

4-2019

Outcomes of Communication, Workflow Efficiency, & Patient Care Quality Resulting from a Hands-free, Wireless Communication Device

Hyacinth Flores Carreon

California State University, Northern California Consortium Doctor of Nursing Practice

Follow this and additional works at: https://scholarworks.sjsu.edu/etd_doctoral

 Part of the [Other Nursing Commons](#)

Recommended Citation

Carreon, Hyacinth Flores, "Outcomes of Communication, Workflow Efficiency, & Patient Care Quality Resulting from a Hands-free, Wireless Communication Device" (2019). *Doctoral Projects*. 114.

DOI: <https://doi.org/10.31979/etd.tanp-8252>

https://scholarworks.sjsu.edu/etd_doctoral/114

This Doctoral Project is brought to you for free and open access by the Master's Theses and Graduate Research at SJSU ScholarWorks. It has been accepted for inclusion in Doctoral Projects by an authorized administrator of SJSU ScholarWorks. For more information, please contact scholarworks@sjsu.edu.

ABSTRACT

OUTCOMES OF COMMUNICATION, WORKFLOW EFFICIENCY, & PATIENT CARE QUALITY RESULTING FROM A HANDS- FREE, WIRELESS COMMUNICATION TECHNOLOGY

Purpose: Failures in communication have long been identified as one of the root causes of preventable medical errors. The purpose of this quality improvement project was to assess staff perceptions on the outcomes of communication, workflow efficiency, and patient care quality after the implementation of a hands-free, wireless communication device in a federal acute care setting.

Methodology: Replicating the quantitative component of a 2012 study by De Grood et al., a 10-item survey using a 5-point Likert scale was administered within a 4-week period to healthcare team members from two inpatient units composed of monitor technicians, nurses, nursing assistants, and unit clerks. **Results:** Out of 110 staff sampled, 84 surveys were returned garnering a 76.4% response rate. Frequencies for each of the 10 survey statements within the strongly agree/agree category ranged between 54%-88%. Pearson correlation coefficient generated statistically significant results and yielded strong, positive correlation values between each pair: communication and patient care quality, workflow efficiency and patient care quality, and communication and workflow efficiency.

Implications: Healthcare team members positively perceive the use of the hands-free, wireless communication device. Staff believed that as communication improved, their workflow efficiency increased, and the quality of patient care they delivered was enhanced with the technology used. Investments in communication technology can positively influence patient care quality and staff satisfaction.

Hyacinth Carreon
April 2019

OUTCOMES OF COMMUNICATION, WORKFLOW EFFICIENCY,
& PATIENT CARE QUALITY RESULTING FROM A HANDS-
FREE, WIRELESS COMMUNICATION DEVICE

by

Hyacinth Flores Carreon

A project

submitted in partial

fulfillment of the requirements for the degree of

Doctor of Nursing Practice

California State University, Northern California Consortium

Doctor of Nursing Practice Program

April 2019

APPROVED

For the California State University, Northern California Consortium
Doctor of Nursing Practice:

We, the undersigned, certify that the project of the following student meets the required standards of scholarship, format, and style of the university and the student's graduate degree program for the awarding of the Doctor of Nursing Practice degree.

Hyacinth Flores Carreon

Project Author

Danette Dutra

Danette Dutra, EdD, MSN, FNP-C (Chair)

CSU – Fresno

Nicolette Estrada

Nicolette Estrada, PhD, MAOM, RN, FNO

University of Arizona

Revena Gantuangco

Revena Gantuangco, MSN, RN

VA Northern California HCS

AUTHORIZATION FOR REPRODUCTION
OF DOCTORAL PROJECT

 X I grant permission for the reproduction of this project in part or in its entirety without further authorization from me, on the condition that the person or agency requesting reproduction absorbs the cost and provides proper acknowledgment of authorship.

 Permission to reproduce this project in part or in its entirety must be obtained from me.

Signature of project author: *hansen*

ACKNOWLEDGMENTS

I would like to convey my heartfelt thanks to my doctoral project chair, Dr. Danette Dutra, and my mentor, Dr. Nicolette Estrada. I will always be grateful for all the guidance and support you so generously gave throughout this journey. Your wisdom has helped shape this project.

Thank you to my committee member, Revena Gantuangco, for her support and friendship. Montina Dudley-Alford and Jacob Nur, for their invaluable assistance in the implementation of this project. Also, my aunt Norma McCurdy, for her phone calls and text messages of encouragement and love.

DEDICATION

This doctoral project is dedicated to my two boys, Jed and Jake. I love you with everything in me. Both of you are the reasons I strive daily. On many difficult days, your smiles, the sound of your laughter, and your warm hugs were all the fuel I needed to keep on moving forward. Know that I'll always be here for you no matter what.

This project is also dedicated to my husband, Joel. I could not have completed this without your love and support. You stepped in and took care of everything when I had to focus and write. This accomplishment is as much yours as it is mine. I am blessed to have you as my partner in life.

Lastly, I dedicate this to my late father. I will always be grateful for the values of good education, hard work, and humility you have imparted. You have always believed in me even when I didn't believe in myself. This is for you, Dad.

TABLE OF CONTENTS

	Page
LIST OF TABLES	vii
LIST OF FIGURES	viii
CHAPTER 1: INTRODUCTION.....	1
Significance	1
Background.....	3
Purpose	5
Theoretical Framework	6
Summary	9
CHAPTER 2: LITERATURE REVIEW	11
Improved Communication.....	12
Increased Workflow Efficiency.....	15
Enhanced Patient Care Quality.....	17
Summary	17
CHAPTER 3: Methodology	18
Methodology.....	18
Summary	22
CHAPTER 4: RESULTS	23
Demographic Results	24
Survey Results	26
Summary	30
CHAPTER 5: DISCUSSION	31
Limitations.....	33
Implications for Nursing Informatics	33

Page

Future Study 34

Conclusion..... 35

REFERENCES 37

APPENDICES 45

APPENDIX A: SURVEY TOOL PERMISSION 46

APPENDIX B: HWCD SURVEY TOOL 48

APPENDIX C: INTERNAL EMAIL SURVEY INTRODUCTION..... 50

LIST OF TABLES

	Page
Table 1 <i>Frequencies of Demographic Categorical Results with Missing Data ...</i>	24
Table 2 <i>Frequencies and Percentage Results for the Demographic Data Categories</i>	25
Table 3 <i>Frequencies of Staff Perceptions on Improved Communication, Workflow Efficiency, and Patient Care Quality</i>	26
Table 4 <i>Descriptive statistics for Perceptions on Communication, Workflow Efficiency, and Patient Care Quality</i>	28

LIST OF FIGURES

	Page
<i>Figure 1.</i> Vocera B3000n badge. October 10, 2018.....	5
<i>Figure 2.</i> Staff was wearing the Vocera B3000n badge with a lanyard. October 10, 2018.	5
<i>Figure 3.</i> Scatterplot for Communication and Patient Care Quality.....	29
<i>Figure 4.</i> Scatterplot for Workflow Efficiency and Patient Care Quality.....	29
<i>Figure 5.</i> Scatterplot for Improved Communication and Workflow Efficiency....	30

CHAPTER 1: INTRODUCTION

Reliable and efficient communication is crucial within hospital settings for patient safety and quality patient care (Agency for Healthcare Research and Quality [AHRQ], 2019; Breslin, Greskovich, & Turisco, 2004; Cooney, Banbury, & Plunkett, 2018; De Grood et al., 2012; Dunphy, Finlay, Lemaire, MacNairn, & Wallace, 2011; Ernst, Weiss, & Reitsema, 2013; Fang et al., 2018; Friend, Jennings, Copenhaver, & Levine, 2017; Vandenberg, Hall, Wilson, Gay, & Duhn, 2009; Wilson et al., 2014). To deliver quality care, effective communication must transpire between healthcare team members (Propp et al., 2010). Delivery of high-quality patient care involves intricate processes contributed by various members of a multidisciplinary team (Agarwal, Sands, & Schneider, 2010). Healthcare environments are continually evolving. The AHRQ (2018) emphasized the need for clinical staff to practice *situational awareness* in such a complex setting, which, in turn, requires functional communication channels that promote swift information exchange. Acute care environments are typically seen using standard communication systems that include regular telephones, cell phones, and one-way communication channels such as overhead paging and alphanumeric pagers.

Significance

Patient safety and the impact of communication failures were highlighted when the Institute of Medicine (IOM) released its 2000 quality report, *To Err is Human: Building a Safer Health System*. In the report, IOM (2000) disclosed data that approximately 44,000 to 98,000 deaths due to preventable medical errors occur each year in hospitals within the United States. In the same report, failures

in communication were identified as one of the root causes of these preventable medical errors.

The Joint Commission, a United States independent regulatory organization providing accreditation of healthcare facilities, published data showing communication failures as the root cause behind more than 60% of sentinel events (Joint Commission, 2007). Joint Commission (2007) urged healthcare organizations to find sustainable strategies to enhance communication processes and promote collaboration within interdisciplinary healthcare teams. Improving the effectiveness of staff communication has been established as a Joint Commission national patient safety goal (NPSG) since the 2002 development of NPSGs as an accreditation requirement, and initially published in 2003 (Joint Commission, 2017). This particular goal has stayed for many consecutive years in the Joint Commission National Patient Safety Goals for hospitals. Ten years after the first 2007 report, Joint Commission cited a 2015 report attributing communication failures as the cause for 1,744 deaths in 30% of malpractice claims that resulted to \$1.7 billion in fees over a five-year period (Bronk, 2017).

Cooney et al. (2018) noted that the flow of information that must be shared with the healthcare team and the need to collaborate with other staff increase the necessity to communicate promptly. In a complex environment such as an acute care setting, researchers have studied the amount of walking the clinical staff performs in a given shift (Pemmasani, Paget, van Woerden, Minamareddy, & Pemmasani, 2014; Welton, Decker, Adam, & Zone-Smith, 2006). The constant traveling of clinical staff can impede the timely transfer of information. Cooney et al. (2018) noted that these delays could lead to patient safety risks. Utilizing a mobile communication technology was a viable option to enhance communication

processes. Shortly after the IOM report was published, an innovative information and communication technology (ICT) was introduced in the healthcare arena.

News and studies evaluating the effectiveness of a wearable, lightweight, voice-controlled, hands-free, wireless communication device (HWCD) providing synchronous, closed-loop or bidirectional, and asynchronous communications technology started getting published (Breslin et al., 2004; Joch, 2004; “University Hospital,” 2004). Several studies evaluating the effectiveness of the HWCD technology (developed by Vocera® Communications, San Jose, CA) across a variety of clinical environments that include the perioperative setting (Jacques, France, Pilla, Lai, & Higgins, 2006; Richardson, Shah-Hosseini, Fiadjoe, Ash, & Rehman, 2011), general surgical unit (Vandenkerkhof et al., 2009), medical unit (De Grood et al., 2012; Dunphy et al., 2011), and emergency department (Ernst et al., 2013; Richards & Harris, 2011) have been conducted. Majority of the research are qualitative studies focusing on a specific acute care area. Quantitative studies on the effectiveness of this particular ICT are minimal. Additional quantitative studies on outcomes related to the integration of HWCD technology within hospital communication systems will add depth to an emerging body of literature focused on this specific ICT as more health organizations are looking into investing their resources to help improve communication within the hospital environment.

Background

The HWCD, a novel ICT system, is unique in its features as it is lightweight, weighing less than two ounces (1.9 oz./53.9 grams), and wearable with a lanyard or lapel clip, making it hands-free (Breslin et al., 2004; Ernst et al., 2013; Richardson & Ash, 2008; Richardson et al., 2011; Vocera, n.d.) (see Figures

1 and 2). The audio component was designed with a front-facing speaker enhancing its hands-free capability with four internal microphone system and an acoustic noise reduction feature (Vocera, n.d.). Additional components of the HWCD (Vocera®) system include

- voice-command control to answer calls,
- one-touch call button to initiate calls,
- capability to call using a person's full name, first name with department, or the role (e.g., MSU charge nurse, TCU nurse manager, RT in ICU);
- send an announcement or broadcast messages to a group or department,
- send voicemail messages,
- create personal audio task reminders,
- call an internal landline or outside telephone numbers,
- staff assignment to specific patient rooms, and
- receive urgent alerts within the unit (e.g., bed exit, staff emergency, code blue).

The HWCD system boosts of a speech recognition software that utilizes Voice-over-Internet Protocol (VoIP) through the hospital's the secure wireless local area network (WLAN) (Ernst et al., 2013; Fang et al., 2018; Friend et al., 2017; Richardson & Ash, 2008; Richardson & Ash, 2010).



Figure 1. Vocera B3000n badge. October 10, 2018.



Figure 2. Staff was wearing the Vocera B3000n badge with a lanyard. October 10, 2018.

Purpose

The purpose of this doctor of nursing practice (DNP) quality improvement project was to assess staff perceptions on the outcomes of communication, workflow efficiency, and patient care quality after the implementation of a hands-free, wireless communication device (HWCD) in a federal acute care setting. The staff perceptions were voluntarily collected through the completion of a validated survey for which permission has been obtained. Gathering end-user perceptions

and satisfaction with the use of the innovative communication technology assisted in validating whether the organizational project goal of improving communication has been met. Results of the quality improvement initiative provided evidence-based data that can guide leadership decision-making regarding the allocation of resources for expanding technology use within the organization.

Theoretical Framework

Lewin's change theory was considered a unified change methodology based on four interrelated concepts that included field theory, group dynamics, action research, and the 3-step (Burnes, 2004; Burnes & Bargal, 2017). Dr. Kurt Lewin, a German Jew Gestalt social psychologist, was teaching at the University of Berlin before moving to the United States in 1933 when Hitler was elected in Germany (Burnes, 2004). Lewin's work started by studying the behaviors of groups, the factors that influence their connections, including the individual responses within the group (Burnes, 2004). His research led to the field theory, which posited that changes in individual behaviors within groups were driven by "forces within the field" or "group environment" (p. 981), and if one can determine those forces influencing the field, then change could be achieved (Burnes, 2004).

From the field theory, Lewin's work evolved, and he was credited as the primary psychologist who introduced *group dynamics* and its significant sway on group conduct (Bargal et al., as cited in Burnes, 2004). His work on group dynamics had shown Lewin that to bring about change in a group required a structured approach so members could actively participate in the procedure (Burnes, 2004). From this point, the action research theory was developed. Action research theory, originating from Gestalt psychology, postulated that a *felt-need*

must be present (Burnes, 2004). A *felt-need* was characterized as the individual's recognition and acceptance of a need for change (Burnes, 2004). Projects based on the action research theory were successful in bringing the projected changes; however, those outcomes were fleeting (Burnes, 2004). Lewin recognized that it needed to reach a distinct stage that necessitated a state of constancy, which led to the development of the 3-step model (Burnes, 2004).

Theory Relevance

Literature revealed that numerous studies on health information technology implementations had used Kurt Lewin's change theory as a conceptual model to help guide the project implementation to its successful end. Sutherland (2013) discussed how Lewin's 3-step model aided the barcode medication administration implementation at a large psychiatric hospital. She explained that using Lewin's change management model as a framework supported their nursing staff through the transition process, maximized areas of strength, and addressed sprouting resistance. Shirey (2013) described Lewin's model as a vital tool that guides organizations and individuals through the change process. She recounted its widespread use in nursing research, educational administration, nursing education, clinical nursing practice, and healthcare operations. The theory's strengths were described as "versatile, practical, simple to use, and easy to understand" (Shirey, 2013, p. 70). She expounded that Lewin's model was more favorable in stable settings such as hospital environments because change implementation can be carefully planned with a limited scope. Kaminski (2011) validated that Lewin's change theory provides an applicable framework for informatics-related changes making it well-suited for health information systems and technology implementation projects.

Theory Concepts and Application

The 3-step model comprised of the following steps in particular order – *unfreezing*, *moving*, and *refreezing* (Lewin, as cited in Burnes, 2004). The first step, unfreezing, described as the stage where the imbalance must occur because of the *unlearning* that must take place and was acknowledged to be the most challenging phase requiring varied strategies befitting the setting (Lewin, as cited in Burns, 2004). Schein (as cited in Burnes, 2004) asserted that what was crucial in the unfreezing phase was establishing a sense of safety for the staff to avoid anxiety over the intended change. During the *unfreezing* stage, data gathering for technical specifications and requirements were completed. Identification of stakeholders, plus infrastructure, and software configuration were finalized. Leadership and staff communication, including project needs assessments, were conducted to prepare for implementing the HWCD system. The nursing informatics team consisting of two informatics nurse specialists within the organization functioned as project co-leads assigned by nursing leadership. Bozak (2003) noted that creating open communication channels with leadership and staff were vital for nurse informaticists leading health information technology projects to achieve as these instill trust and a sense of security with the impending change. To exemplify this principle, regular meetings were held, and consistent updates were provided to the leadership team and selected staff champions. Identification of unit champions was an effective strategy in sustaining group motivation (Stevens, Bader, Luna, & Johnson, 2011). Development of organizational policy and procedures surrounding the use of HWCD and staff training activities were completed during this phase.

The model's second step, *moving*, represented the phase where the planned change was executed to accomplish target goals (Kaminski, 2011). The core

project team made up of the nursing informatics team, key nursing management and unit champions across various departments collaborated closely with the external vendor (Vocera®) staff for a year from technical build to staff training before the HWCD system was implemented in April 2018. The third and final step in Lewin's change model, *refreezing*, focused on the group balance with the changes and new functions assimilated by the staff experiencing the change (Lewin, as cited in Burnes, 2004). Schein maintained that changes must be aligned with the existing group structure or it will lead to a new set of problems (as cited in Burnes, 2004). The first six months of the HWCD post-implementation period was the core of the model's refreezing phase. Informatics nursing specialist project leads conducted unit rounds during the first two weeks of the post-implementation period to reinforce training, address technical setup issues, and obtain feedback from end users. Evaluation rounds were performed with the vendor (Vocera®) clinical informaticist and the organization's nursing informatics team two months after implementation to reassess any additional infrastructure gaps and observe staff usage of devices. This DNP quality improvement project utilizing a structured survey approach was another evaluation methodology to evaluate whether the refreezing phase was successful in integrating the technological changes within the healthcare team's daily workflow.

Summary

There is a rapidly growing body of literature supporting the positive impact of an HWCD system within healthcare teams in various acute care settings. In 2010, after several hospital interviews and review of extensive data from the AHRQ, the Bureau of Labor Statistics, and in literature, researchers presented an estimate of cost for healthcare wastes amounting to over \$12 billion per year due

to communication inefficiencies in U.S. hospitals (Agarwal et al., 2010).

Implementation of an HWCD system, a current ICT innovative tool, was a feasible approach for healthcare organizations to invest on to strengthen communication processes that allow bi-directional dialogue and immediate transfer of information among clinical staff promoting patient safety and high-quality care delivery.

CHAPTER 2: LITERATURE REVIEW

Technology's rapid evolution over the last decade has revolutionized the way people communicate, and healthcare is slowly catching up with this trend. There is an emerging body of literature concentrated on investigating the impact of using mobile, wireless technologies on clinician communication within hospital environments as more major healthcare organizations invest their resources on ICT systems. A literature search was conducted on the PubMed, Academic Search, MEDLINE, Clinical Key, and CINAHL databases using various keyword combinations: "hands-free", "wireless communication", "hands-free AND wireless communication", "wireless communication AND hospital" and "Vocera". As expected, the keywords "wireless communications" generated the most results with over 5400 references that were refined to less than 200 when combined with the "hands-free" keyword with the publication year of 2000 and later. A majority were excluded based on the title. The extensive list was narrowed down to 15 studies in full-text articles from peer-reviewed journals. From this group, three articles were excluded: two were systematic literature reviews, and the third was a retrospective review. The final group of 12 articles included the earliest study published in 2004 (Breslin et al., 2004), and the most current at the time of the database search, which was published in April 2018 (Cooney et al., 2018).

The different studies focus on a variety of key areas influenced by the HWCD technology: staff communication, clinician workflow impact, quality of patient care delivered, emergency events, interruptions experienced by providers, staff response times, distance traveled, noise level, the flow of information, and collaboration. Since the purpose of this project focused on the outcomes of communication, workflow efficiency, and patient care quality resulting from the

use of the HWCD technology, the literature supporting these three themes were analyzed in this chapter.

Improved Communication

Provision of quality care and the promotion of positive patient outcomes remain the primary goals of an inpatient healthcare team. To achieve this, timely communication between team members is fundamental. HWCD systems were installed primarily to enhance communication across a multidisciplinary team, and this purpose was demonstrated in the selected articles reviewed. One study was implemented within a pediatric intensive care unit (PICU) using three methodologies, and the research data showed statistically significant improvements with communication response times from HWCD use (Cooney et al., 2018). In their discussion, Cooney et al. validated the conclusions from two previous studies, the Vandenkerkhof et al. 2009 study and the Friend et al. 2017 study, where results of high staff satisfaction were seen with the substantial amount of time saved from trying to find other staff. Because of the HWCD technology, the interdisciplinary team members perceived that it was easier to communicate and information exchange was achieved promptly (Cooney et al., 2018). Cooney and colleagues observed and surveyed bedside nursing staff and PICU departmental staff that included residents, consultants, nurse coordinators, and senior nurses. Vandenkerkhof and associates' (2009) study participants were nurses, nursing assistants, and unit clerks from a general surgical unit, while several perioperative staff participated in the Friend et al. (2017) HWCD study.

Focusing on specialty nurses as the sole study participants, Wilson et al. (2013) conducted a cross-sectional study of intensive care unit (ICU) nurses to determine adoption predictors for HWCD use using the same questionnaire from

the Vandenberg et al. 2009 study. In their study, nurses perceived that HWCD use in the ICU strengthened staff communication as it decreased care interruptions since the nurse can obtain help promptly without leaving the bedside (Wilson et al., 2012). Wilson and colleagues confirmed that this conclusion reflected a similar report from studies completed by De Groot and colleagues (2012), Dunphy et al. (2011), and Vandenberg et al. (2009).

Similar to Vandenberg and colleagues' (2009) study population, De Groot et al. (2012), in a mixed-methodology study, used focused interview and thematic survey with inpatient medical unit nurses, nursing assistants, and unit clerks. The researchers corroborated the other HWCD studies with their data results illustrating staff perceptions that recognized an improvement in communication with the use of the HWCD system. In a similar medical unit setting, Dunphy et al. (2011) executed a case exemplar approach study and yielded substantiating results on communication improvement from staff feedback.

Targeting a more concentrated participant pool, Fang et al. (2018) completed a study with over 100 physicians rotating within inpatient medicine units in a federal teaching hospital. Their survey results illustrated that the providers perceived a significant positive impact on communicating and reaching their colleagues with the addition of the HWCD to their existing alphanumeric paging tool (Fang et al., 2018). Another study focusing on HWCD use by physicians was completed by Ernst et al. (2013), which drew a similar conclusion regarding the positive perception of providers on the outcome of utilizing the technology to improve communication with their colleagues. The researchers performed a cohort study of emergency department providers where the participants affirmed that HWCD use bolstered their communication processes.

Unlike all of the other studies that focused on clinical staff, Richardson and Ash (2008) extended their investigation to include information technology (IT) staff perceptions. In November 2008, Richardson and Ash presented their preliminary findings on the HWCD effects on clinical communication during the American Medical Informatics Association (AMIA) 2008 Symposium in Washington, DC. Twenty-six focused group interviews were completed from a mix of nurses, nurse managers, and IT staff from an academic teaching hospital and a community hospital in Portland, Oregon. They expounded on two of the five themes identified from their study and presented their participants' perceptions confirming that the HWCD boosted communication access (Richardson & Ash, 2008). A few years later, Richardson and Ash (2010) published their full article discussing the five themes and elaborating on interview results where the participants confirmed that use of the HWCD system enhanced communication access as it allowed for rapid and organized communication. In 2011, Richardson collaborated with more researchers and studied HWCD use by anesthesia staff within a pediatric surgical unit to validate themes from the previous study utilizing interviews and observation methods (Richardson et al., 2011). With a different sample group, the perceptions of positive communication impact from HWCD use was once again validated.

The earliest published study discussing the impact of the HWCD system on nursing communications and workflow was accomplished by Breslin et al. (2004) in a 299-bed community teaching hospital in Baltimore, MD. The researchers noted that majority of the staff (83% of nurses and 80% of unit secretaries) preferred using the HWCD as a communication tool compared to the overhead paging because it was more user-friendly and provided better communication across members of a multidisciplinary team. The researchers also pointed out how

the time and motion aspect of their study aligned with their survey results showing significant time savings from both the nurses and the unit secretaries while using the HWCD. This early study had set an example for many healthcare organizations to examine their communication channels and invest resources in obtaining a unique ICT system to improve communication between multidisciplinary team members.

Within the same year that Breslin and colleagues published the first HWCD study, news articles featuring HWCD pilot projects in various hospitals were featured in peer-reviewed journals. Joch (2004) presented the different types of communication technologies using VoIP and wireless networks that was rapidly gaining popularity in many hospitals. He highlighted HWCD's distinct advantage of having no interfering signals with hospital equipment compared to that of cellphones as seen with the HWCD use in the surgical and pediatric units in El Camino Hospital. This feature gave the HWCD system a niche of its own that has sustained for more than a decade since it was introduced in a clinical setting. The popularity it has gained can be attributed mainly to the positive outcomes it has produced not just on improving staff communications but also on streamlining workflows (Health Management Technology Mag, 2011).

Increased Workflow Efficiency

Caring for admitted patients require an inpatient nurse to juggle and manage multiple tasks in a given shift. Completion of these patient care tasks includes initiating and receiving calls for information exchange, asking for help, or coordinating and collaborating with various healthcare team members. Wilson et al. (2013) pointed out that "clinical environments are fraught with inefficiencies, distractions, and nonvalue-added activities that have a potential impact on health

outcomes for patients” (p. 24). Organizations are continually looking into investing in technological tools that directly enhance communication channels by eliminating nonvalue-added activities to reduce inefficiencies in many workflow processes (Vandenkerkhof et al., 2009). Cain and Haque (2008) emphasized that healthcare facilities need organized and efficient workflows that enable clinicians to complete tasks promptly resulting in care delivery that is reliable, consistent, and safe. Some of the studies that measured improvements in communications included staff perceptions associating the HWCD impact on their workflows.

In the physician-focused study completed by Fang et al. (2018), the providers’ survey results illustrated a positive response when questioned whether the integration of the HWCD made a difference with their existing alphanumeric paging system during unit rounds, patient admissions and discharges, and during teaching sessions. For nursing workflow, Breslin et al. (2004), De Grood et al. (2012), Dunphy et al. (2011), Richardson and Ash (2008, 2010), and Vandenkerkhof et al. (2009) generated identical results establishing that HWCD use led to a more productive workflow by decreasing time-wasting tasks. Vandenkerkhof and colleagues (2009) determined that there was a statistically significant decrease in non-value added nursing activities such as going back and forth to the telephones and walking around to locate other staff. Also, a decrease in distance traveled by nurses, nursing assistants, and unit clerks was determined from the study results leading to an improvement in their workflow. In the Breslin et al. (2004) study, 79.2% of nurses indicated that HWCD improved their workflow. Outcomes on staff workflow are one of the significant considerations examined in any health information technology or ICT project as it affects successful implementation and sustainability of the technology (Henriksen, Dayton, Keyes, Carayon, & Hughes, 2008).

Enhanced Patient Care Quality

In AHRQ's 2008 publication, *Patient Safety and Quality: An Evidence-Based Handbook for Nurses*, the IOM work groups postulated that "quality care is safe, effective, patient centered, timely, efficient, and equitable" (Mitchell, 2008, p. 1). Acute care environments are information-rich settings that rely heavily on information transfer, and unnecessary delays can lead to adverse outcomes (Cain & Haque, 2008; Cooney et al., 2018). The first HWCD study yielded data that showed 65% of nurses and 80% of unit secretaries positively expressed having the ability to deliver higher quality patient care with the use of the HWCD (Breslin et al., 2004). This early study was further validated by the results in two other studies conducted by Vandenkerkhof et al. (2009) and De Grood et al. (2012). Another corroborating study to this, conducted by Wilson et al. (2013), showed that ICU nurses perceived continuity of care was accomplished from the HWCD use. Data in the ED physician cohort study implied an increase in patient safety as frequent communication increased between the provider team (Ernst et al., 2013).

Summary

There is a limited but growing body of evidence supporting the quantitative impact of the HWCD use in improving communication, increasing workflow efficiency, and enhancing patient care quality, as presented in this chapter. Majority of the studies in literature for HWCD impact in acute care settings utilized a qualitative design. Since the project goal was to conduct a quantitative, descriptive, cross-sectional study using a post-implementation survey approach focusing on the three themes presented in this chapter, the decision to replicate the quantitative component of De Grood et al.'s (2012) mixed-methodology study was formulated as these researchers have developed and validated a survey tool designed to evaluate the same three outcome variables.

CHAPTER 3: METHODOLOGY

The focus of this quality improvement project was to assess the staff perceptions on the outcomes of communication, workflow efficiency, and quality of patient care with the use of a hands-free, wireless communicative device. Post-implementation evaluation of the information and communications technology tool provided vital information to organizational leaders to determine whether the organizational goal of improving communication has been met and obtain evidenced-based data to guide leadership decisions for expanding technology use within the organization.

Methodology

Project Design

This quality improvement project used a quantitative, descriptive, cross-sectional study design to assess staff perceptions on the outcomes of communication, workflow efficiency, and patient care quality resulting from the HWCD implementation.

Survey Tool

The project's purpose mirrored the elements measured in the quantitative segment of the mixed-methodology study from De Grood et al. (2012). Both were concentrated on evaluating staff perceptions focused on the outcomes of communication, workflow efficiency, and patient care quality during the post-implementation phase of the HWCD installation. With these similarities, a potential quantitative replication was formulated for a larger population in a broader setting. Permission to use the 10-item survey was obtained from the corresponding author (De Grood et al., 2012) in April 2018 (see Appendix A). The

project evaluation survey included demographic information to present the descriptive data of the population. The one-page paper-and-pen format contained two components: 7-item demographic categories and the 10-item survey statements adopted from De Grood et al. (2012) in a similar 5-point Likert scale (see Appendix B).

Setting and Population

The quality improvement project survey was conducted within two inpatient units in a federal acute care hospital in Northern California: the medical-surgical unit (MSU) and transitional care unit (TCU). A total of 110 healthcare staff from the two units were invited to participate in the anonymous paper survey. The inpatient staff was composed of monitor technicians, nurses, nursing assistants, and unit clerks (or medical support assistants). The introduction letter presented with the survey stipulated the submission of the completed paper survey implied consent to participate. This project utilized a convenience sampling methodology.

Ethical Considerations

Following the organization's research department policies and procedures, a completed research determination checklist form and a brief project proposal were submitted for preliminary review in June 2018 to the organization's research department. In August 2018, the facility's Chief Nurse of Acute Care Services signed a letter of approval and support for the quality improvement project. The organization's Institutional Review Board (IRB) team approved the proposal within the same month. Subsequently, in September 2018, the study was approved by the IRB team at California State University, Fresno.

Data Collection Procedure

Discussion with the respective nurse managers and unit educator were conducted with a presentation of the one-page survey tool and explanation of survey procedures. Participant recruitment was initiated through an email that introduced the project's purpose, benefits, procedural steps, timeline, and incentive including information that completion and submission of the survey form would imply participant consent (see Appendix C). Completion of the form took approximately 2 to 5 minutes. The paper surveys were made available through the unit educator. Staff was invited to participate in the survey during huddles on different days and shifts. Data were collected within four weeks, from October 2 to October 30, 2018.

Potential Benefits

Participation in the survey process provided the inpatient staff with the opportunity to share their feedback and perceptions on the impact of the HWCD use specific to communication, workflow efficiency, and quality of patient care they provide. Survey results are evidence-based data that provided meaningful information for leadership to evaluate the effectiveness of the technology and guide decisions for additional budget allocations for expansion in other organizational areas.

Potential Risks and Management of Risks

Participation was voluntary and anonymous; thus there was no social risk involved or adverse consequences when they chose not to participate. Survey responses were anonymous, so there was no impact to work conditions. Participants were asked for their opinions by rating the impact of their HWCD (Vocera®) use together with some demographic data for descriptive statistics.

Rating the statements may have caused a minimal psychological risk if they led to some discomfort or made the participant feel undecided on how to rate their HWCD experience. To manage this risk, the participants were informed that they were free to refuse to respond to a particular statement that may have caused any discomfort or psychological stress. Because the project did not require any patient care data, physical tasks, or monetary cost from the participants, there were no physical, economic, or legal risks. Completing the survey tool was not time-consuming.

Compensation of Subjects

Participants had the opportunity to enter in a raffle drawing for ten (10) \$10.00 Starbucks gift cards. The random ticket drawing was conducted in the units with the unit educator and staff participating. The list of winning ticket numbers was posted in the staff break rooms with instructions for claiming the prize. The incentive was solely used as a strategy to encourage participation.

Data Processing and Analysis

The survey forms were collected from the designated submission location twice a week for the first two weeks and once a week for the last two weeks of data collection. The paper forms were coded, and the data were entered into the IBM SPSS® Statistics (Version 24.0) software for statistical analysis. The demographic information collected from the population included staff role, age, gender, race, level of education, number of years working in the specific role, and number of years working with the organization. Descriptive statistics calculating for frequencies was performed on the demographic data obtained.

To replicate De Grood et al.'s (2012) methodology, the Pearson correlation coefficient was utilized to analyze the relationships of communication and

workflow efficiency to the quality of patient care. To expand on the 2012 study and provide additional knowledge, the relationship between communication and workflow efficiency was examined using the same statistical method.

Summary

To answer the research question: does the implementation of the HWCD (Vocera®) technology positively impact staff perceptions on communication, workflow efficiency, and patient care quality, a quality improvement initiative using convenience sampling in two acute care units was conducted to assess the perceptions of nurses, nursing assistants, and unit clerks. The project utilized a quantitative, descriptive, cross-sectional study design. The paper survey form contained seven demographic categories and a 10-item survey adopted from De Grood et al. (2012) with written permission. Participation was voluntary and anonymous. The data collection period was four weeks. Collected forms were coded, and data entered into the IBM SPSS® (24.0) software for data analysis.

CHAPTER 4: RESULTS

This quality improvement project evaluated the impact of the HWCD technology by obtaining staff perceptions on the outcomes of communication, workflow efficiency, and patient care quality. The first part of the survey instrument collected the participants' demographic data for a better understanding of the target sample through descriptive statistics. The demographic data collected included staff role, age, gender, race, level of education, number of years working in the specific role, and number of years working with the current employer (see Appendix B). The second part of the survey tool listed ten statements focused on evaluating the use of the HWCD and its impact on communication, workflow efficiency, and patient care quality based on staff perceptions. The 10-item survey statements were obtained with permission from the De Grood et al. (2012) study (see Appendix A) that utilized a similar 5-point Likert scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neither agree nor disagree*, 4 = *agree*, and 5 = *strongly agree*). The first two questions assessed perceptions on improved communication, the next four questions addressed perceptions on the improvement of workflow efficiency, and the last four questions evaluated perceptions on the improvement of the quality of patient care provided (see Appendix B).

Within the four-week data collection period, a total of 84 ($n = 84$) paper survey forms were collected garnering a total response rate of 76.4% from a total population size of 110 ($N = 110$). Data from the survey form were entered into IBM SPSS® (Version 24) software for statistical analysis. Descriptive statistics were used to calculate the frequency results for all demographic categories and the ten survey statements. To explore the relationships across the three improvement measures, Pearson correlation coefficient was conducted between communication

and workflow efficiency, communication and patient care quality, and workflow efficiency and patient care quality.

Demographic Results

Of the 84 (76.9%) surveys returned, there were missing data within the categories. Table 1 shows the frequencies for the valid and missing data for each demographic category.

Table 1

Frequencies of Demographic Categorical Results with Missing Data

	Role	Age Group	Gender	Race	Education Level	Years in Role	Years with Employer
Valid (n)	83	77	75	79	81	83	80
Missing (n)	1	7	9	5	3	1	4

Demographic Data

The healthcare team members surveyed from MSU and TCU were medical support assistants (MSAs) (commonly known as unit clerks), monitor technicians, nurses, and nursing assistants. As seen in Table 2, of the four roles, the nurses comprised the majority of the sample surveyed and had the highest number of respondents at 59% ($n = 49$). Majority of the respondents were under the age of 30 (29%, $n = 22$), of the female gender (72%, $n = 54$), from the Asian or Asian American race (44%, $n = 35$), attained a bachelor's degree (61%, $n = 49$), working in their identified role between 1 to 4 years (34%, $n = 28$), and, working with the current organization between 1 to 4 years (45%, $n = 36$).

Table 2

Frequencies and Percentage Results for the Demographic Data Categories

Demographic	Frequency (<i>n</i>)	Percentage (%)
Role		
Monitor Technicians	5	6%
MSAs (Unit Clerk)	5	6%
Nurse	49	59%
Nursing Assistant	24	29%
Age Group		
20-29	22	29%
30-39	18	23%
40-49	20	26%
50-59	9	12%
60-69	7	9%
70+	1	1%
Gender		
Female	54	72%
Male	21	28%
Race		
American Indian or Alaskan Native	1	1%
Asian or Asian American	35	44%
Black or African American	7	9%
Caucasian or White	18	23%
Hawaiian or Other Pacific Islander	6	8%
Hispanic or Latino	8	10%
From multiple races	4	5%
Education Level		
High School / GED	15	18%
Associate's Degree	10	12%
Bachelor's Degree	49	61%
Master's Degree	7	9%
Years in Role		
< 1	10	12%
1 - 4	28	34%
5 - 14	25	30%
15 - 24	12	14%
25 - 34	8	10%
Years with Employer		

< 1	14	18%
1 - 4	36	45%
5 - 14	20	25%
15 - 24	10	12%

Survey Results

Frequencies of Survey Statements

The frequency results for each of the ten statements presented in the evaluation survey tool was outlined and presented in Table 3. The summary results revealed that majority of the sample had positive perceptions for each variable investigated. There were no missing data on any of the ten statements from the survey instrument.

Table 3

Frequencies of Staff Perceptions on Improved Communication, Workflow Efficiency, and Patient Care Quality

Because of Vocera being used on the unit...	SA / A	NAD	D / SD
Improvements in communication			
I can communicate better with others I work with than before.	86%	12%	2%
The relationships among different healthcare providers have been improved.	64%	29%	7%
Improvements in work efficiency			
I can accomplish my work tasks more quickly than before.	75%	19%	6%
I spend less time trying to locate people than I did before.	88%	10%	2%
I find Vocera helps me to accomplish my tasks more quickly than I did before.	71%	23%	6%
I find Vocera allows me to spend more time with patients than I did before.	54%	33%	13%
Improvements in quality of patient care			
The care I provide my patients has been improved.	69%	24%	7%

The quality of care I provide to patients is better than before.	64%	25%	11%
The quality of care I provide to patients is safer than before.	69%	24%	7%
I feel I provide safer care to my patients.	71%	24%	5%

Note. SA = Strongly Agree; A = Agree; NAD = Neither Agree nor Disagree; D = Disagree; SD = Strongly Disagree. Adapted from “Evaluation of a hands-free communication device in an acute care setting: A study of healthcare providers’ perceptions of its performance,” by J. De Grood, J. E. Wallace, S. P. Friesen, D. E. White, J. G. Gilmour, and J. B. Lemaire, 2012, *CIN: Computers, Informatics, Nursing*, 30, p. 153.

Relationship between Variables

Since the purpose of this quality improvement project was to assess staff perceptions on the outcomes of communication, workflow efficiency, and patient care quality resulting from the HWCD implementation, the Pearson correlation coefficient was used to analyze the relationship between each pair of variables. De Grood et al. (2012) used the same statistical analysis to verify the relationship between communication and patient care quality and workflow efficiency and patient care quality. Using the same statistical methodology with the same survey tool can yield validating results, which strengthens the generalizability of the results on the impact of the communication technology when used by acute care clinical staff. Polit and Beck (2010) reiterated the significance of generalizability when it comes to appraising the quality of quantitative research. To expand further from the De Grood et al. (2012) study, the relationship between communication and workflow efficiency was analyzed using the Pearson correlation coefficient to determine how these two improvement measures influence each other.

The descriptive statistics for the three improvement measures: communication, workflow efficiency, and patient care quality, were outlined in Table 4.

Table 4

Descriptive statistics for Perceptions on Communication, Workflow Efficiency, and Patient Care Quality

		Communication	Workflow Efficiency	Patient Care Quality
N	Valid	84	84	84
	Missing	0	0	0
	Mean	4.0119	4.0179	3.7798
	Standard Deviation	0.74436	0.80733	0.92685

The correlation analysis yielded a positive correlation between communication and patient care quality ($r = 0.748, p = \leq .001$) as depicted on the scatterplot illustrated in Figure 3. There was a positive correlation between workflow efficiency and patient care quality ($r = 0.849, p = \leq .001$) as displayed on the scatterplot in Figure 4. Lastly, there was a positive correlation between communication and workflow efficiency ($r = 0.847, p = \leq .001$) as depicted in the scatterplot exhibited in Figure 5. Overall, the correlation analyses revealed strong positive correlations across the relationships of the three improvement measures suggesting that based on staff perceptions

- quality of patient care delivered was enhanced as communication improved,
- quality of patient care delivered was enhanced as workflow efficiency increased, and
- workflow efficiency increased as communication improved.

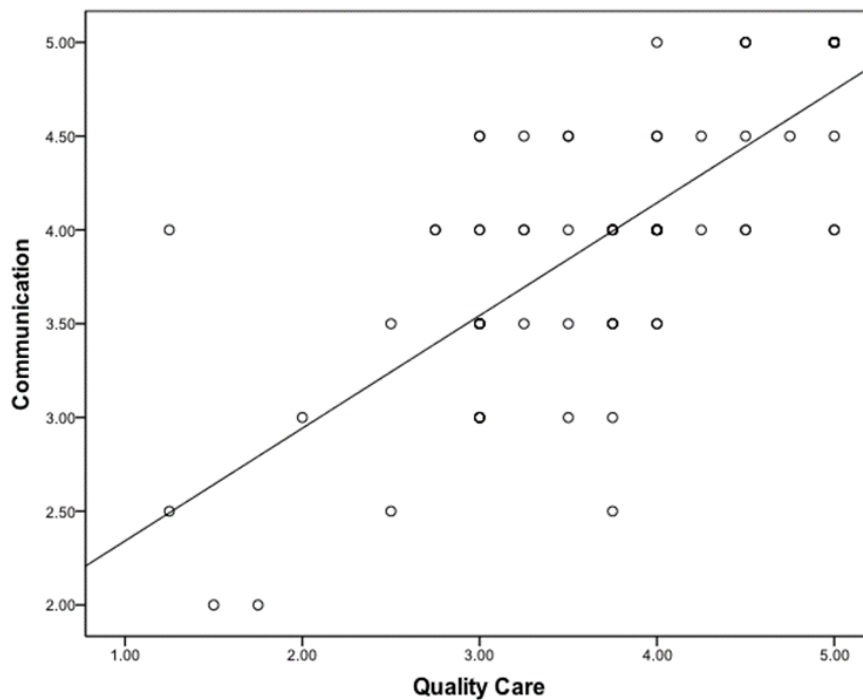


Figure 3. Scatterplot for Communication and Patient Care Quality.

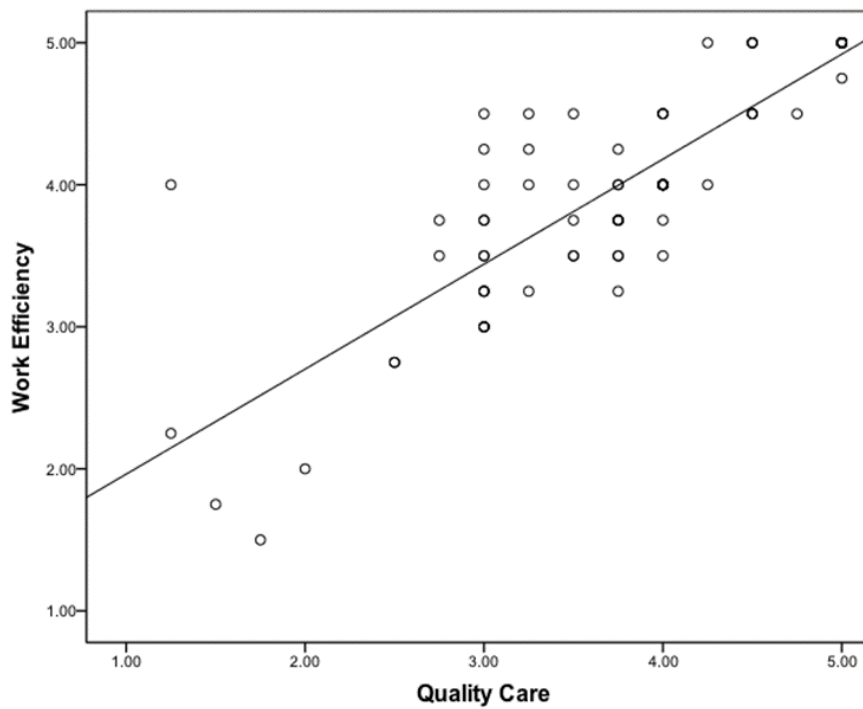


Figure 4. Scatterplot for Workflow Efficiency and Patient Care Quality.

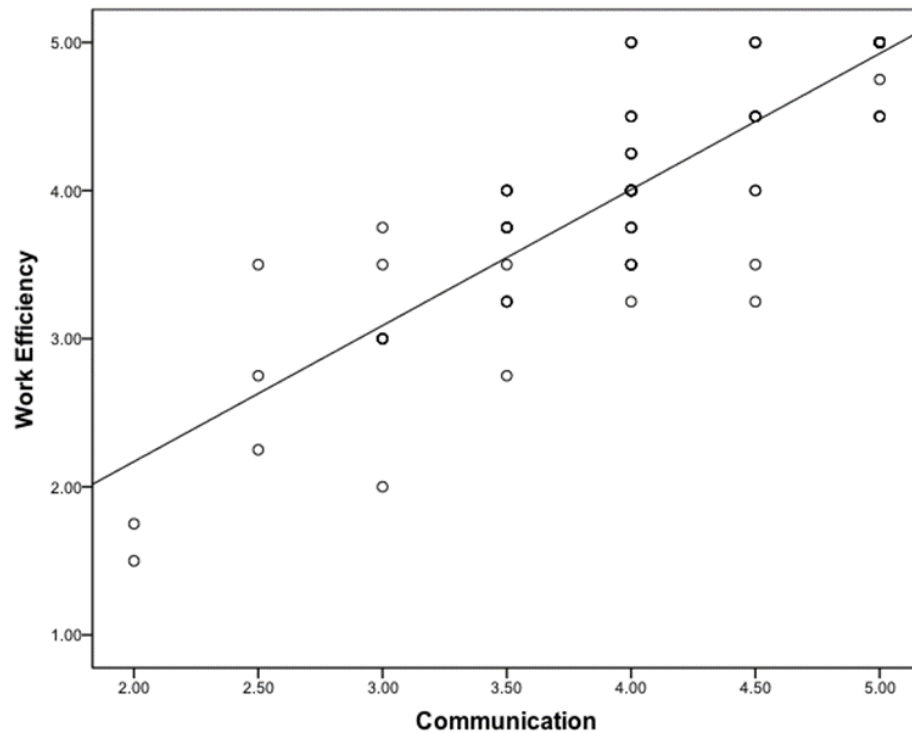


Figure 5. Scatterplot for Improved Communication and Workflow Efficiency.

Summary

Using the same survey instrument from the De Grood et al. (2012) study with a larger sample and analyzing similar outcomes, it was logical to utilize the same statistical analysis for validity and generalizability of results. Based on staff perceptions, positive correlations were seen across the relationships between the three improvement variables. The frequencies table revealed the positive perceptions from the MSU and TCU healthcare team regarding their use of the HWCD technology. The implications of the data analysis results can serve as evidence-based data to guide leadership in budget decisions for technology expansion and the informatics nursing specialists team in developing strategies to enhance optimal use of the communication technology.

CHAPTER 5: DISCUSSION

The primary purpose of this quality improvement project was to assess the impact resulting from the implementation of the HWCD (Vocera®) technology. The evaluation methodology measured three outcome variables: communication, workflow efficiency, and patient care quality based on staff perceptions. Installation of the HWCD infrastructure for use within the acute care units of a Northern California federal hospital entailed more than a year of project work. It involved extensive collaboration with vendor staff and internal coordinated effort across multiple departmental teams that included the information technology staff, the Biomedical engineering group, and the nursing informatics team. Since the implementation, executive leadership has received requests from other departments (e.g., surgical services, gastrointestinal laboratory department, and primary care clinics) to have the HWCD technology installed in their respective areas based on the positive feedback from the inpatient healthcare team. The HWCD technology remains to be a distinctive information and communications technology of its kind, thus, requiring a sizeable portion of an organization's capital budget.

The evaluation of staff perceptions and satisfaction from two of the largest inpatient areas, the MSU and TCU, within the federal facility 20 weeks after HWCD implementation was conducted using a validated, structured tool replicating use in a previous clinical study (De Grood et al., 2012). The positive outcomes from the survey results serve as evidence-based data capable of supporting the executive leadership's decision-making process in allocating additional capital budget for technology expansion. Joint Commission (2009) emphasized the responsibility of healthcare leadership to continuously improve

communication processes as it is ubiquitous in a multidisciplinary healthcare environment aiming to provide safe and high-quality care.

The evaluation survey data showed that the MSU and TCU healthcare staff strongly believed that the use of the HWCD technology promoted better communication with others, improved the efficiency of their workflow, especially in saving time locating colleagues, and it enhanced the quality of patient care they delivered. Positive results were anticipated, but not to the extent the survey generated. The HWCD was expected to deliver the value of efficiency because of the time it saves staff from walking back and forth to the nursing stations to make calls or physically searching for others around the unit to relay information (Breslin et al., 2004; Cooney et al., 2018; Dunphy et al., 2011; Friend et al., 2017; Richardson & Ash, 2010; Richardson et al., 2011; Vandenkerkhof et al., 2009; Wilson et al., 2013). These communication barriers may lead to a care quality or safety risk (Cooney et al., 2018; Pemmasani et al., 2014; Welton et al., 2006). The ability of the device to provide instant and bidirectional communication was its most compelling advantage (Dunphy et al., 2011; Erst et al., 2013; Fang et al., 2018; Friend et al., 2017). Its features that allow the user to accept calls hands-free, record messages, and reminders, have the flexibility to call people by role, send announcements (broadcasts) to specific groups, and its lightweight design were additional benefits strengthening its value.

Statistical analysis yielded strong positive relationships between the measured variables (communication and quality of patient care; workflow efficiency and quality of patient care; communication and workflow efficiency). These data imply that the HWCD system has shown to be an invaluable communications tool, which influenced the improvement of staff workflow efficiency, staff perceptions of quality, and safe patient care delivered. These

outcomes corroborate the evaluation results from the De Grood et al. (2012) study and were consistent with the other clinical evaluation studies conducted in various clinical settings (Dunphy et al., 2011; Ernst et al., 2013; Jacques et al., 2006; Richards & Harris, 2011; Richardson et al., 2011; Vandenkerkhof et al., 2009). This study provided additional evidence to the growing body of literature focused on the impact of the HWCD system in a complex healthcare environment.

Limitations

There were limitations recognized for this study. The first limitation relates to the organization of the survey statements. On the table listing the ten evaluative statements for Likert scale scoring, the variable being measured was listed as a header caption above the questions that belong under that outcome category (see Appendix B). The identification of the variables may have potentially influenced a participant's perception as they were scoring each statement. Another limitation is that this study only focused on the post-implementation aspect of the project. Evaluating staff perceptions regarding communication processes before the HWCD implementation could potentially provide essential information that may highlight other factors that can improve communication channels. The time frame set for project completion did not allow for the inclusion of the HWCD pre-implementation phase. Finally, the use of selected hospital units and convenience sampling limited this study as this may make the results less generalizable to other units within the federal facility or other healthcare organizations.

Implications for Nursing Informatics

The nursing informatics team was an integral part of the project team from the planning phase, to the implementation period, and post-implementation evaluation of the HWCD technology. The entire project necessitated more than a

year of weekly meetings and extensive work that included workflow analyses for the various clinical roles (nurses, respiratory therapists, nursing assistants, unit clerks, and monitor technicians) that were identified as the end-users of the HWCD system. The nursing informatics team served as the clinical subject matter experts and liaisons for both the nursing and ancillary departments to complete pre-implementation project tasks. Once the technology was deployed, the maintenance and support of the HWCD system database was a shared responsibility between the nursing informatics team and the Biomedical engineering team. The nursing informatics team continues to serve as the primary support to the nursing staff and nursing management for any questions or issues related to the HWCD use.

The evaluation survey results served as evidence-based data and are vital tools that can be utilized by the nursing informatics team for analyses and deeper dives into the usability of the HWCD tool. A follow-up survey to identify usage gaps can be developed to assist the nursing informaticists in pinpointing areas of improvement to assist staff in fully maximizing the technology's benefits and leveraging it to influence positive patient outcomes.

Future Study

It would be beneficial to conduct further research in many areas related to this study. First, further inquiry could be performed in the other acute care areas that used the HWCD technology (i.e., intensive care unit and the emergency department) to determine if their results would confirm similar outcomes from the MSU and TCU areas. Second, further statistical analysis could be conducted to determine if the survey results were related to any of the demographic factors. In this study, the majority of the participants belong to younger generations, under

the age of 30 (26%), and have baccalaureate degrees (58%). It would be beneficial to analyze the relationship of these factors to the results as it may provide insights on primary elements that lead to successful acceptance and usage of this type of technology. Third, conducting a longitudinal study may be fruitful to produce validating or opposing results. Fourth, a study focusing on disadvantages and concerns related to the use of the HWCD tool may underscore some areas of improvement previously overlooked. Identification and resolving concerns will likely increase technology adoption. Lastly, further research on the impact of the HWCD against specific patient outcomes such as hospital fall rates and inpatient call responsiveness are possible and would be relevant to explore since the HWCD technology can be capable of integrating with a hospital's nurse call system in an inpatient unit.

Conclusion

Bidirectional, instantaneous, and efficient communication with healthcare team members is critical in a complex inpatient environment aiming for high quality and safe care (AHRQ, 2017; Cooney et al., 2018; De Grood et al., 2012; Dunphy et al., 2011; Ernst et al., 2013; Fang et al., 2018; Friend et al., 2017; Joint Commission, Wilson et al., 2014). Joint Commission (2009) emphasized that it is every healthcare leadership's responsibility to champion effective and timely communication by building communication channels and promoting teamwork that nurtures robust communication and information exchange with a multidisciplinary healthcare team. Joint Commission also recommended that organizations must expend time and resources to measure the outcomes of communication initiatives. The evaluation process allows the end users, the healthcare staff, to voice concerns and issues, give feedback, or make suggestions.

A nursing informatics DNP quality improvement project was executed to assess staff perceptions focusing on the outcomes of communication, workflow efficiency, and patient care quality after the implementation of a hands-free, wireless communication device (HWCD) in a federal acute care facility utilizing a survey approach. Staff perceptions were voluntarily collected using a validated survey tool (De Grood et al., 2012). More than three-quarters of the population sampled (76%) responded. Majority of the respondents provided positive survey feedback. Statistical analysis yielded a positive correlation among the three variables measured – communication and patient care quality, workflow efficiency and patient care quality, communication and workflow efficiency. The survey data affirmed the executive leadership’s initial decision to invest a portion of the capital budget in the installation of the HWCD technology within the inpatient setting. The positive survey results also served as evidence-based data to justify additional budget allocation for expansion in other departments within the organization. Finally, the evaluation outcomes substantiated the results of other HWCD studies, thereby expanding evidence-based data specific to the healthcare use of this communications tool.

REFERENCES

REFERENCES

- Agarwal, R., Sands, D. Z., & Schneider, J. D. (2010). Quantifying the economic impact of communication inefficiencies in U.S. hospitals. *Journal of Healthcare Management, 55*(4), 265-281.
- Agency for Healthcare Research and Quality (AHRQ). (2019, January). *Communication between clinicians*. Retrieved from AHRQ's Patient Safety Network: <https://psnet.ahrq.gov/primers/primer/26/communication-between-clinicians>
- Bozak, M.G. (2003). Using Lewin's force field analysis in implementing a nursing information system. *CIN: Computers, Informatics, Nursing, 21*(2), 80-85.
- Breslin, S., Greskovich, W., & Turisco, F. (2004). Wireless technology improves nursing workflow and communications. *CIN - Computers Informatics Nursing, 22*(5), 275-281. <https://doi.org/10.1097/00024665-200409000-00007>
- Bronk, K.L. (2017, September). *The Joint Commission issues new sentinel event alert on inadequate hand-off communication: Communication failures a major contributor to adverse events in health care*. Retrieved from the Joint Commission website: https://www.jointcommission.org/the_joint_commission_issues_new_sentinel_event_alert_on_inadequate_hand-off_communication/
- Burnes, B. (2004). Kurt Lewin and the planned approach to change: A re-appraisal. *Journal of Management Studies, 41*(6), 977-1002.
doi:10.1111/j.1467-6486.2004.00463.x

- Burnes, B., & Bargal, D. (2017). Kurt Lewin: 70 years on. *Journal of Change Management, 17*(2), 91-100.
<http://dx.doi.org/10.1080/14697017.2017.1299371>
- Cain, C., & Haque, S. (2008). Organizational workflow and its impact on work quality. In R. G. Hughes (Ed.), *Patient safety and quality: An evidence-based handbook for nurses* [E-reader version] (pp. 217-244). Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/21328752>
- Cooney, H. J., Banbury, H. E., & Plunkett, A. C. (2018). Impact of a hands-free wireless communication device on communication and clinical outcomes in a pediatric intensive care. *Pediatric Quality and Safety (PQS), 3*(2). doi: 10.1097/pq9.0000000000000074
- De Grood, J., Wallace, J. E., Friesen, S. P., White, D. E., Gilmour, J. G., & Lemaire, J. B. (2012). Evaluation of a hands-free communication device in an acute care setting: A study of healthcare providers' perceptions of its performance. *CIN: Computers, Informatics, Nursing, 30*(3), 148-156.
- Dunphy, H., Finlay, J. L., Lemaire, J., MacNairn, I., & Wallace, J. E. (2011). Hands-free communication technology: A benefit for nursing? *Journal of Nursing Administration, 41*(9), 365–368.
<https://doi.org/10.1097/NNA.0b013e31822a7301>
- Ernst, A. A., Weiss, S. J., & Reitsema, J. A. (2013). Does the addition of Vocera hands-free communication device improve interruptions in an academic emergency department? *Southern Medical Journal, 106*(3), 189-195.

- Fang, Z. A., Patil, T., Belitskaya-Levy, I., Yeung, M., Posley, K., & Allaudeen, N. (2018). Use of a hands free, instantaneous, closed-loop communication device improves perception of communication and workflow integration in an academic teaching hospital: A pilot study. *Journal of Medical Systems*, 42(4), 1-6. <https://doi.org/10.1007/s10916-017-0864-7>
- Friend, T. H., Jennings, S. J., Copenhaver, M. S., & Levine, W. C. (2017). Implementation of the Vocera communication system in a quaternary perioperative environment. *Journal of Medical Systems*, 41(6). <https://doi.org/10.1007/s10916-016-0652-9>
- Health Management Technology, HMT Mag. (2011, March 1). *Ensuring safety through wireless communication*. Retrieved from <https://www.healthmgtech.com/ensuring-safety-through-wireless-communication.php>
- Henriksen, K., Dayton, E., Keyes, M. A., Carayon, P., & Hughes, R. (2008). Understanding adverse events: A Human Factors Framework. In R. G. Hughes (Ed.), *Patient safety and quality: An evidence-based handbook for nurses* [E-reader version] (pp. 67-85). Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/21328752>
- Institute of Medicine (IOM). (2000). *To err is human: Building a safer health system* [E-reader version]. L.T. Kohn, J.M. Corrigan, & M.S. Donaldson (Eds.). Washington, D.C: National Academy Press.

- Jacques, P. S., France, D. J., Pilla, M., Lai, E., & Higgins, M. S. (2006). Evaluation of a hands-free wireless communication device in the perioperative environment. *Telemedicine Journal and E-Health: The Official Journal of the American Telemedicine Association*, 12(1), 42–49. <https://doi.org/10.1089/tmj.2006.12.42>
- Joch, A. (2004). Can we talk? Hospitals combine technologies to increase communication. *Materials Management in Healthcare*, 13(8), 36.
- Joint Commission. (2007). *Improving America's hospitals: The Joint Commission's annual report on quality and safety – 2007*. Retrieved from https://www.jointcommission.org/improving_americas_hospitals_the_joint_commissions_annual_report_on_quality_and_safety_-_2007/
- Joint Commission. (2017, December). *Facts about the national patient safety goals*. Retrieved from https://www.jointcommission.org/facts_about_the_national_patient_safety_goals/
- Joslin, J.D., Goldberger, D., Johnson, L., & Waltz, D.P. (2016). Use of the Vocera communications badge improves public safety response times. *Emergency Medicine International*, 2016. <http://dx.doi.org/10.1155/2016/7158268>
- Kaminski, J. (2011). Theory applied to informatics: Lewin's change theory. *Canadian Journal of Nursing Informatics*, 6(1). Retrieved from <http://cjni.net/journal/?p=1210>

- Mitchell, P. H. (2008). Defining patient safety and quality care. In R. G. Hughes (Ed.), *Patient safety and quality: An evidence-based handbook for nurses* [E-reader version] (pp. 1-5). Retrieved from <https://www.ncbi.nlm.nih.gov/pubmed/21328752>
- Pemmasani, V., Paget, T., van Woerden, H. C., Minamareddy, P., & Pemmasani, S. (2014). Hands-free communication to free up nursing time. *Nursing Times*, *110*(13), 12–14.
- Propp, K. M., Apker, J., Zabava Ford, W. S., Wallace, N., Serbenski, M., & Hofmeister, N. (2010). Meeting the complex needs of the health care team: Identification of nurse—team communication practices perceived to enhance patient outcomes. *Qualitative Health Research*, *20*(1), 15–28. <https://doi.org/10.1177/1049732309355289>
- Richards, J. D., & Harris, T. (2011). Beam me up Scotty! Impact of personal wireless communication devices in the emergency department. *Emergency Medicine Journal*, *28*(1), 29–32. <https://doi.org/10.1136/emj.2009.082370>
- Richardson, J. E., & Ash, J. (2008). The effects of hands free communication devices on clinical communication: Balancing communication access needs with user control. *AMIA ... Annual Symposium Proceedings / AMIA Symposium. AMIA Symposium*, 621–625. Retrieved from <http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=2656106&tool=pmcentrez&rendertype=abstract>

- Richardson, J. E., & Ash, J. S. (2010). The effects of hands-free communication device systems: Communication changes in hospital organizations. *Journal of the American Medical Informatics Association*, 17(1), 91–98.
<https://doi.org/10.1197/jamia.M3307>
- Richardson, J. E., Shah-Hosseini, S., Fiadjoe, J. E., Ash, J. S., & Rehman, M. A. (2011). The effects of a hands-free communication device system in a surgical suite. *Journal of the American Medical Informatics Association*, 18(1), 70–72. <https://doi.org/10.1136/jamia.2009.001461>
- Shirey, M.R. (2013). Lewin’s theory of planned change as a strategic resource. *Journal of Nursing Administration*, 43(2), 69-72. doi: 10.1097/NNA.0b013e31827f20a9
- Sutherland, K. (2013). Applying Lewin’s change management theory to the implementation of bar-coded medication administration. *Canadian Journal of Nursing Informatics*, 8(1&2). Retrieved from <http://cjni.net/journal/?p=2888>
- Stevens, J. D., Bader, M. K., Luna, M. A., & Johnson, L. M. (2011). Cultivating quality: Implementing standardized reporting and safety checklists. *American Journal of Nursing*, 111(5), 48-53. doi: 10.1097/01.NAJ.0000398051.07923.69
- University Hospitals Pilots Hands-Free Communications Device. (2004). *Journal of Cardiovascular Management*, 15(2), 26-27.

- Vandenkerkhof, E. G., Hall, S., Wilson, R., Gay, A., & Duhn, L. (2009). Evaluation of an innovative communication technology in an acute care setting. *CIN - Computers Informatics Nursing*, 27(4), 254–262. <https://doi.org/10.1097/NCN.0b013e3181a91bf6>
- Vocera. (n.d.). *Vocera B3000n communication badge*. Retrieved from <https://www.vocera.com/resource/vocera-b3000n-communication-badge>
- Welton, J. M., Decker, M., Adam, J., & Zone-Smith, L. (2006). How far do nurses walk? *Medsurg Nursing: Official Journal of the Academy of Medical-Surgical Nurses*, 15(4), 213–216. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/16999182>
- Wilson, R., Duhn, L., Gonzalez, P., Hall, S., Chan, Y. E., & VanDenKerkhof, E. G. (2013). Wireless communication in clinical environments with unique needs. *Journal for Healthcare Quality*, 36(6), 24-32.

APPENDICES

APPENDIX A: SURVEY TOOL PERMISSION



Hyacinth Carreon <hcarreon@mail.fresnostate.edu>

Permission for Questionnaire Use

Jean <jwallace@ucalgary.ca>
To: Hyacinth Carreon <hcarreon@mail.fresnostate.edu>

Mon, Apr 23, 2018 at 7:46 PM

Hi Hyacinth, thank you for your interest in our research. You can use or adapt any of the items listed in the article (Table 2) with a citation to that article.

All the best in your research,

Jean

On 2018-04-23 12:45 PM, Hyacinth Carreon wrote:

Dear Dr. Wallace,

My name is Hyacinth Carreon, a nurse informaticist and current doctoral student from the California State University Northern California Consortium DNP Program. I am working on my DNP project and found your 2012 article, Evaluation of a Hands-Free Communication Device in an Acute Care Setting, during my literature review. I would like to seek your permission to adopt your questionnaire to survey the perceptions of the healthcare team on the impact of using the Vocera system. We are currently going through a rolling go-live project for this technology. My project design is only focused on studying the quantitative aspect with a survey due to the narrow data collection timeframe. May I please have your permission to adopt your questionnaire?

Your consideration and help is highly appreciated.

Respectfully,

Hyacinth Carreon, MSN, RN-BC, CMSRN, CPHIMS
Doctoral Student
California State University Northern California Consortium Program

--
Jean E. Wallace, PhD
Professor, Department of Sociology
University of Calgary
2500 University Drive NW
Calgary, Alberta T2N 1N4
Phone: 403-220-6515
email: jwallace@ucalgary.ca
<http://soci.ucalgary.ca/profiles/jean-wallace>

APPENDIX B: HWCD SURVEY TOOL

Vocera Evaluation Survey for MSU & TCU Staff

1. Role: MSA Monitor Tech Nurse Nursing Assistant
2. Age: 20-29 30-39 40-49 50-59 60-69 70+
3. Gender: Female Male
4. Race:
- American Indian or Alaskan Native Hawaiian or Other Pacific Islander
- Asian or Asian American Black or African American
- Hispanic or Latino Caucasian or White
- From multiple races
5. Level of Education: High School/GED Associate's Bachelor's Master's
6. Number of Years Working in your Role (#1 question):
- < 1 1-4 5-14 15-24 25-34 35+
7. Number of Years Working with this Employer:
- < 1 1-4 5-14 15-24 25-34 35+

	Because of Vocera being used on the unit...	Strongly Disagree	Disagree	Neither Agree nor Disagree	Agree	Strongly Agree
	Improvements in communication					
1	I can communicate better with others I work with than before.	1	2	3	4	5
2	The relationships among different healthcare providers have been improved.	1	2	3	4	5
	Improvements in work efficiency					
3	I can accomplish my work tasks more quickly than before.	1	2	3	4	5
4	I spend less time trying to locate people than I did before.	1	2	3	4	5
5	I find Vocera helps me to accomplish my tasks more quickly than I did before.	1	2	3	4	5
6	I find Vocera allows me to spend more time with patients than I did before.	1	2	3	4	5
	Improvements in quality of patient care					
7	The care I provide my patients has been improved.	1	2	3	4	5
8	The quality of care I provide to patients is better than before.	1	2	3	4	5
9	The quality of care I provide to patients is safer than before.	1	2	3	4	5
10	I feel I provide safer care to my patients.	1	2	3	4	5

Adopted with permission from De Grood et al. (2012)

APPENDIX C: INTERNAL EMAIL SURVEY INTRODUCTION

September 24, 2018

Dear MSU and TCU Colleagues:

You are invited to voluntarily participate in a quality improvement survey assessing staff perceptions on the outcomes of *communication, workflow efficiency, and patient care quality* resulting from the use of hand-free, wireless communication device (Vocera system).

As a valued member of the inpatient healthcare team, your input is crucial in the post-implementation evaluation of the technology as you deliver care to our Veteran patients.

I encourage you to complete the one-page paper survey that will be available in your nursing units or through your unit educator. No personal identifiers will be obtained on the survey.

Confidentiality of responses will be observed at all times so please place your completed form inside the envelope provided and submit to the designated area for Vocera survey submission. Submission of completed forms will imply consent to participate.

As an incentive for your time and input, participants who submit a completed survey will be given a raffle ticket for a chance to win one \$10.00 Starbucks gift card. Ten (10) gift cards will be raffled when the survey period closes. Announcement to follow on the venue of the raffle drawing. Winning ticket numbers will be posted in your unit breakroom with instructions on how to claim the prize.

Please feel free to contact me for any questions or concerns regarding this survey project. Thank you for your support!

Respectfully,
Hyacinth Carreon, MSN, RN-BC, CMSRN, CPHIMS
Nurse Informaticist/BCMA Coordinator
Ext. # 1-9341