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THE DEVELOPMENT OF A WAYFINDING SMART PHONE APPLICATION AS A LARGE HEALTHCARE FACILITY INVESTMENT OPPORTUNITY

by

Jessie Fortson Marshall

A Capstone Project
Submitted to the Graduate School,
the College of Nursing,
and the Department of Advanced Practice
at The University of Southern Mississippi
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Nursing Practice

December 2017

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2017

Published by the Graduate School

THE UNIVERSITY OF SOUTHERN MISSISSIPPI®

ABSTRACT

THE DEVELOPMENT OF A WAYFINDING SMART PHONE APPLICATION AS A LARGE HEALTHCARE FACILITY INVESTMENT OPPORTUNITY

by Jessie Fortson Marshall

December 2017

Health care is a continually growing field. New hospitals are constantly being built, while older facilities are experiencing renovation and expansion. With this growth comes a set of difficulties for patients as they try to navigate through large, multi-building facilities. Most large facilities have multiple parking garages, numerous buildings, and medical towers with an unending number of floors. Patients are forced to rely on directional signage to find their destination that is often insufficient. Attempting to navigate through large facilities is often overwhelming for visitors leading to frustration and stress.

New technology has allowed a convenient solution to this problem using visitors' personal smart phones. NaviHealth is a wayfinding smart phone application that has been created to safely assist visitors in navigating though healthcare facilities. The application gives step-by-step, real-time navigation through parking areas, buildings, floors, and even to the facility itself.

The purpose of this Doctor of Nursing Practice (DNP) project is to develop a wayfinding smart phone application, NaviHealth, for a large healthcare facility to decrease visitor stress and hospital costs, while improving patient satisfaction. The application was presented to a large healthcare organization in South Mississippi as an investment opportunity. Participants of the project were six employees of the

organization's marketing department. After a presentation discussing NaviHealth, participants completed a Likert-type evaluation tool to assess the organization's interest in the investment and implementation of the application. Open-ended questions were also competed, and qualitative data was collected.

Results of this project determined that although the application showed many positive benefits for the facility, the willingness to further pursue the application for investment was strong but not overwhelmingly unanimous. Changes to the application were recommended by participants to improve the likelihood of application investment.

ACKNOWLEDGMENTS

My sincere appreciation goes to Dr. Patsy Anderson, my committee chair, and committee members, Dr. Allan Lovern and Dr. Cathy Hughes, for their encouragement and guidance throughout this DNP project. I give them my gratitude and thanks for their continuous support, expertise, and advise that allowed me to complete this DNP project.

DEDICATION

I dedicate this DNP project to my grandmother, Kay Stokes Rucker. Despite many challenges, she never let disability distract from the importance of her education. Through her, I learned not to bury my potential under excuses. She is loved and idealized. This achievement is for her.

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LIST OF ABBREVIATIONS

BCH	Boston Children's Hospital
CITI	Collaborative Institutional Training Initiative
CMS	Centers for Medicare and Medicaid Services
DNP	Doctor of Nursing Practice
HCAHPS	Hospital Consumer Assessment of Healthcare Providers and Systems
IHD	Institute for Health Design
IHI	Institute for Healthcare Improvement
IPPS	Inpatient Prospective Payment System
IRB	Institutional Review Board
PDSA	Plan-Do-Study-Act
PICO	Population, Intervention, Comparison, Outcome

CHAPTER I – SUMMARY OF EVIDENCE

Clinical Question

Will a large healthcare organization invest in a navigational smart phone application for their facility as a means to effectively assist visitors in finding their desired location?

Problem Statement

Large healthcare facilities are often intimidating and overwhelming for many visitors. Multiple buildings, parking garages, hallways, elevator banks, and departments create a difficult environment to navigate, which leads to lost, confused, and frustrated visitors and patients. The following scenario is an example of the problem that many people face as they visit large hospitals:

It's the day of surgery for Barbara Jones, who has recently been experiencing moderate, lower back pain that radiates down her right leg. She sought medical care a week previously where she learned that she has a "pinched" lumbar nerve that can only be relieved through surgical intervention. Ms. Jones has never had surgery before, rarely is ill, and has never visited the hospital's surgical center. She has been in constant discomfort for over a week, and has received little sleep because of the pain of her condition as well as the anxiety that has accompanied the news of her upcoming surgery. She is overall mentally and physically fatigued. Barbara's sister agreed to drive her to the hospital today for her procedure, and will stay to assist in her recovery. Barbara provides her sister with the stack of paperwork given to her by her surgeon's office that includes her expected arrival time of 6:00 am. The paperwork also states, "Please arrive on time to the Ambulatory Surgery Center of the hospital, located on the second floor, south side

facility entrance. You may park in the visitor-parking garage located on the east side of 14th Avenue, on the corner of 14th Avenue and State Street".

After several missed turns and mild frustration between the two of them regarding directions, they arrive at the unfamiliar hospital 15 minutes behind schedule and have found the correct parking garage on their third try. Barbara's anxiety begins to increase as she gathers her things and searches for a sign that will point them to the second floor entrance. They see a person wearing scrubs that they assume is a hospital employee. Barbara's sister flags down the employee who directs them to the correct entrance and even gives them directions to where the Ambulatory Surgery Center area can be found. "Once you enter here, find the south elevators and take them to the second floor. Take a right out of the elevator and follow the signs," states the hospital employee. They do as the employee says, but once they enter the facility they quickly realize that there are multiple elevator banks with unreadable signs using abbreviations that are unfamiliar to them.

As the women struggle to find their destination in the complex maze of endless hallways, Barbara begins to cry. The lack of sleep, stress of surgery, pain from her condition, and now the anxiety of being lost and late for her procedure has become too much for Barbara. What seemed like a once simple outpatient procedure has turned into a terrible experience for Barbara Jones, and she has yet to even go under the knife.

Background and Significance

For many healthcare workers in a large, multi-building facility, being stopped in the hallways and asked for directions to specific departments, offices, or other desired destinations is a daily task. Even well designed hospital signage and information desks

are not effective in navigating patients, families, and other guests through difficult hospital corridors, parking areas, and buildings (Ulrich, Zimring, Joseph, Choudhary, & Quan, 2004).

Patients who begin their hospital experience lost, late for appointments, and frustrated start their visit with a poor experience and an initial decrease in patient satisfaction that is difficult to recover from. Visitors who are lost in facilities and ask staff members for directions may cost the hospital money related to interruption of staff workflow. Late or missed appointments result in delayed procedures, overtime pay for staff members, and the inability to bill for appointments that did not occur. Wayfinding difficulties visitors experience is likely the root of this problem. Wayfinding is defined as "signs, maps, and other graphic or audible methods used to convey location and directions to travelers" ("Wayfinding", n.d.). Advancements in technology have allowed for navigational assistance in the palm of the patient's hand that can help solve this growing problem.

Purpose of the Project

The intent of this Doctor of Nursing Practice (DNP) project was to develop a wayfinding smartphone application and assess the likelihood of a large healthcare facility to invest in the application for patient navigational use. The application, NaviHealth, was to be used as a tool for the facility to decrease visitor stress and improve overall patient satisfaction. NaviHealth was presented to hospital administration as an investment opportunity.

Needs Assessment

Implementing NaviHealth into large facilities may prove to have great strengths in the healthcare industry. The application can assist patients and visitors of healthcare organizations to locate the hospital and navigate through parking areas, indoor facilities, and between multiple buildings. The application may relieve the stress of unfamiliar facilities with poor or unreadable signs, and assist in finding visitors' desired location through turn-by-turn, real-time navigation.

Adoption of NaviHealth may reduce late or missed appointments and delayed procedures related to patient's inability to find their destination, costing the hospital money through lost payment for services not rendered. Navigation is also available in the palm of the patient's hand, making the service easily accessible. The NaviHealth application is free to download to an already purchased smart phone, meaning there is no cost to the patient for use. There is currently no facility in the city of focus, or surrounding areas that offers this service to patients and visitors. The intimidation of navigating through a large facility may be reduced if the patient were to utilize NaviHealth's services. There may also be improved staff workflow for the facility due to a reduction in hospital staff being stopped to provide directions. Free guest wifi and installation of Bluetooth navigational beacons at the facility can be used to access navigational capabilities of NaviHealth. Once the user is inside the facility, a data plan is not required.

Although there are many benefits of NaviHealth, weaknesses are also possible. Hospital services beyond navigation are not provided by the application, but are discussed as a future implication. Forty-six percent of Americans do not own a

smartphone (Zickuhr, 2012), and this limited availability may decrease the number of patients capable of application access. Although 44% of Americans do have a smartphone, 25% of owners do not use their navigational services (Zickuhr, 2012). NaviHealth does require Internet access through either cellphone provider networks or facility wifi. The requirement of Internet access may also limit use to visitors based on cell phone reception at particular locations. Problems may also occur if a facility wifi connection becomes inadequate or slow.

NaviHealth is free for customer download, but it will cost the hospital startup and maintenance fees that require adequate funding. NaviHealth was developed at the opportune time for hospitals needing to find cost-effective ways of improving patient satisfaction. Government reimbursement to U.S. hospitals is subject to government administered patient satisfaction survey scores. If patient satisfaction scores are not adequate, hospitals will receive less money (Adamy, 2012).

Technology is also quickly becoming the way that many people communicate and a main source of everyday information. A survey conducted by the Pew Research Center's Internet & American Life Project showed that 44% of Americans own a smartphone with 41% of owners using location-based services (Zickuhr, 2012). Factors that may threaten the development and success of NaviHealth include the increasingly growing number of hospitals that are using wayfinding smart phone applications, which is currently over 50 hospitals in the U.S. Smart phone applications exist that provide more than wayfinding capabilities for patients including lab results and appointment reminders.

Summary of the Evidence

A systematic review of literature was completed in order to plan and develop this doctoral project using the following databases and other resources: Center for Health Design, Journal of Healthcare Management/ American College of Healthcare Executives, MEDLINE and PubMed of the U.S. National Library of Medicine, EBSCO Host, Google Scholar, Medscape, and other evidence based resources. Search terms included: wayfinding, navigation, hospital navigation, hospital signage, hospital directions, patient satisfaction, patient stress, healthcare costs, and healthcare technology. The search resulted in 302 articles, but this number was reduced to 4 relevant articles. Duplicate articles were excluded and articles without full-text availability were excluded. Citation chasing resulted in 14 articles relevant to the project

The PICO (Population, Intervention, Comparison, Outcome) question that directed this review of literature was: When presented to stakeholders within a large healthcare organization (P), will the development of a wayfinding application for smart phones (I), compared to directions given by facility signs and information desks (C), deem likely for organizational investment as a quality improvement plan (O)? The review was used to search for evidence-based research and literature that investigates topics related to wayfinding applications. Areas searched included wayfinding's effects on patient satisfaction and visitor stress, whether navigational technology is utilized by the public, the cost effectiveness of wayfinding applications, and whether current hospital signage is sufficient.

Ineffective Signage

When researching the topic of current hospital signage within healthcare organizations, a number of articles (Aruba, 2016; Lee and Bauer, 2013; Lorenzi, 2011; Ulrich, Zimring, Joesph, Choudhary, & Quan, 2004) supported the concern that navigational needs of facility visitors are not being met. In 2004, The Institute for Health Design (IHD) published an article that discussed how outdated hospitals would soon be replaced in one of the largest healthcare building booms the U.S. has experienced. New facilities must also be equipped with new technologies to meet the changing needs of the upcoming generation of patients.

When comparing over 17 studies, researchers found that wayfinding continues to be a significant problem with in hospitals. Even in hospitals that have thoughtfully placed signage, it is difficult to navigate due to the complexity of the buildings and the lack of "simple cues that enable natural movement" (Ulrich, Zimring, Joseph, Choudhary, & Quan, 2004, p. 1). Researchers found most hospitals with wayfinding problems are those that have large facilities that attempt to assist navigation by superimposing signs on preexisting ones. This combination of new and old signage was found to be ineffective for most visitors.

The IHD recommended a multimodal approach to wayfinding including, but not limited to, informational handouts, maps mailed to patients, information desks, electronic directions through kiosks or the web, verbal directions, you-are-here maps, directories, and wall signage (Ulrich, Zimring, Joseph, Choudhary, & Quan, 2004). These sources of navigation for patients should be chosen based on facility needs that fit the hospital design best. Keeping that in mind, the IHD stated that the primary goal of the

organization should be to “develop wayfinding systems that allow users, and particularly outpatients and visitors, to find their way efficiently and with little stress” (Ulrich, Zimring, Joseph, Choudhary, & Quan, 2004, p. 1). The American Academy of Healthcare Interior Designers suggested that organizations should place great importance on the clarity of navigational tools and the need for wayfinding systems to change as often as hospitals do (Lee & Bauer, 2013). Information should lead visitors from one point to another with simple directions rather than creating confusion with “typical directional flagpoles and directory floor plans” (Lee & Bauer, 2013, p. 31). Although Lee and Bauer discussed how signage could be confusing, they later explained that if designed correctly, signage could be beneficial if incorporated in wayfinding (2013).

Unfamiliar terminology can also be a factor to the ineffectiveness of hospital signage. The lack of signage is often not the issue when visitors become lost, instead the over use and over crowding of different directional signs causes confusion (Aruba, 2014). Wayfinding applications can be beneficial as a source of a direct path to a destination to decrease the confusion created by too many signs (Aruba, 2014). Another issue that arises is the fact that stationary signs do not display directions in real time, while a navigational application has those capabilities (Lorenzi, 2011).

A significant study was done in 1985 on the topic of hospital signage as part of a wayfinding system. Researchers Carpman, Grant, and Simmons (1985) conducted a study involving 100 randomly-selected participants at the University of Michigan Hospital, and was developed due to a high complaint rate by first-time visitors that the signage did not lead them to their desired destination. The authors began by showing participants a videotaped simulation of a parking area and asked where they would park if coming to

the facility to visit a patient. The simulation also showed a "quick turn-around" area with signage directing drivers to continue straight ahead for parking. Despite clearly displayed signage, 36.8% of the drivers turned into the "quick turn-around", while only 64.2% followed to the correct parking area. The study concluded that facility signs alone were not sufficient. Other conclusions were found from the study involving alternative parking design choices for the facility (Carpman, Grant, & Simmons, 1985).

The intimidation of hospitals alone can be overwhelming and somewhat confusing. To accompany this confusion, hospitals often serve a population that is "uniquely vulnerable to stress" (Aruba, 2014, p. 1). Wayfinding problems within a large facility can cause significant anxiety (Aruba, 2014). Health concerns for patients and their families should be discussed as a potential health hazard. Ulrich, Zimring, Joseph, Choudhary, and Quan (2004) stated that, "Wayfinding problems in hospitals are costly and stressful and have particular impacts on outpatients and visitors, who are often unfamiliar with the hospital and are otherwise stressed and disoriented" (p.1).

Aruba Networks, the company that created the wayfinding smart phone application for Boston Children's Hospital (BCH) discussed in their 2014 executive brief how confusing hospital floor plans have become and the effect it could have on patients. "Patients' feelings of anxiety may be compounded by fatigue and confusion related to injury or disease" (Aruba, 2014, p. 1). Stresses caused by the unknown physical environment patients are in can also lead to prolonged recovery from illnesses (Carpman, Grant, & Simmons, 1985).

Visitor Stress and Patient Satisfaction

Patients and visitors who enter healthcare facilities stressed, anxious, and frustrated may have a difficult time recovering from the experience. Frustration may be carried over into their entire hospital stay, greatly effecting patient satisfaction. Delvin (2014); Lee & Bauer (2013); Ulrich, Berry, Quan, & Parish (2010); and Wu, Robson, & Hollis (2013) agreed that when patients become lost and confused navigating through a facility, it can in turn have a negative effect on their overall satisfaction level. Not only does it improve patient satisfaction, but also demonstrates that an organization is focused on patient-centered care (Lee & Bauer, 2013).

Wu, Robson, and Hollis (2013) also recommend that hospital administrators keep in mind when making future improvement plans that "hospitality oriented enhancements" (p. 57) such as wayfinding tools, should remain a priority as it helps achieve the goal of providing quality clinical care. These wayfinding tools assist in improving the experience of a complex hospital visit, particularly mobile wayfinding technology (Delvin, 2014). Further studies are needed to fully understand the impact wayfinding problems can have on visitors as it relates to anxiety and stress development (Ulrich, Zimring, Joseph, Choudhary, & Quan, 2004).

BCH, a large multi-building hospital, discovered a severe wayfinding crisis in their facility. Patients were unable to navigate their large campus without the stress of becoming lost. BCH is a 395-bed care facility with 12 separate buildings, of which most provide patient and family care services. Visitors were provided with a multi-colored map of common routes to locations on the campus. Although most staff members used a map, even they became lost despite their time spent at the facility during their career.

Families with sick, agitated, and fatigued children should not have the added stress of navigating through this large campus with complex directional maps. BCH officials believed that by relieving patients and families of this stressful task, the standard of care the patient receives improves (Aruba, 2014). In 2012, BCH opened a new door for campus navigation.

The MyWay smart phone application at BCH became available for visitors, and provides turn-by-turn directions. MyWay allows for real time updates while navigating the hospital. For example, if an elevator on the first floor is out of order the application is aware of the closure and will reroute visitors to their destination using the next easiest path. "The app is considered to be part of patient care, specifically in reduction of stress and offering guidance" (Aruba, 2014, p. 3).

The initial results of the implementation of MyWay showed that the app was downloaded by more than 4,500 people in the first 6 months. Patient surveys showed that of the patients who downloaded the application, 65% reported it improved their overall hospital experience. Surveys also revealed that 45% of visitors use smartphones and have the ability to download the application. Initial findings showed promising results for BCH and further evaluation of the MyWay application will be conducted (Aruba, 2014).

Another study, conducted by Yona Nelson-Shulman, Ph.D. at City University of New York (1983), sought to find the main causes of environment stress and their impact on patients and visitors of a facility. Participants of the study were 94 inpatients of a major urban hospital. Half of the participants entered the hospital with directional signs and other information regarding hospital admission/registration was displayed in the waiting area. The other half entered under normal hospital conditions with no additional

information. Participants were then interviewed regarding their experience. Patients reported they were confused and unaware of where to go despite the directional signs clearly displayed (Nelson-Shulman, 1983). They also reported they were unaware of where to find certain hospital services, restrooms, telephone, cafeteria, and other hospital amenities. The lack of adequate information provided to the patients was reported to "exacerbate pre-existing anxieties and increase dissatisfaction with the hospital" (Nelson-Shulman, 1983, p. 305).

Navigational Technology

Technology has become a major aspect of day-to-day life in the 21st century. A 2013 Internet project by the Pew Research Center reported that as of January 2014, 46% of American adults own a smartphone. Of those who own smartphones, 29% reported that they could not live without their phone (Pew Research, 2013). It was also reported that 50% of Americans download apps on their smartphone regularly. Using the location-based applications for download was reported by 49% of adult users, while 75% of adults over the age of 18 stated that they use their phone to get directions (Pew Research, 2013). A significant increase in this type of wayfinding technology should be expected.

Technology now allows for navigation from a patient's home to the facility parking area, then to kiosks or cell phone navigational applications with directions, often in a different language if needed (Lee & Bauer, 2013). Lorenzi (2011) also supported the use of new technology to assist patients with wayfinding in facilities. He stated that modern technology including handheld devices is "the next digital revolution" in the healthcare setting and will assist an organization in becoming a "high-tech hospital of the future" (Lorenzi, 2011, p. 14).

Although there are many benefits reported from using new technology, such as smart phones, as a source of navigation through a facility, Delvin (2014); Lee and Bauer (2013); Pew Research (2013); and Wu, Robson, and Hollis (2013) agreed that there are benefits, but also limitations if used as the facilities sole source of wayfinding. According to Lee and Bauer (2013), wayfinding technology will likely be highly favored by younger visitors and patients, but not utilized or understood by the older adult population. If this wayfinding technology takes the place of greeters and information desk employees, a loss of personal connection may occur.

In the incident of technology failure visitors who relied upon the advanced system may find themselves lost and/or confused (Lee & Bauer, 2013). Wu, Robson, and Hollis (2013) also noted that difficulty may develop when an attempt is made to integrate the device-based system with pre-existing wayfinding elements. Technology failure may also be an issue due to slow download speeds.

According to the Pew Research Internet Project (2013) previously mentioned, 77% of smart phone users experience delays in downloading with 46 % reporting an episode of slow speeds weekly or often. Another problem that may arise is the concern for the safety of the user if he or she is attempting to use it during an emergent situation (Delvin, 2014). The population of users who can benefit from a wayfinding smart phone application may also be reduced due to the elimination of patients with blindness, hearing loss, cognitive impairments such as dementia and Down Syndrome (Delvin, 2014). Cultural barriers may exist as well as language barriers (Delvin, 2014).

Cost

Navigational technology is also economically friendly as electronic devices are usually less expensive than people and often work smarter (Lee & Bauer, 2013). Aruba (2014); Lee and Bauer (2013); Ulrich, Simrin, Joseph, Choudhary, and Quan (2004); and Wu, Robson, and Hollis (2013) agreed that the implementation of new wayfinding technology in a facility can lead to cost savings in many different ways. The workflow of employees is disrupted by visitors who need directions to their destination. Distracted medical and nursing staff can lead to medical and medication errors, delayed procedures, delayed admission and discharge processes, and overall slowing of effective work. The problems caused by interrupted staff lead to considerable annual costs (Ulrich et al., 2004).

Wu, Robson, and Hollis (2013) agreed that effective wayfinding systems should lessen the need for staff to stop working in order to provide directions. Lost patients can also lead to missed appointments (Wu et al., 2013). "When patients miss appointments or are late because of wayfinding issues, this causes inefficiencies in scheduling, which means that fewer patients are able to receive treatment or consultation from each physician" (Aruba, 2014, p. 1).

A 2004 British study by Hussain-Gambles, Neal, Dempsey, Lawlor, and Hodgson explored how medical staff perceived missed appointments by patients. In their questionnaire to medical staff, researchers asked questions regarding the frequency of missed appointments. Of the 304 staff, 136 (44.7%) reported that missed appointments were a problem in their practice (Hussain-Gambles, Neal, Dempsey, Lawlor, & Hodgson, 2004). According to BCH and the implementation of the MyWay app in their facility,

they “have plans to study the Meridian-powered app on the number of missed appointments, and on physician scheduling. Initial results are considered to be highly encouraging” (Aruba, 2014, p. 4).

Large hospitals are continuously growing and developing new services. As the facility grows, the technology should as well. Wayfinding costs can be reduced as a hospital grows if the primary wayfinding system is based in a mobile phone application (Aruba, 2014). The application can be updated and easily changed to adapt to construction or new buildings, while the purchase of new signage costs money and lengthy production time (Aruba, 2014).

Costs can also be found when it comes to facility wayfinding and patient satisfaction. The Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) measures the inpatient experience through a survey tool sent to patients 48 hours to 6 weeks after discharge. The 27-question survey asks multiple questions related to their hospital stay including a rating of their overall patient experience. Centers for Medicare and Medicaid Services (CMS) requires that all hospitals that accept Medicare and Medicaid patients must report HCAHPS scores (Centers for Medicare and Medicaid Services, 2014). CMS states the following regarding to hospital reimbursement:

> The enactment of Deficit Reduction Act of 2005 created an additional incentive for acute care hospitals to participate in HCAHPS. Since July 2007, hospitals subject to the Inpatient Prospective Payment System (IPPS) annual payment update provisions (“subsection (d) hospitals”) must collect and submit HCAHPS data in order to receive their full IPPS annual payment update. IPPS hospitals that fail to publicly report the required quality measures which include the HCAHPS

survey, may receive an annual payment update that is reduced by 2.0 percentage points. Non-IPPS hospitals such as Critical Access Hospitals, may voluntarily participate in HCAHPS. ("CMS", 2014)

Despite the affordability of wayfinding applications for smart phones, Ulrich, Berry, Quan, and Parish noted that further studies need to be conducted to understand the correlation (2010). Lorenzi (2011) also mentioned that a wayfinding application may not be the best choice for small hospitals based on the cost-benefit ratio.

Theoretical Background

The Institute for Healthcare Improvement (IHI) 'Model of Improvement' is a tool for organizations to use to move forward with changes meant to improve outcomes (IHI, 2016). The resource assists in the planning and implementation of new ideas or theories that are then evaluated for effectiveness. The model consists of two important sections. The first section asks three important questions:

1. What are we trying to accomplish?
2. How will we know that the change is an improvement?
3. What change can we make that will result in improvement?

The second section is the Plan-Do-Study-Act cycle (PDSA) or the Shewart cycle that is commonly used in the area of organizational and quality improvement (Butts & Rich, 2015). The PDSA cycle is implemented into practice by W. Edwards Deming, and is sometimes also referred to as the Deming cycle (Butts & Rich, 2015). The cycle is a fundamental framework that serves as “a practical method for applying a scientific method in an operational space” (Bennett & Provost, 2015, p. 38). The four components

of the PDSA cycle are organized steps for planning, implementation, studying of the outcomes, and then acting on what is observed (IHI, 2016).

NaviHealth was presented to the department of marketing for a large healthcare organization as a solution to the growing problem of misdirected or lost patients in their facility. The organization then evaluated the product, and reported how likely they were to invest in the development of the NaviHealth application for patient use. Results were evaluated and necessary changes were made according to participant feedback. In order for this doctoral project to be implemented successfully, steps were carefully followed to ensure all aspects of the organizational improvement plan could be met. The four major components of Deming's PDSA cycle were followed step-by-step in order to complete this process.

1. During the 'Planning Phase', current wayfinding applications were evaluated, an application building company was selected, a business plan for NaviHealth company start-up was developed, and a meeting with shareholders of the facility was scheduled.
2. During the 'Doing Phase', a meeting with the stakeholders occurred where NaviHealth was proposed as a possible investment for the organization. Evaluators provided feedback.
3. During the 'Studying Phase', shareholder feedback was analyzed.
4. During the 'Acting Phase', changes were made to the NaviHealth application according to feedback and participant recommendations.

The ideal outcome after NaviHealth proposal to facility stakeholders was for participants to be a unanimous willing to invest in the development and implementation

of the application at their facility. Through download and use of NaviHealth for the organization's patient population, a decrease in visitor stress and an increase in patient satisfaction is predicted. The area of interest for NaviHealth was customer satisfaction through facility improvement. The IHI 'Model of Improvement' assisted in the planning and implementation of an organizational change in order to speed up the improvement process (IHI, 2016). It also allowed for an evaluation of the outcomes. The process can then be started over with the cycle beginning again after changes have been made. This process can prove to be beneficial with the implementation of NaviHealth. Suggested changes to the application made by the facility participants followed the IHI 'Model of Improvement' plan through the PDSA cycle. In this case, the PDSA cycle will repeatedly be used in the future until stakeholder satisfaction is reached.

Doctorate of Nursing Practice Essentials

There are eight DNP essentials that serve as the foundation on which the DNP project is built. These essentials must be met by all DNP program candidates. This doctoral project has met all eight essentials listed below.

Essential One: Scientific underpinnings for practice

Literature suggested a significant increase in patient satisfaction related to effective wayfinding systems, improved hospital workflow, and less missed procedures/ appointments resulting in decreased hospital costs. Advancements in technology have allowed for the majority of hospital patients to own personal cell phones with application downloading abilities.

Essential Two: Organizational and Systems Leadership for Quality Improvement and Systems Thinking

Research articles suggested that organization improvement measures include improving patient satisfaction as a quality improvement strategy. Improving the patient's ability to navigate through large, confusing hospital facilities decreases stress and improves their organizational experience.

Essential Three: Clinical Leadership and Analytical Methods for Evidence-based Practice

Although further research is recommended, BCH found that 65% of visitors reported that the hospital's wayfinding application helped improve their experience (Aruba, 2014).

Essential Four: Information Systems/Technology and Patient Care Technology for the Improvement and Transformation of Health Care

Conflicting literature suggested that technology can be confusing to certain older patient populations, while other populations can find great benefit from the implementation of more technology in the healthcare setting. Statistical results from Pew research also stated that 65% of adults own a smartphone, with 75% of those adults reporting the use of their smartphone in obtaining navigational directions (Pew Research, 2013).

Essential Five: Healthcare Policy for Advocacy in Health Care

Organization improvement was the goal of NaviHealth. Improvement can be achieved by increasing patient satisfaction and decreasing hospital costs through the implementation of NaviHealth.within facilities. These improvments are primarily the result of improved employee workflow and a reduction in missed or late appointments.

Essential Six: Interprofessional Collaboration for Improving Patient and Population Health Outcomes

Literature revealed that wayfinding matters significantly in terms of patient-centered care and improved patient satisfaction. Patient advocacy is achieved in healthcare organizations who focus on improving patient outcomes as their primary concern (Lee & Bauer, 2013). Changing organizational policies involving wayfinding for hospitals can improve patient outcomes.

Essential Seven: Clinical Prevention and Population Health for Improving the Nation's Health

Collaboration between physicians, administrators, nurses, and other hospital employees is essential in the implementation of the application in the future. Collaboration is also necessary in obtaining a needs assessment for specific facilities. Personalized facility application design for patient use required input from multiple hospital disciplines.

Essential Eight: Advanced Nursing Practice

Driving directions to and from healthcare organizations is one of the features provided by the Navihealth application. Making it easier for patients to travel to and from their provider can have significant impacts on improving the public's access to health care.

Summary

Chapter 1 discussed the clinical question being addressed, problem statement, background and significance, purpose of the project, summary of evidence, and theoretical background. The eight essentials required by all DNP projects are also provided in detail. These essentials are critical in ensuring that projects are centered on improving health care outcomes. The evidence discussed provides insight on effects of

navigational technology on decreasing costs, decreasing visitor anxiety and stress, and improving patient satisfaction.

CHAPTER II – METHODS

Target Population and Sample

The target population for this project consisted of stakeholders of large healthcare facilities who did not currently have a wayfinding system. The participants for this doctoral project were six full-time employees of a large, multi-building healthcare facility in South Mississippi. These employees serve in the marketing department. There was no random selection for this sample. A convenience sampling plan was used in selection of the population based on the facility. Exclusion criteria for the population includes any staff member who may financially benefit directly from the investment of the application. Financial benefit does not include benefits for the organization with whom they are employed, only personal financial gain. Males and females were included in the study. All participants were over the age of 18.

Setting

The setting for this project was a multi-building healthcare facility in South Mississippi. This 512-bed hospital provides health services to 19 counties in the surrounding region. Serving as a level 2 trauma center, the facility provides emergency services as well as behavioral health, cancer services, heart and vascular care, home care and hospice, internal medicine, neurology and neurosurgery, occupational health services, orthopedics, radiology, rehabilitation services, surgical services, women and children's services, and a wound care center.

Design

This doctoral project focused on whether or not the NaviHealth application was desirable to organizational stakeholders, and what enhancements could be made in the

future to improve likelihood of investment in the application. The design for this project was a descriptive method. Faculty evaluated and approved the evaluation tool developed for this project.

After a presentation to participants about NaviHealth, they were administered five questions where they used a Likert-type scale to rate their perception of the application in relation to use within their healthcare facility. The Likert-type scale used for the evaluation instrument was analyzed to calculate measures of central tendency and develop a frequency distribution. The scale for evaluation ranged from one to five. The rating scale is as follows: 1- strongly disagree, 2- somewhat disagree, 3-neither agree nor disagree, 4- somewhat agree, 5- strongly agree. See detailed evaluation results in Table 1. The Likert-type evaluation tool was also followed by three open-ended questions where participants entered comments and recommendations to improve the application.

Summary

This DNP project was completed with a focus on the following outcomes: Complete a business plan for the development of the NaviHealth smart phone application. Next, present NaviHealth as an alternative solution for alleviating visitor stress and improving patient satisfaction related to difficult navigation of a large healthcare organization. Following the presentation, a 5-point Likert-type scale (1- 5) questionnaire was be administered. The survey tool was constructed to determine facility stakeholder attitude toward the use of the application. The overall score was used to assess how favorably the participants view the value of NaviHealth. If participants wish to implement within the organizational setting, NaviHealth has the potential to improve patient satisfaction, decrease visitor stress, and decrease hospital spending.

CHAPTER III - RESULTS

Overview

The group of organizational stakeholders, as previously described, were asked to attend an informal presentation during their lunch break at the designated facility. A group conference room at the hospital was be utilized for the presentation. The NaviHealth smart phone application was presented as a possible opportunity for improvement of the facility's wayfinding system. Lunch was provided for participants. After a 20-30 minute demonstration on NaviHealth, questions were asked by stakeholders and discussed as needed. A 5-point Likert-type scale (1-5) evaluation tool was provided to participants at the completion of the presentation. Likert scale options included: *Strongly Agree, Agree, No Opinion, Disagree, and Strongly Disagree*. The evaluation also provided additional feedback with open-ended questions at the end in hopes to shine light on areas of improvement for NaviHealth in the future. The evaluation tool provided information regarding stakeholder opinions or attitudes about the application. The evaluation tool used is provided (see Appendix E).

Statistical Analysis

Five of six participants (83%) reported that they strongly agree that the application would decrease patient/visitor stress, improve patient satisfaction, and benefit patients, visitors, and staff overall. The sixth participant reported she somewhat agreed with the previous statements (17%), while no participants disagreed. When asked if they would recommend purchase and implementation of the app in their facility, five participants (83%) either somewhat agreed or strongly agreed with the statement. Five of the six participants (83%) also said they somewhat agreed or strongly agreed when asked

if hospital administrators would be likely to invest in the NaviHealth application. In the previous questions related to purchase and investment, one participant (17%) strongly disagreed with both statements.

Table 1

NaviHealth Product Evaluation: Results from Likert-type scale Items

	Participant Responses (n=6)				
Evaluation Items	Strongly Disagree	Somewhat Disagree	Neither Agree or Disagree	Somewhat Agree	Strongly Agree
1. NaviHealth would decrease patient/visitor stress related to navigating within this facility.	0	0	0	1 (17%)	5 (83%)
2. NaviHealth would be a good tool this facility could use to improve overall patient satisfaction scores.	0	0	0	1 (17%)	5 (83%)
3. Based on the presentation, NaviHealth is something that would benefit patients, visitors, and staff of this facility.	0	0	0	1 (17%)	5 (83%)
4. I would recommend purchase and implementation of the NaviHealth wayfinding application for this facility.	1 (17%)	0	0	4 (66%)	1 (17%)
5. Based on the information presented, my facility administrators would likely be interested in possible investment in the NaviHealth application.	1 (17%)	0	0	2 (33%)	3 (50%)

According to the open-ended questions provided on this participant's evaluation tool, the application was a great idea that is currently being addressed. She explained that there are further developed applications than NaviHealth with a history of success on the market. Other participants discussed that they would highly recommend investment to

hospital administrators, but at a later date due to current internal facility construction. See complete transcription of participant comments in Table 2.

Table 2

NaviHealth Product Evaluation: Open-Ended Question Results

Participant Responses (n=6)						
Open-Ended Evaluation Questions	Participant #1	# 2	#3	#4	#5	#6
1. If you do not believe NaviHealth would be beneficial within this facility, please explain why.	"N/A"	(no response)	(no response)	(no response)	(no response)	"Great idea but already add-ressing. Better apps available w/ history of success."
2. If you do not believe this facility would invest in the NaviHealth application, please explain why.	"N/A-would invest, but later date due to internal con-struction."	(no response)	(no response)	(no response)	"My only concerns are the sections of the hospital where cell phone/ GPS service is not available. How would this be remedied?"	"Will invest in a more proven company."
3. Do you have any	"Possibly add how it	"Inte-gration of	"It would be great	"I like the idea of	"No, I don't have	"Not enough

suggestions to improve the NaviHealth application ? If so, what would you like to see different about the application ?	could be used on back end for survey purposes.”	wayfindin g kiosk synced to app that would reduce physical signage inaccuracy . Facility push notify-cations. ‘I need help’ function-ality to page staff”	paired with digital signage wayfindin g around a facility, and the app could be ad-vertised on digital signage as well.”	combining patient appointme nt scheduling and way-finding (ex: Boston Children’s Hospital). ”	any sug-gestions at this time.”	info to make this decision-app was not pres-ented as a function-ing model, just concept. ”

Summary

Chapter III provided a brief presentation of the overall findings of the application evaluation tool. Responses were grouped to show frequency and participant attitude towards the app. Chapter IV further discusses the evaluation tool findings, recommendations, implications for future practice, limitations, and the conclusion.

CHAPTER IV – DISCUSSION

Summary of Findings and Interpretation of Results

Overall, participants expressed a strong interest in the application, as seen in Table 1. Difficulty navigating the healthcare facility was discussed as a problem they have been approached about many times in the past 4 to 5 years. The participants stated that it remains a problem in their facility today and has not been successfully addressed. Participants strongly agreed the application would most likely have a positive impact on facility visitors and staff.

The potential impact on patient satisfaction through implementation of modern technology was a strong discussion point where all participants agreed that mobile wayfinding is something that has been needed in their facility for quite some time. When questioned about facility investment, most participants also agreed their healthcare facility would likely invest and implement the application with the exception of one participant. This participant was identified as the director of the marketing department and is suspected of possible bias related to her position. The above-mentioned participant expressed concern related to previous work with a similar application that was not implemented due to unspecified contract disagreements with the developing company. The adoption of a wayfinding tool was then moved lower on the priority list for the marketing department but was said not to be forgotten. Mobile wayfinding was said to still be an idea they would like to pursue.

Recommendations

Participants gave multiple recommendations verbally and through open-ended questions on the evaluation tool. One participant recommended having the application

developed completely and providing a functioning version for a trail. Integrating the application with hospital kiosk areas was also recommended for those visitors who do not have smart phones. Digital signage was a recommendation as an addition to the application implementation. Most participants supported the implementation of the application without changes, while others recommended not changing the app, but adding more features in the future. Features to the application such as patient appointment scheduling were suggested.

Implications for Future Practice

NaviHealth was greatly accepted by the majority of participants as a solution to the wayfinding problem in their facility. Although the concept of the application was supported, it lacked the ability for participants to physically use it at this time. Based on this finding it was difficult for some participants to commit to pursuing the application for investment.

In the future, I would recommend development of a trial application for participants to test. Based on discussion with the application development company, I would recommend pursuing a different company that can build a trail application at a decreased cost. I would also recommend that once the application is implemented for facility use, research be conducted to evaluate how the application affects visitor stress levels, patient satisfaction scores, and costs savings associated with the application. Cost savings can be reviewed by evaluating if the rate of missed or late appointments decreased once the wayfinding application is implemented.

Limitations

Limitations for this project are primarily financial. Based on feedback from participants, a trial application for testing would improve willingness to pursue the application. After speaking with the development company, a great deal of work is required to build the application. A trial version is not available at this time at a decreased cost, only the completed application. It is estimated to cost $27,500 to develop the application. Cost of the application is not a financial possibility at this time without signed agreement of purchase by the facility. Cost is the primary limiting factor for furthering the application development and implementation. Other limitations include the inability to present the application directly to facility administration. Participant sample size was also limited due to the number of employees in the hospital marketing department.

Dissemination

Utilization of the fourth step in Deming's PDSA cycle, the 'Acting Phase' will be implemented to make necessary changes to the application based on previously discussed participant feedback. The 'Planning Phase' of the Deming Cycle will once again be implemented. Stakeholders will be contacted and informed that improvements have been made to the application based on their feedback. A plan for presenting the new, improved NaviHealth application to a large healthcare facility in South Mississippi will be scheduled. If the facility does not wish to pursue the application further, another healthcare facility with similar wayfinding problems will be contacted about possible interest in the application.

Conclusion

The NaviHealth application was created with the purpose of decreasing visitor stress, improving patient satisfaction, and decreasing hospital costs through the implementation of a wayfinding smartphone application. The purpose of this DNP project was to evaluate the likelihood of a large healthcare facility investment and implementation of the application based on a presentation about the possible benefits of NaviHealth for their facility. Results of this project determined that although the application showed many positive benefits for the facility, the willingness to further pursue the application for investment was strong but not overwhelmingly unanimous. Changes to the application were recommended by participants to improve the likelihood of application investment.

APPENDIX A – Synthesis Matrix Table

Table A1.

Synthesis Matrix

	Cost	Ineffective Signage	Patient Satisfaction and visitor stress	Navigational Technology
Ulrich, Zimring, Quan, Joesph, and Choudhary	The interruption of staff workflow have major costs associated with it annually	In large, confusing buildings, even well-designed signage is most likely ineffective because it does not give simple directions that encourages natural movement.	Visitor stress is hard to assess as being the result of wayfinding problems; more studies are needed.	
Lee and Bauer	Machines work better and cost less money than employees; therefore industries will see an increase in wayfinding technology use.	Point-to-point directions should be used. An overwhelming amount of information is not effective, and is common in directional flagpoles and directories.	Wayfinding should begin with material that the patient received before they initially go home from a pre-procedural appointment. "Proven fact that wayfinding matters significantly in terms of patient-centered care and improved patient satisfaction."	Highly accepted in the new generation, but is less familiar or used by older generations. Loss of person touch that visitors receive from greeters or information desk workers if wayfinding technology takes their place. Technology failure can occur and result in

				navigational difficulty "Visitors need navigation support, not natural navigational replacement." Machines work better and cost less money than employees; therefore, industries will see an increase in wayfinding technology use.
Wu, Robson, and Hollis	Patients are less likely to be late for or miss an appointment when using a wayfinding tool. Wayfinding tools also help keep staff from being interrupted to give directions. Based on the type of facility, staff work may not be interrupted daily based on the work type of hospital.		"The hospital must not lose sight of its primary goal of providing quality clinical care when it considers allocating resources to hospitality-oriented enhancements." Wayfinding tools improve patient and visitor satisfaction	Integration of new wayfinding technology and older wayfinding tools may be difficult.
Aruba	Physicians loose money	Facilities display	Unfamiliar surroundings,	The Boston Children's

	when appointments are missed or patients are late. Signage is expensive and takes a long time to create and install compared to mobile wayfinding apps that can quickly adapt to a changing hospital. Boston Children's Hospital is planning to evaluated if mobile wayfinding apps positively impact physicians and facilities. Initial evaluations look promising.	terminology that is unfamiliar to visitors. "The problem is not that there aren't enough signs, but far too many that point in all different directions" Wayfinding is beneficial in providing a direct path to a destination.	new noises, and busy movement are all factors that contribute to the stress patients experience associated with healthcare facilities. Boston Children's Hospital believes that a higher standard of care is given when patients stress needs is brought to the center of patient care. BCH reported that visitors missed services provided for their families due to the rushing through a facility to make an appointment. The BCH navigation app also helps alleviated the frustration of construction by rerouting elevator routes so that patients often never know there is a problem.	Hospital app was downloaded by more than 4,500 patients in the first 6 months. 45% of those who visit BCH have smartphones capable of application access if desired.

			BCH reported that 65% of patients reported that the wayfinding app improved their overall satisfaction.	
Pew Research				90% of adults own a cellphone 64% of adults own a smartphone 7% of adults are "smart-phone dependent" 29% of cellphone owners describe that it is "something they can't live without" 50% download apps 49% get directions, recommendations, or use location based services 7$% of adults age 18 or older say they used their phone to get directions 77% report slow download speeds that prevent things from loading quickly (46% experience this weekly or often)
Delvin			Improved wayfinding assists in	Most visitors will benefits from a

			improved patient satisfaction scores.	wayfinding application. "It is difficult to be used by patients who suffer from blindness, hearing loss, cognitive impairments such as dementia and down syndrome. Cultural barriers may exist as well as language barriers" From a safety standpoint, it can be dangerous or be difficult to use in an emergency situation.
Ulrich, Berry, Quan, and Parish	It is reasonable to suspect that wayfinding problems cost facilities money, but more research on the topic is needed.		"A reliable, easy to use wayfinding system as design factor is supported by empirical studies to increase overall satisfaction and influences perceived patient service quality" For health care to improve, the environment in which it is given must first be improved.	

Lorenzi	When looked at closely in a cost-benefit analysis, wayfinding technology may not be beneficial for small facilities.	Displayed signage does not give information in real time. Facilities can not get rid of signage that provides brail and tactile letters in order to comply with the Americans with Disabilities Act.		Hospitals of the futures are those who have a grasp on new technology "Wayfinding is the next digital revolution for hospitals"

APPENDIX B – Project Timeline Table

Table A1.

Project Timeline

Month	***Activities***
August 2015	Complete Collaborative Institutional Training Initiative (CITI)
October 2016	Submit gradate committee and chair names (3) to Nurse Anesthesia Program
February 2017	Defense of Proposal and submission of approval form
May 2017	Submit Institutional Research Board (IRB) applications for process approval
June 2017	Application submitted for Degree and Plan of Study
June 2017	Submit Contact Graduate Reader form to the Reviewer of Graduate Nursing Capstone Projects
June 2017	Submission of title page
June 2017	Data Collection
July 2017	Capstone paper corrections
July 2017	Rework data interpretation
September 2017	Final presentation/ Capstone defense
September 2017	Submit copy of capstone project to Graduate Reader for proofing and approval
December 2017	Graduate

APPENDIX C –IRB Approval

THE UNIVERSITY OF
SOUTHERN MISSISSIPPI.

COLLEGE OF NURSING
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August 16, 2017

To Whom It May Concern:

The doctoral project submitted to IRB by Jessie Marshall titled "The Development of a Wayfinding Smart Phone Application as a Large Health Care Facility Investment Opportunity" has been reviewed by Bonnie Harbaugh, PhD, RN, who is a College of Nursing representative of The University of Southern Mississippi Institutional Review Board. The project is an organizational business development/analysis that does not involve human subjects. Since the doctoral project does not use human subjects, this project does not require IRB Approval.

In this doctoral project proper protection of organizational data will be adhered to by Ms. Marshall and her advisor, Dr. Patsy Anderson. If Ms. Marshall's project changes to include Human Subjects, she will notify her doctoral project advisor, and apply for IRB approval.

Sincerely,

Bonnie Lee Harbaugh, PhD, RN

Bonnie Lee Harbaugh, PhD, RN
USM IRB Member
College of Nursing Representative

Professor and Chair
Department of Systems Leadership and Health Outcomes
College of Nursing
The University of Southern Mississippi
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APPENDIX D –Letter of Support

To Whom It May Concern:

I have reviewed Jessie Marshall's plan for her DNP Project. I understand that she plans to give an informal presentation to our marketing department and gather feedback related to the navigational smart phone application she has developed for healthcare facilities. She has explained that she will be providing lunch for our department during her presentation, and we will complete a short survey following the presentation.

[redacted]pital's marketing department supports Mrs. Marshall's project. We look forward to participating in the near future.

Sincerely,

Michelle Leslie

Director, Marketing and Communications

APPENDIX E –NaviHealth Evaluation Tool

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
1. NaviHealth would decrease patient/visitor stress related to navigating within this facility.	1	2	3	4	5
2. NaviHealth would be a good tool this facility could use to improve overall patient satisfaction scores.	1	2	3	4	5
3. Based on the presentation, NaviHealth is something that would benefit patients, visitors, and staff of this facility.	1	2	3	4	5
4. I would recommend purchase and implementation of the NaviHealth wayfinding application for this facility.	1	2	3	4	5
5. Based on the information presented, my facility administrators would likely be interested in possible investment into the NaviHealth application.	1	2	3	4	5

If you do not believe NaviHealth would be beneficial within this facility, please explain why.

If you do not believe this facility would invest in the NaviHealth application, please explain why.

Do you have any suggestions to improve the NaviHealth application? What would you like to see different about the application?

APPENDIX F –NaviHealth Logo

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