulte et al. (2016) found the workflow interruptions imposed on the anesthesia clinical director to be attributable to phone calls and pages. Cellular phone data including the number of calls, length of calls, and number of text messages received from a single cellphone carried by the clinical director were analyzed. The frequency of cellphone distractions was very high; however, operating room efficiency often depends on the responses of calls and texts (Schulte et al., 2016).

The American College of Surgeons and the American Association of Nurse Anesthetists have instituted warnings that Smartphones may distract providers, but do not suggest full restriction of use in the operating room (Pinar et al., 2016). Pinar and colleagues (2016) sent a study questionnaire to the Turkish Society of Anesthesiology about Smartphone habits during anesthesia care (n=955). The results of the study indicated that 93.7 percent of participants used Smartphones during anesthesia care, yet the rate of use was significantly lower during critical stages of anesthesia such as induction and emergence (Pinar et al., 2016). Only seven percent of

study participants supported restrictions on Smartphone use in the operating room (Pinar et al., 2016). Distraction during patient care is a primary concern when considering Smartphone use. However, the data continues to suggest that it may be impractical to completely restrict the use of Smartphones as they are an important means of communication and play a fundamental role in accessing medical information (Pinar et al., 2016).

In sum, Smartphone use in the OR has advantages and disadvantages. Differences in opinions exist in terms of imposing a full restriction of Smartphone use in the OR as seen in Table 1. Hospital policy and employee handbook should be regularly updated to reflect current trends in technology use and patient safety.

Methods

Design

This study utilized a descriptive, cross-sectional survey design.

Sample and Setting

The target population included anesthesiologists, certified registered nurse anesthetists (CRNAs), student registered nurse anesthetists (SRNAs), and anesthesia medical residents within a large, academic hospital organization in the midwest.

Phase 1: Smartphone Survey Adaptation

In this study, Pinar et al. (2016) and Robinson et al. (2013) surveys were adapted to fit the context of the current study. The adapted online survey was developed using Qualtrics software technology. The DNP project committee chair emailed the survey link to all anesthesia providers within the hospital system with multi-center medical academic facilities. The adapted online survey aimed to assess the anesthesia provider's attitude and beliefs regarding Smartphone use in the operating room. Survey questions inquired about provider demographics,

frequency and purpose of Smartphone use during anesthetized patient care, as well as the

participants' beliefs about Smartphone handling during patient care (Appendix D). Survey

questions were formatted as either multiple-choice or select-all-that-apply.

Phase 2: Smartphone Survey Implementation

Informed consent was received from all study participants prior to formal participation in

the online survey. The recruitment process included an information sheet asking for voluntary

participation in the study. The DNP Project committee chair delivered the link for the survey via

email to all qualifying participants within the organization's database. This guaranteed

anonymity of respondents because the primary investigators did not have access to the

participant email addresses. The survey was open for 30 days, which allowed for sufficient time

to gather data. Person triangulation strategy was utilized by collecting data from anesthesia

practitioners with different levels of experience, including students (Polit & Beck, 2017). This

strategy improved the questionnaire validity by receiving multiple perspectives (Polit & Beck,

2017).

Human subjects' protection was ensured by Institutional Review Board (IRB) approval

from both DePaul University IRB and NorthShore University HealthSystem IRB (Appendix E).

The authors completed CITI certification to ensure adequate education and training for human

subjects protection to prevent any unnecessary risk to participants.

Phase 3: NorthShore University HealthSystem Smartphone Policy Analysis

The current hospital policy regarding Smartphone use in the operating room for all

medical employees includes restrictive language that leaves no room for misinterpretation. The

policy clearly states that hospital employees may not use their Smartphones during direct or

indirect patient care and/or while in patient care areas.

Results

Twenty-eight total survey responses were received. Using the Statistical Package for

Social Science (SPSS) version 24 software (International Business Machines, 2017), descriptive

statistics such as frequencies and percentages were analyzed to describe the demographic

characteristics of study participants. Results were compiled using valid percentages to account

for missing data. On average, it took participants about 2.75 minutes to complete the online

survey. Participants' ages ranged from 20 years to older than 60 years. Survey options were

given in age ranges to protect the anonymity of the participants and consisted of the following

choices: 20-30 years, 31-40 years, 41-50 years, 51-60 years and over 60 years of age. Results

showed that 50% of participants were under the age of 40 years and 50% were over the age of 41

years. Anesthesiologists accounted for 28.6% (n=8) of the participants, 32.1% (n=9) were

CRNAs and 39.3% (n=11) were SRNAs. None of the anesthesia residents responded to the

survey. Of the total sample, 57.2% (n=16) of participants have been in practice for less than 10

years, while 42.9% (n=12) have been in practice for over 11 years. All (N=28) participants

owned a Smartphone, with 89.3% (n=25) having anesthesia applications on their Smartphones.

The survey found that the greatest use of Smartphones in the operating room, listed using

exact verbiage from survey options, was "medical apps" and a combination of "medical apps,

writing/reading e-mail, and text messages." The most specific uses for Smartphones during

anesthesia care included "phone calls", "surfing the internet", "medical apps", "social media",

"writing/reading e-mail", "playing games", and "text messages". The majority of participants

(96.4%) indicated that Smartphones are "very useful" or "useful" in their anesthesia practice.

"Information gathering" and "communication" were the most useful reasons for Smartphone use

during anesthesia care. Overall, 24 (85.7%) of participants indicated that Smartphones are "very

useful" for accessing medical information instantly during anesthetized patient care. "Complicated" was the word chosen the most frequently (13.1% of participants) to describe their attitude towards the use of Smartphones in the operating room.

The majority of participants (92.9%) indicated that they never use Smartphones during critical times of anesthesia, such as induction and emergence. Similarly, 96.4% of subjects had never experienced a distraction while using a Smartphone and 71.4% had never witnessed a negative consequence of using Smartphones during anesthetized patient care. When asked whether there should be a restriction of Smartphone use in the operating room, 57.1% of participants responded "no".

A statistical analysis to examine the association between demographic variables (age, provider type, number of years in practice) and attitudes and perceptions of Smartphone use during patient care was performed using Fisher's exact test or Chi-square test as appropriate. The results were considered statistically significant when p value was less than 0.05. Our analysis showed that there were no statistically significant correlations between dichotomous groupings of sociodemographic variables such as age (40 years and younger versus 41 years and older), provider type (anesthesiologist attending physicians versus nurse anesthetists), or number of years in practice (1-10 years versus 11 years and above) and dichotomous groupings of participants' attitudes (Yes or No opinion of restricting Smartphone use in OR) and perceptions of Smartphone usefulness (useful versus very useful) .

Discussion

The participants were asked if they owned a Smartphone. 100% of respondents answered yes to this question. This supports the efforts of the principle investigators in exploring the research topic. Additionally, the adapted survey successfully answered all of the intended

questions of this research study. It was important that a variety of anesthetic providers (anesthesiologist, CRNA, SRNA) give their feedback to ensure external validity. There was an almost equal dispersion between the different types of providers, age of participants, and the years of experience. The data showed that there was no statistically significant difference in the attitudes and beliefs of anesthesia providers in regards to intraoperative Smartphone use for anesthetic management based on demographic information. This knowledge convinced the researchers that the study sample was a fair representation of the anesthesia department at NorthShore University HealthSystem and hence the results convey the general attitudes and perceptions among providers.

Participants were asked for what purposes they use their Smartphone during anesthetized patient care. Since the majority of participants use their Smartphones for medical apps and/or communication by email or text message, the data demonstrates Smartphones are commonly utilized for productive work functions and rather than unrelated tasks. As anesthesia providers, misuse of Smartphones is an important concern with serious implications with patient care. Misuse of Smartphones can lead to distractions that may result in negative outcomes for patients. Given the concern for misuse, these results show that most anesthesia providers at the hospital limit the use of Smartphone technology to deliver safe anesthesia care. Although results do not definitely prove that Smartphones are solely used in the operating room for patient care related tasks, it appears the standard among most providers. Encouraging proper use of this technology and embedding proper use in the culture can serve as methods to continue proper use of Smartphones in the operating room.

The survey inquired as to which apps participants use most regularly. "Epocrates" was used the most frequently followed by a combination of "Vargo Anesthesia, MedScape and

Blockbuddy". This information is beneficial for faculty and clinical instructors to evaluate the

preparation of students before an anesthetic as well as their diligence to look up correct

information intraoperatively. The information highlights the use of non-traditional educational

tools used by students today as alternatives to clunky textbooks. These results also show the

trend towards non-traditional educational tools in current Nurse Anesthesia training.

Understanding which apps are used by students and learning about these apps and their

limitations are valuable ways to improve students' educational experience. Incorporating both

textbook information and Smartphone technology could lead to improved accessibility to

information, especially in times that textbook references may not be available, as in the operating

room. Real time access of information benefits students by allowing them the means to

immediately look up answers to questions and situations they encounter in the clinical setting.

     The majority of participants in all demographic groups believe there should not be

restrictions to Smartphone use in the operating room during anesthetized patient care. This

demonstrates that the current hospital policy regarding Smartphone use is not reflective of the

beliefs of the department. It also shows that a great number of employees in the anesthesia

department are violating the policy on a daily basis and putting them in a hazardous legal

position should an adverse event occur. Due to this research revelation, the primary investigators

suggest a reevaluation of the hospital's Smartphone policy objectives.

Limitations

     The results of this study are based on 28 total responses. A smaller sample size, with a

large percentage of SRNA participants, may have skewed the results in favor of participants who

were more passionate about the topic of Smartphone use in the operating room compared to the

actual anesthesia department in its entirety.

Another limitation was that none of the anesthesia residents responded to the survey. There is the potential that being residents of University of Chicago, they do not regularly open their NSUHS email and therefore did not open the survey in the allotted period of time. Having anesthesia residents in the survey would have allowed the researchers to evaluate the beliefs and perceptions of Smartphone use in a second student population and furthered the ability to generalize the findings to the entire department.

Furthermore, more research, department specific, is warranted to evaluate the distractions and negative consequences that occur due to misuse of Smartphone use in the operating room. Although results show that most providers use their Smartphones for patient care, there is still some evidenced misuse. In order to change policy and procedures, data must evidence that negative consequences have not occurred due to use of Smartphones in the operating room. Also, policy must specify the proper use of Smartphones and incorporate ways to monitor the use, which in reality may be a complicated task.

Ethical Considerations

Prior to implementation, steps were taken to keep all participant demographic information anonymous. Responses were not linked to email addresses and were therefore blinded to the principal investigators. Institutional Review Board (IRB) approval was obtained from both NorthShore University HealthSystem as well as DePaul University. All legal and ethical considerations required of both IRBs were met prior to moving forward. All committee members including the principle investigators completed CITI (Collaborative Institutional Training Initiative) and FCOI (Financial Conflict of Interest) training prior to the start of the study (Appendix).

The principle investigators were both students of NorthShore University HealthSystems School of Nurse Anesthesia and SRNAs who participated in the survey were students of the same academic program. There is a possibility that SRNA's felt obligated to respond to the survey. In order to minimize potential bias and account for a vulnerable population, all participants were sent an information sheet prior to taking the survey to inform them that their decision to participate will not affect grades or clinical standing at the NorthShore University HealthSystem School of Nurse Anesthesia (Appendix D).

Future Recommendations

The goal of this study was to assess the attitudes and beliefs of Smartphone use intraoperatively for anesthetic management and to consider the suitability of the current Smartphone policy at NSUHS. The study results and analysis were shared with NSUHS stakeholders including the Director and Assistant Director of Surgical Services as well as the Department Chair of Anesthesiology. The principle investigators recommend revising the current Smartphone policy in order to reflect realistic practice standards regarding Smartphone technology in providing safe, high quality care. As the reliance on technology in operating rooms continues to progress, institutional policies and procedures must be made less restrictive in order allow access to educational technology that promotes a culture of safety and also protects providers in legal terms.

Conclusion

The goals of this study were all successfully met through this project. The attitudes and beliefs of anesthesia providers regarding the use of Smartphones intraoperatively were used to develop a recommendation for policy revision at NSUHS.

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Appendix A
Recruitment E-mail

Dear Anesthesia Provider,

Hello. Our names are Marjorie Reeves and Jasprit Dulat, and we are members of the NorthShore University HealthSystem School of Nurse Anesthesia. We are conducting a research study for our Doctorate of Nursing Practice through DePaul University. We are writing to invite you to participate in our research study about "Attitudes and Beliefs among Anesthesia Providers Regarding Smartphone Use for Intraoperative Anesthetic Management".

If you agree to be in this study, you will be asked to complete a survey. You will be provided a link for the survey via email through a secure website.
The link will be available for a limited time and the survey should take about five minutes to complete.

Your participation is voluntary and you have the right to withdraw at any time without consequence. If you change your mind later while answering the survey, you may simply exit the survey and there will be no negative consequences.

Your responses will be completely anonymous and will only be used for this study by the researcher. The participant reviewing the information sheet and continuing to the survey will serve as voluntary agreement.

Please see the attached Information Sheet for more information.

Thank you very much.

Sincerely,
Marjorie Reeves
jorie.reeves@gmail.com

Jasprit Dulat
jkmarahar@gmail.com

Appendix B

Information Sheet for Participation in Research Study

Attitudes and Beliefs among Anesthesia Providers regarding Smartphone Use for Intraoperative Anesthetic Management

Principal Investigator: Jasprit Dulat and Marjorie Reeves, Department of Nursing - graduate students

Institution: DePaul University, USA

Faculty Advisor: Dr. Karen Kapanke, DNP, Nurse Anesthesia

Research Team: Dr. Shannon Simonovich, DNP

We are conducting a research study because we are trying to learn more about the attitudes and beliefs of Smartphone use among anesthesia providers for intraoperative management of patients. With our findings, we aim to evaluate whether a need for modification of the current NorthShore University HealthSystem Employee handbook exists, in respect to Smartphone use. We are asking you to be in the research because you are involved in anesthesia care of patients. If you agree to be in this study, you will be asked to fill out a survey. The survey will include questions about the use of Smartphones in the operating room and for the anesthetic management of patients. We will also collect some personal information about you such as your age and years of experience as an anesthesia provider. The survey will be an online format, distributed via e-mail.

This study will take about five minutes of your time. Research data collected from you will be completely anonymous.

Your participation is voluntary, which means you can choose not to participate. There will be no negative consequences if you decide not to participate or change your mind later after you begin the study. You can withdraw your participation at any time prior to submitting your survey. If you change your mind later while answering the survey, you may simply exit the survey. Once you submit your responses, we will be unable to remove your data later from the study because all data is anonymous and we will not know which data belongs to you.
Your decision whether or not to be in the research will not affect status or employment at NorthShore University HealthSystem and, for students, your grades or clinical standing at the NorthShore University HealthSystem School of Nurse Anesthesia.

If you have questions, concerns, or complaints about this study or you want to get additional information or provide input about this research, please contact Jasprit Dulat or Marjorie Reeves at jkmarahar@gmail.com or via phone at 1-248-202-9339. You may also contact the faculty committee chair, Dr. Karen Kapanke, KKapanke@northshore.org or at 1-847-570-3165.

If you have questions about your rights as a research subject, you may contact Susan Loess-Perez, DePaul University's Director of Research Compliance, in the Office of Research Services at 312-362-7593 or by email at sloesspe@depaul.edu. You may also contact DePaul's Office of Research Services if:

- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.

You may keep [or print] this information for your records.
By completing the survey you are indicating your agreement to be in the research.

Appendix C
Survey Instructions

This study is being conducted to learn more about attitudes and beliefs among anesthesia providers regarding smartphone use for intraoperative anesthetic management.

The purpose of the study is
1) to assess the attitudes and beliefs of Smartphone use among anesthesia providers for intraoperative management of patients
2) to evaluate whether a need for modification of the current NorthShore University HealthSystem Employee handbook exists, in respect to Smartphone use

The findings will serve as the basis for the determination of whether a change to the NorthShore University HealthSystem Employee Smartphone policy is necessary.

Your participation is voluntary and you have the right to withdraw at any time without penalty. If you change your mind later while answering the survey, you may simply exit the survey without negative consequences. You also have the option to skip a question if you do not feel like answering.

Your responses will be completely anonymous and will only be used for this study by the researcher. Completion and submission of the survey will serve as participate in the study.

Appendix D
Survey

1. Which is your age range?
    a. 20–30
    b. 31–40
    c. 41–50
    d. 51–60
    e. >60 years
2. What is your profession?
    a. Anesthesiologist
    b. Certified Registered Nurse Anesthetist
    c. Anesthesia Resident
    d. Student Registered Nurse Anesthetist
3. How many years have you been in practice?
    a. <1 year
    b. 1-5 years
    c. 6-10 years
    d. 11-20 years
    e. >20 years
4. Do you own a smartphone?
    a. Yes
    b. No
5. "I have the technological skills to use a smartphone." Considering this statement, do you:
    a. Strongly agree
    b. Agree
    c. Neutral
    d. Disagree
    e. Strongly disagree
6. Is there any restriction for Smartphone usage in the operating room at your institution?
    a. Yes
    b. No
    c. Partly (Only in-house communication permitted)
    d. Unsure
7. How often do you use your Smartphone during anesthetized patient care?
    a. Very often
    b. Often
    c. Sometimes
    d. Seldom
    e. Never
8. Are there any anesthesia related applications on your Smartphone?
    a. Yes
    b. No
9. If yes, which application(s) do you use most regularly? (Select all that apply)
    a. Vargo
    b. Epocrates
    c. Medscape

  d. Block Buddy

  e. Other

10. For what purposes do you use your Smartphone during anesthetized patient care? (Select all that apply)

  a. Phone calls

  b. Surfing the internet

  c. Medical apps

  d. Social media

  e. Writing/reading e-mail

  f. Playing games

  g. Text Message

11. How often do you use your Smartphone during critical stages of anesthesia such as induction and emergence?

  a. Very often

  b. Often

  c. Sometimes

  d. Seldom

  e. Never

12. Have you ever experienced any distraction or negative medical consequence because of Smartphone usage during anesthetized patient care?

  a. Never

  b. Once

  c. 2–5 times

  d. More than 5 times

13. Have you ever witnessed one of your colleagues experience any distraction or negative medical consequence because of Smartphone usage during anesthetized patient care?

  a. Never

  b. Once

  c. 2–5 times

  d. More than 5 times

14. Which of the following Smartphone usage methods might result a distraction or negative medical consequence during anesthetized patient care? (Select all that apply)

  a. Phone calls

  b. Surfing internet

  c. Medical apps

  d. Social media

  e. Writing/reading e-mail

  f. Playing games

  g. Text Message

  h. None

15. Do you think that Smartphone usage should be restricted in the operating rooms?

  a. Yes, it should be restricted

  b. No need for restriction

  c. It should be partly restricted (only in-house communication should be allowed)

16. How useful would you find a smartphone in your anesthesia practice?

  a. Very useful

       b. Useful
       c. Not useful
       d. Completely useless

17. In which areas do you think a smartphone would be most useful? (Select all that apply)
       a. Time management
       b. Information gathering
       c. Assessment
       d. Communication
       e. Bedside teaching

18. How useful would you find the ability to access medical information instantly during anesthetized patient care?
       a. Very useful
       b. Useful
       c. Not useful
       d. Completely useless

19. Please select the words you feel best describe your attitude towards the use of smartphones in the operating room. (Select all that apply)
       a. Brilliant
       b. Distracting
       c. Complicated
       d. Simple
       e. Essential
       f. Unnecessary
       g. Expensive
       h. Innovative
       i. Helpful
       j. Terrible

Appendix E

NorthShore
University HealthSystem

Research Institute

1001 University Place
Evanston, Illinois 60201
www.northshore.org
Phone (224) 364-7100
Fax (847) 570-8011

September 26, 2017

Jorie Reeves, RN, MSN
Department of School of Nurse Anesthesia
2650 Ridge Ave.
NorthShore University HealthSystem
Evanston, IL 60201

Re: EH17-326: Reeves, Jorie RN, MSN: Attitudes and Beliefs Among Anesthesia Providers
        Regarding Smartphone Use for Intraoperative Anesthetic Management.
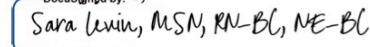   *Protocol Version 1, dated 6/24/17*

Dear Ms. Reeves:

The above-referenced project was reviewed in the Research Institute and by a member of the Third Friday Institutional Review Board (IRB) of NorthShore University HealthSystem. This project was approved on the date of this letter and has IRB approval through **9/25/2019**.

The project was reviewed in accordance with the Code of Federal Regulations (45 CFR 46 - as revised). The NorthShore University HealthSystem Institutional Review Board has an approved assurance of compliance with OHRP which covers this activity (Federal Wide Assurance: FWA00003000). This project conforms to the requirements for exemption from the Code of Regulations and does not require a Consent form because the research involves survey procedures, where information obtained is recorded in such a manner that human subjects cannot be identified, directly or through identifiers linked to the subjects[45 CFR 46.101(2)].

According to institutional policy, your project must be reviewed **every two years**. A Progress Report Form (RI-5.0) will be **due** in the Research Institute **no later than 45 days prior** to the above expiration date. **Changes in the experimental protocol must not occur without prior approval of the IRB.** Unanticipated problems must be reported to the IRB. If this project is terminated before its next Review, please submit a Termination Report Form (RI-5.1) to the Research Institute.

Sincerely yours,

Sara Levin, MSN, RN-BC, NE-BC

Sara Levin, MSN, RN-BC
Chairperson, Institutional Review Board

/lk

cc: Mary Keegan, R.N.
        Robert Stanton, J.D.
        Jasprit Dulat, RN
        Karen Kapanke, CRNA, DNP

A Teaching Affiliate of
the University of Chicago
Pritzker School of Medicine

Hospitals · Medical Group · Research Institute · Foundation

Appendix E

DEPAUL
UNIVERSITY

Office of Research Services
Institutional Review Board
1 East Jackson Boulevard
Chicago, Illinois 60604-2201
312-362-7593
Fax: 312-362-7574

Research Involving Human Subjects
NOTICE OF INSTITUTIONAL REVIEW BOARD ACTION

To: Jasprit Dulat, Graduate Student, School of Nursing

Date: October 10, 2017

Re: Research Protocol # JD091417NUR
"Attitudes and Beliefs among Anesthesia Providers regarding Smartphone Use for Intraoperative Anesthetic Management"

Please review the following important information about the review of your proposed research activity.

Review Details
This submission is an initial submission.

Your research project meets the criteria for Exempt review under 45 CFR 46.101 under the following category:

> *(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless:*
> *(i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation.*

Approval Details
Your research was reviewed and approved on October 10, 2017.

> **Number of approved participants:** 188 Total
> *You should not exceed this total number of subjects without prospectively submitting an amendment to the IRB requesting an increase in subject number.*

> **Funding Source:** 1) None.

> **Approved Performance sites:** 1) NorthShore University HealthSystem; 2) DePaul University.

Reminders
- Under DePaul's current institutional policy governing human research, research projects that meet the criteria for an exemption determination may receive administrative review by the Office of Research Services Research Protections staff. Once projects are determined to be exempt, the researcher is free

Table 1. Evidence-Based Table on the Attitudes, Knowledge and Perceptions of Smartphone Use by Student Registered Nurse Anesthetists for Clinical Preparation and Anesthetic Management							
Author and Year	Study Objectives	Methods (Design, Sample, Size, Setting, Human Subjects Issues)	Study Variables or Constructs Measured or Variables Controlled for by Researchers	Instrument/s Used to Measure the Construct/s	Statistics Used for Data Analysis	Study Findings	Conclusion
Schulte, Roberts, Birch, and Lisco (2016)	The purpose of this study was to assess the workflow interruptions imposed on an anesthesiology clinical director (CD). Researchers hypothesized that frequent interruptions would distract the CD from medical direction of residents or certified nurse anesthetists in operating rooms.	Data study and literature review Keywords: "Clinical director" "Operating room management"	Phone calls, texts, and pager interruptions	Cellular phone data were obtained from Verizon Wireless statements over 10 months (Aug 2012- May 2013). These data were from a single cellular phone carried by the anesthesia CD and subsequent overnight anesthesiologist 24 hours a day. Data included number of calls, date and times, number of minutes per call, and number of texts received.		A total of 19,924 calls and 19,803 texts were received by the CD. A total of 15,831 (80%) of the calls occurred during 0600- 1800. A total of 24,489 minutes (78%) of the total minutes occurred during this time.	This study revealed that distracting events are frequent for an anesthesia clinical director (high volume of calls and text messages). The nature of these interruptions can be viewed as positive or negative; yet many of these events are necessary to efficiently run the operating rooms.
Snoots and Wands (2016)	The purpose of this article was to illustrate the critical need for further research in order to analyze safety risk, appropriately guide CRNA education, and properly develop and enforce media policies within organizations.	Literature review Key words: "Personal electronic devices" "Operating room" "Media policy" "Anesthesia, patient safety" 11 articles met criteria and were included in the study.	Personal electronic devices use, distraction, patient safety, patient privacy, legal and ethical risk.	Cochrane Library, Medline/ PubMed, EBSCO Host		PEDs have benefits including improved communication and the use of medical applications for instant access to resources, but *inappropriate PED use* poses a concern for patient safety and ethical and legal issues. Outside of anesthesia, PED use has been assessed by National Highway Safety Administration and shown to lead to a distracted driver and more motor vehicle crashes. Hence, states have adapted regulations for cell phone use while driving.	There are positive attributes that PEDs serve CRNAs, but also CRNAs must be cautious about the ethical and legal implications of inappropriate use. Patient safety is at the forefront of anesthesia care and adaptation of PED use is still evolving regarding appropriate application by anesthetist.
Pinar, Karaca,	The study objective was	Questionnaire of 14 questions, 955	Demographic properties,	SPSS	SPSS	93% of respondents used smartphones	Smartphones in OR often

Dogan and Konuk (2016)	to learn about the smartphone use, habits, and views of Turkish anesthesia providers.	participants, distributed via email to anesthesia nurses and anesthesia residents and at national meeting of Turkish Society of Anesthesia and Reanimation.	frequency and purpose of smartphone use during anesthetized patient care, and respondents' opinions on smartphone use during patient care.		Chi-square test used to analyze smartphone use between age groups, p< 0.05 considered statistically significant.	during anesthetized patient care, no difference between 20-30 year old group and 31-40, but significant decrease in use in >40 years (p = 0.011), phone calls (65.4%), messaging (46.4%), social media (35.3%), surfing internet (33.7%) were most common purposes. 96.7% responded seldom use during critical stages, 87.3% reported not being distracted by use, but 41% reported witnessing colleague distracted due to use.	used for non-medical purposes. Distraction is a concern, but not enough evidence-based data to support restrictions on smartphone use.
LaMarche, Park, Fraser, Rich, and MacKenzie (2016)	The aim of this study was to look at the normalization of the use of mobile devices in advanced practice nursing clinical education.	This study utilized a three-year longitudinal survey design and used a multi-panel sampling approach.	The quantitative survey was based on the UTAUT 2 model to determine participants' views on factors that promote or inhibit successful normalization of mobile technology.

UTAUT consisted of 15 questions assessing 5 types of technology acceptance: Effort expectancy, perceived usefulness, social influence, facilitating conditions and trust. | Three specific data collection strategies: 1.) Demographics questionnaire and a brief survey of existing mobile use

2.) Acceptance and Use of Technology (UTAUT) questionnaire

3.) Random selection for semi-structured interviews | Data were analyzed using SPSS

The semi-structured interviews were analyzed using the Ritchie and Spencer framework. | Participants' average rating of effort expectancy was 6.17 (out of 7), indicating a high degree of agreement that mobile technologies are easy to use. In addition participants on average "strongly agreed" that the technology was useful. | Students expressed a developing reliance on accessing point-of-care information during clinical encounters in the clinical setting. |
| Johnson et al. (2015) | The study objective was to survey physicians' and medical students' practices concerning smartphone use in the academic healthcare setting. | Literature review, demographic questionnaire and survey

Keywords: "Smartphones" "Cell phone" "Professionalism" "Medical education" "Patient care" "Technology" | Physicians and medical students were asked to complete an anonymous online survey administered through Surveymonkey.com regarding uses of smartphones within the past month in various healthcare settings. | 5-point Likert-type scale (1 – "not at all" to 5 – "extremely") for respondents' use of various smartphone functions in their daily lives. | SPSS

Chi-Square and Fisher's Exact tests were used to examine the differences in rates. Generalized estimating equations (GEE) were used to examine whether the rates of behaviors | Across most settings, a large number of respondents used their smartphones for looking up relevant information on the Internet (defined as information that would benefit patients), looking at work related apps (e.g., Epocrates), taking and making work related calls, responding to work related texts, and checking texts. Overall use of cell | This study suggests that smartphones are frequently used in medicine for work related purposes |

						differed in the various settings. 'Simple Main Effects' were used to explore significant interactions.	phones for any purpose declined (P<.01) as proximity to patients increased ('during a procedure' or 'with a patient').	
Boruff, and Storie (2014)	The research investigated the extent to which students, residents, and faculty members in Canadian medical faculties use mobile devices and tablet computers to answer clinical questions and find medical information.	A multi-site, multiple user group, cross-country data study An electronic survey was distributed by medical librarians at four Canadian universities to medical students, residents, and faculty members via departmental email discussion lists, personal contacts, and relevant websites.	Variables included: types of information sought, facilitators to mobile device use in medical information seeking, barriers to access, support needs, familiarity with institutionally licensed resources, and most frequently used resources.	Electronic survey		The survey of 1,210 respondents indicated widespread use of smartphones and tablets in clinical settings in four Canadian universities. Third- and fourth-year undergraduate students and medical residents, compared to other graduate students and faculty, used their mobile devices more often, used them for a broader range of activities, and purchased more resources for their devices. These results are intended to inform health libraries how to effectively support mobile technology and collections.	Mobile devices are well suited for use in clinical practice, allowing clinicians and students to find patient care information quickly. While valued by all clinicians, mobile devices appeared to be most heavily used by those in an active clinical trainee role. Of note, barriers to access and lack of awareness might keep them from using reliable, library-licensed resources.
Robinson et al. (2013)	This study investigated the current behaviors and attitudes of clinical medical students regarding the use of smartphones in their education, with the intent of informing curriculum providers on the perceived benefits and barriers to	Cross sectional-questionnaire-based study Keywords: "Attitudes" "Behaviours" "Education" "Medical students" "Mobile phones"	Recent literature relating to smartphone use and attitudes among medical students guided this process. The questionnaire was distributed to third year students at a required lecture. Fourth and fifth year students were sent an electronic version of the questionnaire via email, followed by a reminder 1 week later.	16-point questionnaire & 4-point Likert scale In addition, three questions were open-ended, in order to describe and explain current behaviors and opinions in greater depth.	SPSS Pearson's Chi-squared test determined any significant differences in opinion among students. Summative content analysis whereby key words or phrases were	Over a third of smartphone users (79/214, 37 %) reported using medical apps to aid their learning.	Respondents were generally positive towards the idea of using smartphones in their future education (most believing the device would useful). Others commented that an over-reliance on smartphones

	implementing these devices more widely in future.				identified and counted was used for brief/simple responses. Free text generated at the end of the questionnaire was more complex so responses were read in detail and given initial codes. As ideas began to emerge, these were categorized, with comparisons being made between different categories.		could lead to limited knowledge and poorer clinical judgment in comparison to traditional methods of learning.
Jorm and O'Sullivan (2012)	The purpose of this study was to review the effects of the use of laptops and smartphones in the operating theatre on anaesthetist performance and explore the implications of this practice.	Literature Review Keywords: "Anaesthesia" "Vigilance" "Multitasking" "Distractions"	The first study variables were vigilance and multi-tasking. The second study variables were the nature of anaesthetic work and factors known to affect anaesthetic vigilance and performance.	Snowball literature search sampling from Human Factors journals	To provide guidance for decision-making on the discretionary use of computers and smartphones in the operating theatre, inferences are drawn both from related anaesthesia research and from studies in other fields.	The study found no evidence to support a blanket prohibition on the use of smartphones and laptops in the operating theatre. However, anaesthetic trainees (non-experts) should not be adding optional distractions to their anaesthetic practice.	Laptops and smartphones have the potential to both positively and negatively impact anaesthetic performance and should currently be used with great caution.
Mosa, Yoo and Sheets (2012)	The purpose of this study was to classify smartphone-based healthcare technologies as discussed in literature according to their functionalities and summarize	Systematic Literature Review 55 articles discussing 83 applications were selected from 2,894 articles initially obtained	Articles chosen that discussed design, development, evaluation, or use of smartphone software applications to be used by healthcare professionals or patients. Applications were grouped by the	MEDLINE using PubMed search engine and following PRISMA statement for systematic reviews.	Recall-focused retrieval strategy used to not miss relevant documents in MEDLINE	Total of 83 applications were documented: 57 for healthcare professionals, 11 applications for medical or nursing students focusing on medical education, and 15 applications for patients focusing on disease management with	Several medical applications for smartphones have been developed and are widely used by health professionals and patients. Medical applications

	articles in each category.		targeted user of the applications, as divided into three groups: (1) health-care professionals, (2) medical or nursing students, and (3) patients.			chronic illness. The disease diagnosis, drug reference, and medical calculator applications were reported as most useful by healthcare professionals and medical or nursing students.	make smartphones useful tools in practice of evidence-based medicine at point of care.
Ozdalga, Ozdalga and Ahuja (2012)	The purpose of study was to provide a comprehensive and up-to-date summary of the role of the smartphone in medicine by highlighting the ways it can enhance continuing medical education, patient care and communication.	Systematic literature review Articles chosen that could be applicable to the field of medicine and medical education with the exclusion of only surgical-related uses Key Words: "Smartphone" and related terms "Medicine" Search limited to published work within 5 years	Smartphone, defined as any cellular device that has additional functions; innovative roles of the smartphone in field of internal medicine; use of smartphone in medical education, communication and research.	Medline via PubMed and Scopus databases		60 studies were identified which found many uses for smartphone use in medicine, but few high-quality studies exist to help understand how to best use this technology.	While there is substantial potential for the smartphones role in medicine and education, more high-quality research is needed to understand the role it will have in the field.
Ositelu, Landy, Kadry and Macario, (2012)	The purpose of this study was to measure the prevalence and types of uses of smart devices among residents in seven different specialties at Stanford University Hospital.	Literature review, survey design – online survey distributed to Stanford University house staff in Anesthesia, Medicine, Surgery, Emergency, Medicine, Pediatrics, Psychiatry and Neurology	Variables included prevalence of smartphone ownership and uses of smartphones.	Electronic survey, distributed using Qualtrics Labs, Inc.		97% of participants own a smart phone. Two most common uses of smartphone were 1) communication and 2) obtaining pharmacy/medication-related information. The most common uses were as a medical reference, textbook, or patient-care-related study aid, obtaining information of evidence-based medicine/treatment algorithms, keeping up with medical literature, viewing electronic medical records, taking photos/videos, patient education and guidance for procedures.	Understanding smart device usage by physicians will facilitate proper content and app development and provide connectivity and security.
Payne, Wharrad and Watts (2012)	The purpose of this study was to examine smartphone acceptance and	Survey design – including open response questions about participants'	Variables included frequency of use and type of use.	Electronic survey of medical student and junior doctors.	SPSS Chi-square test	79% of medical students and 74.8% of junior doctors owned a smartphone. Majority of students	There is a high level of smartphone ownership and usage among

| | patterns of medical app usage within the medical student and junior doctor populations. | views on apps that were desired or recommended and the characteristics of apps that were useful. | | | | and doctors owned 1-5 medical related apps and iPhone owners significantly more likely to own apps (p<0.001). Both groups used apps several times per day. Students used apps for disease diagnosis/ management and drug reference apps, with doctors favoring clinical score/calculator apps. | medical students and junior doctors. Both groups endorse the development of more apps to support their education and clinical practice. |