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Running head: BEST PRACTICES FOR MOBILE HEALTH

Pepperdine University

Graduate School of Education and Psychology

BEST PRACTICES TO ESTABLISH SUCCESSFUL MOBILE HEALTH SERVICE IN A
HEALTHCARE SETTING

A dissertation submitted in partial satisfaction
of the requirements for the degree of
Doctor of Education in Learning Technologies

by

Kathy M. Andrews

December, 2016

Dr. Farzin Madjidi—Dissertation Chairperson

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DEDICATION

In loving memory of my best friend and biggest cheerleader, I dedicate this dissertation to my mother, Alva Andrews. You believed in me when I didn't trust or believe in myself. I miss you dearly but know I am forever blessed to have had you as a mother, friend, and mentor.

VITA

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Senior Vocational Rehabilitation Counselor, QRP
- 2009—2010 Unum
Vocational Rehabilitation Consultant
- 2010—2012 Abt Associates
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ABSTRACT

Alternative healthcare programs have been steadily flooding the health care market, with the most notable being mobile health. Mobile health, more popularly known as mHealth, is expected to generate upward of \$59 billion dollars. This is astonishing, considering the mHealth market is still in its infancy as an alternative healthcare model. Still, there are over 100,000 mHealth smartphone applications and platforms on the market. The concept of offering affordable medical services that are accessible to anyone, at any time and in any place appeals to the mission and purpose of healthcare organizations. However, a large number of the studies and publications on mHealth are associated with the technologies behind mHealth and provide very little information on the practices and challenges associated with implementing mHealth, especially within a medical facility. For this reason, it was important to learn from executive health IT professionals who have successfully implemented mHealth services within the US healthcare system. Accordingly, the purpose of this study was to identify the practices used and challenges faced by CIOs in implementing mHealth technologies. The study also obtained recommendations CIOs believe are associated with successful mHealth services.

This was a qualitative study that used a phenomenology lens focused on the viewpoint of CIOs and the growing phenomenon of mHealth as a part of the U.S. healthcare system. This approach allowed the research to obtain data on the lived experiences of seven CIOs through semi-structured interviews who were identified as top experts by *Becker Hospital Review* publications. The analysis of their experiences revealed 13 best practices for mobile health implementation. The findings in this study aimed to identify how mHealth services could expand access to medical services by outlining key considerations and resources required for successful implementation.

Chapter 1: Introduction to the Study

The industrial revolution gave birth to modern medicine and healthcare during the 19th century. People traveled from various parts of the world to take part in the booming economic and industrial growth. With the establishment and growth of towns came a growing number of illnesses and disease. From typhus to yellow fever to black lung disease, the growing populations began to see an increasing number of people becoming sick from infectious and work-related diseases. With the advancement of democracy came the demand for health care as a human right (Nordqvist, 2012). Consumer demands and inadequate medical care created an opportunity for doctors and scientists to innovate and develop new methods to treat illnesses in a manner never done before. During this time, the stethoscope, electroencephalogram (EEG), electrocardiogram (EKG), x-ray machine, and anesthesia procedures were developed. Consumers' needs drove a new frontier in healthcare. Today there is an urgent need to meet new financial, medical, and technological demands in the healthcare sector.

Ehrbeck, Henke, and Kibasi (2010) estimated that \$7 trillion a year was being spent on healthcare globally. The cost has continued to climb with a 2% increase in 2012 and another 2.8% increase in 2013, bringing the total healthcare spending cost to \$7.2 trillion, or 10.6% of the gross domestic product (GDP). This cost is expected grow as high as \$ 9.3 trillion between 2014–2018 (Morris et al., 2015). The United States is a major contributor to this debt, as it spent over \$3 trillion in 2014 on health care cost (Centers for Medicare & Medicaid Services [CMS], 2015). Despite this hefty price tag, accessing healthcare services across the U.S. has become much more complex and time consuming. The escalating cost of healthcare is consuming so much of the income in industrialized and developing worlds that alternative healthcare models appear to be the only way to care for a changing world.

All over the world, examples of alternative healthcare models are emerging. In the United States, a growing number of retail spaces currently house medical centers like CVS's walk-in Minute Clinic or H-E-B's RediClinic, which are staffed with nurse practitioners who work with a patient's insurance provider or use a sliding scale to reduce out-of-pocket cost. India's Life Spring utilizes midwives instead of doctors to deliver babies, passing on savings to consumers who pay \$40 for normal deliveries instead of the standard \$200. In Mexico, consumers can subscribe to a phone-based medical advice and triage service that costs \$5 a month and is paid through the phone bill (Hansen, 2008). The success of these innovative healthcare delivery models is not by chance, but by choice. They directly targeted a healthcare service frequently required but not affordable or readily available. Multiple layers of innovation in healthcare have led to the development of alternative healthcare models, one of which is the utilization of virtual healthcare systems. This study focuses specifically on the development and implementation of mobile health technology as part of the virtual healthcare system in the United States.

Virtual healthcare is not a new concept; it has been in practice since the 1920s. The introduction of the modern telephone receiver along with handheld radios allowed physicians to conduct medical consultations remotely, and these practices have evolved to a growing network of remote clinics, medical advice lines, and virtual consultations (Lee, Stewart, & Barker, 2014). Virtual healthcare is an umbrella term that is often used interchangeably with e-health, virtual care, telemedicine, and telehealth. There are as many definitions for virtual healthcare as there are methods of delivering virtual care, but its core component is the utilization of technology to improve access and affordability of healthcare services. Recent healthcare reforms are quickly fueling virtual healthcare innovations, and as such, it is vital to identify strategies and challenges in implementing virtual healthcare practices.

Background

The healthcare market in industrialized countries has seen a decrease in both the quality of state-run health services and physicians' reimbursement. Healthcare in the United States is dominated by government and third party purchasers so intensely that it has effectively stifled innovation and entrepreneurial efforts that have the potential to change standards and stop the growing high cost of healthcare (Hansen, 2008). Prior to the induction of Medicare in the 1960s, the United States spent only 5% of its GDP on healthcare. Between 1906 and 1996, the average cost of healthcare was between 4% and 7% of the GDP and expected to reach 15% per annum in the coming years (Grimson, 2001). By 2013 the cost had exceeded the expected 15%, with 17.4% of the GDP going towards healthcare spending and projected to reach as high as 25% by the year 2030 (CMS, 2013). Much of the rising cost has been placed squarely on the shoulders of third party insurers, namely the government, Health Maintenance Organizations (HMOs), and Preferred Provider Organizations (PPOs). It has been a long standing practice to exclude people with pre-existing conditions from obtaining coverage, limit coverage for particular conditions, and restrict reimbursements, effectively limiting what services physicians can provide. Adding to the turmoil is the national shortage of physicians and nurses available to provide care, leading to increased wait times to obtain care. Unchecked increases in healthcare services and sparse competition pushed patients to look for alternatives to the growing dissatisfaction and cost associated with traditional healthcare services.

The dissatisfaction with traditional healthcare services has created a new market that caters to patients by offering a variety of medical services online and abroad. Internet pharmacies, medical tourism, retail walk-in clinics and so-called *boutique medicine* are all growing and thriving in the demand for quality healthcare services. The Internet has played an

enormous role in helping consumers shop for alternative healthcare services. From online patient networks to expert medical opinions, millions of people are seeking Internet-based healthcare services. The ease and accessibility of online services accounts for over five million Americans purchasing medication from other countries (Mangan, 2014). It also contributed to a rise in web-based medical companies, medical travel, and medical tourism.

There are several web-based companies that specialize in finding healthcare insurance services, including eHealthinsurance.com, GoHealth.com, and GetInsured.com. These are free web-based private insurance brokers that allow consumers to compare various healthcare plans, prices, and benefits. Consumers can get help via online chats or the telephone to fill out an online application and the web-based company will do everything else, including preparation of the tax credit application (Young, 2013). The drawback to using private web-based insurance brokers is they may only include insurance options from insurance companies with which they have a relationship, so consumers may miss out on a better option. For those seeking specific medical procedures, researching and booking a medical travel trip abroad offers a lot more affordability and ease because of the Internet.

Medical tourism is driven by rising healthcare in countries like the United States, and long wait times in countries like Canada and the United Kingdom. According to the Medical Tourism Association (2013) survey report, 80% of the demand for medical tourism in 2013 was driven by consumers wanting to save money, 92% of the total spending on medical tourism trip was less than \$30,000, and 76% of the consumers interested in medical tourism were American. MedSolutions is a private company that runs a web-based medical tourism service, offering a wide range of surgical procedures in several countries, including India, France, Turkey, Costa Rica, Mexico and South Africa (MedSolutions, 2008). With cost estimated to be between \$7,500

to \$15,000 per medical trip, medical tourism and travel has become a very viable healthcare alternative as well as an additional revenue source for countries in Latin America and Asia. It is estimated that medical tourism contributes between \$45 and \$90 billion to the global GDP (Medical Tourism Association, 2013).

In addition to web-based insurance brokers and online bookings for medical travel, web-based patient networks have also provided a way for consumers to take control of their healthcare needs. One of the largest online patient networks is the Association of Cancer Online Resources (ACOR). Established in 1995, ACOR offers cancer patients, healthcare providers, and family members a virtual space for support, active communication, education, and professional development on various types of cancer (ACOR, 2015). Cancer patient and doctors can also find information on clinical trials for different cancers and various stages of cancer development.

The wave of media-savvy, Internet users seeking healthcare services online is creating a disruption in how healthcare services are provided. Every developed country is experiencing the pressure of this transformation due to increased lifespans, rising medical costs, and advanced medical technologies. If the healthcare industry is to survive the increasing demand for services, it must begin to innovate and implement cost effective virtual healthcare solutions to build a better healthcare model for the 21st century that is not bound by time, space, or location. While there are a number of virtual healthcare models to look at, Mobile health (mHealth) is especially attractive because of its accessibility, affordability, and usability.

Specifically, mHealth has the potential to dramatically cut costs and improve access to care, as well as provide a way for healthcare providers to work with patients in real time and provide personalized care worldwide. Socially, healthcare organizations exist to serve the people and the people need healthcare organizations. As such, it is essential that people be able to access

healthcare services and that healthcare organizations provide services in an efficient and effective manner. Mobile healthcare is an avenue by which people are able to remote access healthcare services in the same way they access friends and family. If healthcare organizations can effectively implement a delivery of service model that incorporates mHealth services, both the people and healthcare organizations benefit from improved health monitoring, decreased hospital admissions, and decrease in excessive spending.

With more than seven billion people subscribed to a mobile network (PR Newswire, 2015) and an estimated 500 million people using personal healthcare apps worldwide (Moyle, 2015), healthcare organizations can take advantage of this visibility and usability to maximize patient outreach at minimal. SNS Telcom Research estimates that the utilization of mHealth services will save as much as \$340 billion on healthcare cost worldwide by the end of 2016 (PR Newswire, 2015). The rising popularity of mHealth services makes it critical to establish what is key in implementing and adopting mHealth strategies within a healthcare organization.

Statement of Problem

Technology has changed the way long standing industries like entertainment, journalism, and transportation do business. In order to stay in business and grow, these industries had to embrace technology. Healthcare is in the midst of a technological revolution, as the status quo of services is no longer acceptable to consumers or healthcare providers. The challenge for healthcare organizations is how to implement a new healthcare delivery model that can alleviate current problems without creating a whole host of new problems. All too often technology is seen as a savior, when it should be viewed as an extension to quality service, development, and advancement.

This dissertation examined the opportunities and challenges associated with virtual healthcare innovation, and went further in-depth on the challenges and practices associated with mHealth services in the United States. The intent was to identify best practices associated with successful implementation of mHealth services. The experience and insight of senior health information technology professionals, such as Chief Information Officers (CIOs), provided a context for factors such as legal considerations, implementation and acceptance of mHealth, and operational procedures.

Purpose of the Study

A steady increase of alternative healthcare programs is coming into the healthcare market utilizing technology as a tool to create new, effective, and affordable virtual healthcare delivery models. Among the emerging virtual healthcare models are mHealth programs that can predict adverse events, reduce hospital stays, and alleviate the shortage of physicians by reducing utilization of urgent care and emergency room visits (Hunt, Scheinrock, & Vyas, 2015).

mHealth programs can help healthcare organizations improve quality of services, reduce operational cost, and expand their reach to a diverse set of patients without the restrictions of time, space, or location. Accordingly, the purpose of this study was to identify the practices used and challenges faced in implementing mHealth technologies. In addition, this study identified procedures and recommendations for a successful mHealth adoption.

Research Questions

1. What strategies and practices do CIOs employ in the implementation and adoption of mHealth technologies?
2. What challenges do CIOs face when implementing best practices for mHealth technologies?

3. How do CIOs measure their success in implementing their best practices?
4. What recommendations do CIOs have for future mHealth providers that want to implement mHealth technologies?

Significance of the Study

There are many benefits to implementing a virtual healthcare system and just as many challenges. Privacy and security, cost and usability, adoption and implementation, and lack of resources and regulations can all undermine efforts to establish a virtual healthcare system. The increased use in mHealth applications and virtual health communities reinforces the need to understand what factors, behaviors, and practices contribute to a successful virtual healthcare system that is sustainable over a period of time. The cornerstone of this study was to identify and define what a successful mHealth program looked like in the United States healthcare market.

The benefits of using telecommunication, remote health assessments, and electronic records are especially appealing, given the influx of newer, cheaper, and smarter technologies. However, there are numerous challenges ahead as healthcare providers, patients, and insurers adjust to new healthcare reforms, service delivery models, and technologies. The rapidly evolving landscape of virtual healthcare has made it difficult to systematically map the prevalence of mHealth or virtual healthcare services across the United States. Fiordelli, Diviani, and Schulz (2013) conducted a systematic literature review on the impact of mobile phones and smartphones in healthcare, and found that while interest in mHealth steadily increased between 2002 and 2012, mapping the evolution of the virtual healthcare field required further development. The American Telemedicine Association, an international resources and advocate of the adoption and implementation of remote medical technologies like mHealth, published a report in May 2015 on telemedicine/virtual healthcare adoption. However, this report, like many others, does not

provide any information on the frequency of use or pervasiveness of virtual healthcare within the United States and D.C. This could be an indication that more research and development is needed in charting which virtual healthcare models are most frequently used and where.

Key Definitions

The following key terms and definitions were compiled and simplified from several sources that have invested significant time in research and development in virtual healthcare, including the World Health Organization, the Centers for Medicare & Medicaid Services, the Office of the National Coordinator for Health Information Technology, the Agency for Healthcare Research and Quality Publication, and the *Journal of the American Medical Association*. More detailed definitions can be found throughout the study.

- Affordable Healthcare Act (ACA)—The Patient Protection and Affordable Care Act and the Health Care and Education Reconciliation Act of 2010 (U.S. Department of Health and Human Services, 2015) expanded Medicaid coverage for millions of low-income Americans. It was signed into law on March 23, 2010.
- Health Information Technology for Economic and Clinical Health (HITECH) Act —The HITECH Act was signed into law on February 17, 2009, as part of the American Recovery and Reinvestment Act, and is included in the ACA to promote the adoption and meaningful use of health IT (U.S. Department of Health and Human Services, 2014).
- Health Information Technology (Health IT or HIT)— The design, development, use and maintenance of information technology systems within healthcare organizations for the purposes of exchanging health information in an electronic environment (Agency for Healthcare Research and Quality, 2015; U.S. Department of Health and Human Services, n.d.).

- Information and communication technologies (ICT)—The use of computers, audio/video devices, and telecommunication systems to store and retrieve electronic information (Zuppo, 2014). The term is used interchangeably with information technology (IT), health information technology (HIT), and health information systems (HIS).
- Mobile Health (mHealth)—The practice of using of mobile devices and tablets in the practices of medicine and public health (Healthcare Information and Management Systems Society, 2012).
- Chief Information Officer (CIO)—a person who is responsible for determining the information technology goals of an organization, and who manages, plans, coordinates, and directs computer-related activities within an organization. (Bureau of Labor and Statistics, 2015).
- Telehealth—A broad scope of remote clinical and non-clinical healthcare services including provider training, medical consultants, and continuing medical education (CME) via ICT (Health Resources and Services Administration, 2015). It is often used interchangeably with telemedicine.
- Telemedicine—The specific practice of providing remote healthcare services via the Internet and electronic communication means (Center for Medicare and Medicaid, n.d.; American Telemedicine Association, 2012b). It is often used interchangeably with telehealth.
- Virtual Healthcare—The practice of using ICT to deliver healthcare services, products, and processes (Harrop, 2001). This umbrella term is used to describe various healthcare services provided from a distance using various types of technology.

Limitations of the Study

1. The study was limited to professionals in the healthcare field associated with information technology demands. Clinical managers and other professionals were not represented.
2. This study limited its analysis to mHealth programs in the United States. Despite being an industrialized nation with a well-established healthcare system, a lot of the research on mHealth comes from developing countries like India, Kenya, and the Philippines. This limitation affected the number of research participants available to participate in the study.
3. The small purposive sample size, as well as the sample population, limited the ability to generalize data across mHealth programs run outside of large healthcare organizations. All participants belong to large organizations that had more than one hospital or facility.
4. The study limited the selection criteria of research participants to senior or executive information technology professionals who work for U.S. healthcare organizations exclusively because of their unique position on having to administer, develop, and manage hospital policies with technology implementation.

Summary

Healthcare costs in the United States has reached \$3.2 trillion a year, accounting for more than 17% of the GDP, and is predicted to increase in the next 15 years. Due to increased lifespans, rising medical costs, and advanced medical technologies, there is a demand for more healthcare services at a time when public and private insurances are cutting services and limiting reimbursements to enact cost saving measures. As a result, healthcare organizations and providers have to do more at a reduced cost with a limited amount of skilled medical professionals. These trends provide ample opportunity for healthcare organizations to implement

more alternative healthcare innovations using information and communication technologies. The rise of web-based healthcare options and Internet patient health networks has demonstrated that consumers are willing to engage in virtual healthcare practices to manage and maintain their health. By providing consumers with virtual healthcare alternatives, healthcare organizations build better healthcare services models that can ease congestion at medical facilities, improve patient health, and reduce healthcare costs. Understanding how the healthcare structure works in the United States and technology's history in healthcare can provide a foundation to building virtual healthcare models.

Chapter 2: Literature Review

Traditional Healthcare System

The major function of a healthcare system is to ensure the health and safety of the people. In the majority of developed countries like Canada, United Kingdom, South Korea, and Sweden, a universal health care system ensures that its citizens and residents have access to health services without incurring financial risk or hardship. Universal health care is not a one-size-fits-all model, but rather is more of an umbrella term used to describe a public policy framework of providing care for all, operating from the ideals that healthcare is a basic human right and providing equal access to such services brings better health and protection from poverty to the people (World Health Organization [WHO], 2010).

Five common themes define a universal health care system: (a) access to care or insurance, (b) comprehensive coverage under a given healthcare plan, (c) primary care as the first identifiable points of entry to care system for common primary conditions instead of multiple rounds of referrals, (d) functions under the right-based belief that essential primary health care is a human right, and (e) provides social and economic risk protection to guard against social distress and economic loss that can result from costs associated with necessary medical treatment (Stuckler, Feigl, Basu, & McKee, 2010). Each country that uses a universal healthcare approach has a different way of implementing the model, but all use general tax revenues as the primary funding source, with additional funds provided by private or public contributions, as well as optional insurances and levies for services beyond covered universal coverage (Physicians of National Health Program, 2004). The U.S. stands alone as the only industrialized country that does not provide universal healthcare to its citizens.

The traditional healthcare model in the United States is very different from that of other developed or industrialized nations. The United States' approach to healthcare is like that of a patchwork quilt, made up of insurers, suppliers, managed care organizations, and a host of various private and public healthcare insurance programs. This may account for why healthcare in the United States is the most expensive system in the world, with as much as 17% of the GDP, or \$3 trillion dollars a year, being spent on healthcare (CMS, 2013). Despite the United States having the most technologically advanced healthcare systems in the world, there has been growing dissatisfaction from consumers and patient advocacy groups with the increased cost of health insurance and decreased access to necessary services. The variety of plans is a main feature of U.S. health insurance and one of the reasons it is next to impossible to provide universal coverage in the country. It would be unwieldy to identify all the available plans available here; however, a list of the common features provides an overview of the design of the healthcare delivery system.

The private insurance sector is the main source of healthcare coverage for the majority of people in the United States, largely through employer-sponsored healthcare benefits. Employers and the self-insured purchase plans through private insurance companies for a monthly fee. The employer pays a portion of the private insurance cost, and employees can subscribe to a HMO (health maintenance organization) or a PPO (preferred provider organization) insurance plan. The basic formula is that the subscriber or sponsor pays a monthly premium fee to cover consumers for healthcare services for which they normally would not be able to pay out of pocket. Private health insurers are for-profit companies, and as such offer several plans based on the level of financial risk the subscriber wants to adopt (Baribault & Cloyd, 1999). If the subscriber is willing to pay a higher out-of-pocket cost in copayments and deductibles, the

insurance premiums he or she pays are lower. Decreased access, increased cost, and the exclusion of pre-existing conditions contributed greatly to more and more people being unable to obtain basic medical services, even with insurance (Sadeghi, Barzi, Mikhail, & Shabot, 2012). In 2013 it was estimated that roughly 49% of private sector companies offered healthcare benefits to their full-time employees across the United States (Henry J. Kaiser Foundation, 2013). The increased problems and deficiencies in providing adequate care, whether through private or public insurance, is caused by the preoccupation with short-term financial performance as well as political gamesmanship (Sadeghi et al., 2012).

The government provides public insurance coverage for individuals who meet certain criteria. Public insurance plans offered through government assistance include Medicare, Medicaid, Tricare, and Department of Veterans Affairs (VA). Tricare and VA healthcare plans are only for individuals who have served in the United States Armed Forces. Veterans and active duty members who have service-connected medical conditions or disabilities can receive medical and healthcare services at no cost through the VA's extensive hospital networks (Defense Health Agency, 2015). When individuals retire from military services they can subscribe to the Tricare medical insurance plan. Unlike VA healthcare services, Tricare insurance covers family members.

For individuals who cannot afford private insurance, there is Medicare and Medicaid, each with very specific criteria for qualification. Medicare is the public health insurance program for individuals who are a minimum of 65 years old, as well as younger individuals with disabilities and those with End-Stage Renal Disease. For individuals who are under 65 with a disability, their disability has to be considered permanent and they have to have been receiving disability benefits for 24 months before they can become eligible for Medicare services (CMS,

2015). This means that for those whose condition may change within 12 months, or who do not qualify to apply for Social Security Disability Insurance will not qualify for Medicare. For those who are 65 years old and older, additional criteria must be met before they can receive healthcare coverage.

Seniors who are of age will be automatically be enrolled in Medicare part A (hospital coverage), but they will have to initiate enrollment in part B (medical coverage), or else not have coverage. Additionally, if the qualified senior, or his or her spouse, has not paid Medicare taxes for at least 10 years, he or she does not qualify for the premium free part A, and will has to pay a monthly fee of \$407 for part A coverage, in addition to \$107 for part B (Center for Medicare & Medicaid Services, 2015). Medicare is funded through income taxes. Federal funds as well as state funds are used to fund the Medicaid program.

Medicaid requires individuals to apply and prove they are very low income in order to qualify. Medicaid and the Children's Health Insurance Program (CHIP) are programs run by each individual state; thus, Medicaid and CHIP can have varying qualifications state to state. Nevertheless, there are minimum federal requirements to qualify for one of several mandatory eligibility groups. Parents with dependent children and caretakers caring for dependent relatives must meet the Federal Poverty Level (FPL) mandate. If the family is receiving Aid to Families with Dependent Children (AFDC), they automatically qualify for Medicaid services (2015).

Working, non-disabled adults without dependents have the greatest difficulty obtaining coverage since individual states were not required to provide any health coverage prior to the Affordable Care Act (ACA). Many states do provide some form of healthcare coverage through additional federal waiver and state-funded programs if non-disabled adults meet the FPL qualifier and are uninsured. There is also coverage for adults if they are classified as *medically*

needy and their income is above the FPL. These individuals will typically have to do a *spend-down*, in which they incur medical costs until they reach the FPL to qualify for Medicaid services. In these cases, the Medicaid program will cover the cost of medical services that exceed what the individual incurred in the way of expenses in order to become eligible (CMS, 2015). The last eligible groups are women diagnosed with breast or cervical cancer, and individuals diagnosed with tuberculosis. A non-disabled adult without children who did not meet the FPL and is uninsured could not receive healthcare coverage until the passing of the Patient Protection and Affordable Care Act (PPACA),

The Patient Protection and Affordable Care Act (PPACA), or Affordable Care Act (ACA) as it is more popularly known, is a reform healthcare law designed to make healthcare more affordable, as well as provide coverage for millions of underinsured and uninsured citizens. The ACA created Medicaid minimum eligibility guidelines that allowed low-income adults to qualify without children for the first time. The ACA also allows states to apply for federal waivers that will allow them to expand their state-funded programs beyond the recognized eligibility groups (Patient Protection and Affordable Care Act, 2010).

Although there is now a national minimum for Medicaid coverage, states can independently decide to charge premiums, similar to private insurance programs. These costs can include co-payments, deductibles, coinsurance, and prescription costs. There is a maximum out-of-pocket cost, but states have the option to charge higher fees to specific groups with higher income to share the cost of healthcare services (Center for Medicare & Medicaid Services, 2015). However, even with a shared cost, uninsured adults are more likely to be able to afford healthcare coverage. The ACA also created guidelines for the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009, which was created the Recovery and

Reinvestment Act of 2009, to promote the creation and adoption of health information technology (HIT). The HITECH Act aims to improve the quality, safety, and efficiency of healthcare in the U.S. by investing in HIT and health information exchange (Office of the National Coordinator for Health Information Technology, n.d.a, n.d.b; U.S. Department of Health & Human Services, 2011).

Relationship between Technology and Healthcare

The HITECH Act established guidelines for the implementation of *meaningful use* of electronic health records (EHRs), and as much as \$36.5 billion is being spent to create a nationwide network of EHRs (O’Harrow, 2009). “Meaningful use” means that healthcare providers need to demonstrate they are using EHRs in a way that is measureable, both qualitatively and quantitatively (CMS, 2011; Jha, 2010). The emphasis on meaningful use is deliberate, as data has shown that adopting EHRs was not enough to substantially improve care; thus, the Obama administration and policy makers focused on scientific evidence that demonstrated how use of EHRs and widespread sharing of clinical data had the ability to lower costs (Jha, 2010). As such, the HITECH Act has very specific criteria for the adoption and usage of EHRs and has tied financial incentives as well as penalties to meaningful use.

Under the HITECH Act, approximately 700,000 practicing clinicians and 5,000 acute care hospitals have a substantial amount of money allocated toward the adoption and usage of HIT. That is to say that clinicians and hospitals must utilize electronic prescribing, HIE, and automated quality performance reports, in addition to having a system in place that allows for recording patients’ history, care summary reports, and at least one decision support tool (Jha, 2010). These goals are significant challenges for the United States, considering that the data shows that only 13% of physicians in the U.S. healthcare system were using some type of EHR

or HIT system to track patient history prior to ACA or HITECH, compared to nearly all hospital clinicians and family practices in the United Kingdom (Schade, Sullivan, De Lusignan, & Madeley, 2006).

Since the passing of HITECH Act, data shows the adoption of EHRs at a rate of 3–6%, which made it difficult to achieve universal adoption of EHR by 2014 (Jha, 2010), despite the establishment of incentive payment programs and guidance programs (Buntin et al., 2011). To aid in the adoption and implementation of HIT and EHR systems, the U.S. Department of Health and Human Services created the Office of the National Coordinator for Health Information Technology (ONC) to help spur the adoption of EHRs. To understand the importance of the HITECH Act, it is vital to understand the role technology has played in healthcare and why current healthcare innovations can increase access and affordability of care in the United States.

Legislation and regulations can become very cumbersome, and the terminology used in the HITECH Act is also confusing. Most notable is the repeated use of the term EHRs or electronic health records. This term is used in reference to the adoption of HIT as if it is an all-inclusive term. This inclusion is simply not the case, based on its functionality in comparison to other technologies used in healthcare. That is to say that EHRs are themselves a type of HIT system, but not inclusive or representative of the variety of systems used in managing healthcare by electronic means.

History of Technology in Healthcare

Healthcare and technology have always shared a working relationship, particularly in the areas of computer technology and healthcare administration. In the 1960s the healthcare sector started discussing how using computers could enhance healthcare practices in the hope of reducing medical errors and improving access to health information data and results (Ambinder,

2005). During this time, the pharmaceutical industry pioneered using automation with computers and telephone systems to create cost-saving measures and control inventory by electronic means (Salmon & Jiang, 2012). It was not until the 1970s with the passage of the Medicare reimbursement mandates that computer systems for administrative functions such as medical billing and physicians' practice management came into widespread use (Johnson, 2003). Gradually, computers systems became part of standard practice for hospitals, pharmacies, radiology departments, and laboratories; however, most systems were designed for isolated use at a specific hospital or private practice. The 1990s brought integrated systems into play, which coincided with the increased presence of large multi-application vendors offering more automated computer services (Salmon & Jiang, 2012). With advancement in technology and access to the Internet came healthcare innovations that moved HIT applications beyond administrative purposes, providing clinical applications and launching the HIT industry.

Information and communication technologies. Information and communication technologies (ICT), health information technology (HIT), health information systems (HIS), and eHealth are umbrella terms used to capture a broad set of functions and items, but it is important to note that these words are not interchangeable. ICT is perhaps the broadest and most challenging term to define because of its diverse application across different sectors, making it difficult to find consensus on a definition that includes its functions across the different disciplines. For example, the education field uses ICTs as a vehicle for learning and teaching through applications, the economic development sector utilizes ICTs to reduce the digital divide in developing countries, and the health sector uses ICTs to collect and analyze data for public health monitoring (Zuppo, 2012). Despite its various usages, the underlying principle is the same regardless of its application; ICTs facilitate the transfer of information through devices and

infrastructures that can be stored, retrieved, transmitted, or received in a digital or electronic format (Zuppo, 2012).

Health information technology (health IT or HIT) refers to dedicated IT infrastructures that deal with the healthcare delivery system. At its simplest, it is defined as the application of computers and technology in healthcare settings (Hersh, 2009). Discussions on EHRs, health information exchange (HIE), electronic prescribing (e-prescribing), and computerized physician order entry (CPOE) are all examples of health ITs. HIS is defined as information systems that capture, store, process, and communicate timely information so that decision makers are better able to coordinate healthcare at both the individual and population levels (Finchman, Kohli, & Krishnan, 2011). It sounds remarkably similar to the definition and function of ICT, because HIS represents the information portion of ICT to help people and organizations interpret and process information.

Health information technology. With a national shortage of physicians and an increase in demand for healthcare services, the development of technological innovations is at an all-time high. Health IT systems that allow for virtual healthcare, telehealth, and e-Health systems are often cited as significant and promising solutions to improving access and quality. In fact, a host of applications and programs are all geared towards improving healthcare locally and worldwide. The lack of standardization and consensus regarding ICT in healthcare has garnered a host of terms and definitions that often overlap with or parallel each other. Establishing clarity and consensus is important to understanding HIT, and as such the most notable and recognizable terms will be explained.

Health information technology (HIT) is an umbrella term that encompasses a wide array of technologies used to store, access, share, and analyze health information (ONC, 2013). Many

have argued that HIT is one of the most important aspects of improving efficiency, cost effectiveness, quality of care, and safety in healthcare. However, use of HIT and EHRs is still low, with healthcare providers citing computer literacy or difficulty using HIT system as barriers to adoption, including issues with order entry or patient-to-provider communications. However, there are examples of HIT improving patients' health and demonstrating cost-saving care. One study found that three dialysis centers in New York City saw a nearly 50% decrease in patient mortality and 25% decrease in nursing staff levels after the adoption and implementation of EHRs (Buntin, Burke, Hoagling, & Blumenthal, 2011).

The disruptive nature of health ITs provides an opportunity for growth, particularly during a time where the demand for services is rapidly increasing and affordable healthcare is more accessible to U.S. citizens and residences. Strategic implementations of HIT systems are critical to their adoption and growth as it educates and trains people on HIT and how they work to improve care, reduce risk, and improve cost-savings. The most popular health IT applications in use are EHRs, picture archiving, and communication systems (PACSs), e-prescribing, computerized decision support systems (CDSSs), and computerized physician order entry (CPOE). Despite HITECH's emphasis on using EHRs to improve healthcare in the United States, it actually calls for the use of several HIT systems, with EHRs being one of them.

Health Information Technologies

HIT applications such as EHR, CDSS, PACS, and CPOE systems are stand-alone systems used with virtual healthcare services. Some of their functions may overlap, but each has very specific functions.

Electronic health records. EHRs are electronic versions of a patient's medical history that include clinical data related to a person's health, such as medications, vital signs, medical

problems, lab results, and radiological findings (CMS, 2012). EHRs can be combined with CDSSs or they can be used as separate systems. The CDSS is an information system designed to improve clinical decision making by matching a patient's records to a knowledge base that generates patient specific recommendations (Garg et al., 2005).

Clinical decision support systems. CDSSs are most commonly used for ensuring accurate diagnoses, screening for preventable diseases, and averting adverse drug interactions; a CDSS can do all of this simultaneously. Because access to a patient's records is needed for clinical decisions, CDSSs can be built into a local EHR or can be maintained as separate systems that are accessed through a facilities EHR system, the Internet, or a hand-held device (Berner, 2009).

Picture archiving and communication systems. PACSs are economical storage systems that provide clinicians with the ability to rapid-retrieve images, access multiple images from various modalities, and access these images from multiple locations (Choplin, Boehme, & Maynard, 1992). Their primary functions are to improve operational efficiency and improve diagnostics. PACSs can also be integrated into an EHR, which improves information sharing, leverages compliance with HITECH regulations, minimizes disruption to care delivery, and provides more information to allow for quicker, better informed decisions (Wells, 2010).

e-Prescribing. Electronic prescriptions, known e-prescribing or eRX, transmit prescription orders, and help physicians avoid prescribing errors, adhere to treatment guidelines, and monitor patients' responses to medication treatments (Bell & Friedman, 2005). Pioneered by large drugstore chains seeking to increase profits and decrease business expenditures, e-prescribing became a popular method of issuing prescriptions because of its ability to prevent prescribing errors, by and large the most preventable hospital error (Salmon & Jiang, 2012). The

e-prescribing technology became more streamlined with the passing of the Medicare Prescription Drug, Improvement, and Modernization (MMA) Act of 2003, which authorized coverage for prescription drugs starting January 2006 (Bell & Friedman, 2005). An e-prescribing system can be used as a stand-alone or within CPOE systems. Similar to an e-prescribing system, a CPOE system allows physicians to place an order for medication as well as tests, labs, and medical procedures, and are designed to reduce medical errors and enhance patient safety. CPOEs feature an integration of medical information that is checked against a patient's diagnosis, medical history, and recent treatments to alert the physician of possible adverse effects (Minesh et al., 2015). These applications make it possible for healthcare providers to meet new regulatory standards, particularly those under *meaningful use* protocol, as well as provide alternative healthcare services that are more accessible to the public through electronic means. The amount of stand alone HIT applications for patient use allows healthcare services to go beyond brick and mortar services to virtual healthcare.

Defining Virtual Healthcare Models

Virtual healthcare is an umbrella term often used interchangeably with e-visits, telemedicine, telehealth, and e-health. Rural medicine and home health are included in the telehealth model because healthcare services are provided outside traditional health facilities. Finding a formal definition is nearly impossible within the literature because of the overlapping nature of these services; however, there are slight differences that will be explored. Lazakidou (2012) identified virtual healthcare as community spaces that bring healthcare providers and patients together for the purpose of improving the quality of healthcare services and to help healthcare providers and researchers conduct various activities, with patient monitoring and medical consultations being the most popular. Virtual healthcare makes telehealth possible via

electronic visits (or e-visits) with medical professionals via computers and mobile devices because it has the benefit of lower cost and increased convenience (Grube, 2015).

The Health Resources and Services Administration (HRSA, 2015) defines telehealth as “the use of technology to deliver health care, health information or health education at a distance” (para. 1), indicating that telehealth can either be done in real-time through teleconferences, patient exams via webcams, or consultants via live web links. They can also be done via store-and-forward methods, as is the case when images or orders are transmitted electronically. Telemedicine is often used interchangeably with telehealth, the only difference being that telemedicine refers specifically to remote healthcare or clinical services, whereas telehealth encompasses remote healthcare services as well as non-clinical services, such as health education or training (ONC, n.d.; American Telemedicine Association, 2012a).

The term e-Health came out of the 1990s Internet boom and, like many other e-terms, was indicative of products and services that were disseminated electronically over the Internet. E-Health represented the promise of an improved health care system that used ICT (Alvarez, 2002). Today eHealth is defined as “the transfer of health resource and health care by electronic means” (WHO, n.d., para. 1). Three main components make up e-Health: (a) health information is delivered through the Internet for healthcare professional and consumers; (b) IT and e-commerce are used to improve public health services such as medical training for providers; and (c) e-commerce and e-business practices are used to market, distribute, sell, deliver, and otherwise manage healthcare systems (WHO, n.d.). Essential e-Health is similar to the other terms except that it includes the business and financial practices associated with healthcare services.

The rapid advancement of technology has made it possible for the healthcare sector to provide care from a distance. Although the method of delivery and the usage of HIT will vary, the overall concept of accessing healthcare services from a distance is the core of virtual healthcare. Virtual health as the umbrella term embodies the essence of using technology to provide healthcare from distance. It includes remote and rural healthcare models, as well as the increasing use of mobile health or mHealth services.

Virtual healthcare models. Virtual healthcare systems come in various models depending on their functionality and cost. Students from the University of California San Francisco's School of Pharmacy and Stanford University's School of Business teamed up to identify the full spectrum of virtual healthcare services available. They identified five levels of virtual healthcare: (a) single, isolated technologies, (b) single electronic health services components (SEHS), (c) virtual points of care (VPCs), (d) Virtual add-ons to existing healthcare systems, and (e) a complete virtual system of healthcare (Kim, Lai, Lamont, Szeto, & Wilson, 2015).

Single, isolated technologies. Single, isolated technologies are the simplest of virtual healthcare models and they function to make up for inefficiencies within the healthcare system, such as limited or restricted access to primary care and poor adherence to care plans (Kim et al., 2015). The direct cost of non-adherence with providers' advice is nearly \$300 billion annually in the United States alone, and this non-compliance leads to excessive or unnecessary use of emergency rooms, outpatient visiting, nursing home admissions, and diagnostic testing. These costs are in addition to the annual half billion dollars associated with non-adherence to medication regimens (Olson, Young, & Schultz, 2015), including failure to take medications, not taking medication as directed, and failure to fill prescriptions, which lead to poor therapy

outcomes, progression of disease, and unnecessary hospitalizations (Iuga & McGuire, 2014). Examples of single, isolated systems include virtual healthcare assistance, online medical scheduling services, and online personal healthcare databases.

Online health databases are also known as personal health records (PHRs) that patients can access from the Internet or a smartphone. They are becoming increasingly popular, and most healthcare facilities and healthcare insurance companies host PHRs as part of their service (Vecchione, 2012). Microsoft's HealthVault is a free online PHR database that allows users to create a medical profile, and add or correct their health information via computer or mobile application. It is estimated that close to 70 home health and wellness devices, such as blood pressure monitors, digital scales, and blood sugar monitors, are able to synch with and transmit data to HealthVault to keep PHRs up to date. Similarly, there are close to 300 applications that can be linked with HealthVault to help users store and track their medications, manage allergies, and save lab results and medical images to create an organized medical database they can share with healthcare providers or anyone else that may need the information (HealthVault, 2015; Vecchione, 2012;).

Single electronic health services (SEHSs). SEHS components are isolated services that can be integrated into different healthcare systems that are either synchronous or asynchronous (Kim et al., 2015). NextMD is an example of an asynchronous SEHS system that allows communication between patients and providers. It is a popular patient portal that can be incorporated into a healthcare facility's IT system, which then allows patients to ask questions to their provider and allows providers to compose and exchange referrals (NextGen, n.d.). Synchronous SEHSs—like American Well, Doctor on Demand, and Teladoc—all conduct virtual consultations in real-time over the phone or via video for a low fee. Pharmacy giant CVS,

which provides in-store and online pharmacy services, has partnered with all three services to provide direct telehealth services. CVS operates retail clinic services through their MinuteClinic in 32 states and has virtual waiting rooms where patients can opt for telehealth treatment and be seen by any available provider in their network (Dvorak, 2015). Additionally, CVS's MinuteClinics are an example of the third level of virtual healthcare services—the virtual point of care.

Virtual point of care (VPC). The third level of virtual healthcare services is virtual point of care (VPC): single health services bundled into an isolated point of care. For example, virtual kiosks can be found in hospitals, retail stores, and corner clinic in neighborhood pharmacy such as CVS's MinuteClinic. VPC virtual services include virtual care visits with a physician, interactive kiosks that conduct diagnostic testing, and prescription drug dispensing (Kim et al., 2015). HealthSpot is a VPC where patients can engage in face-to-face virtual visits via video with a physician or nurse practitioner, as well as be tested and treated remotely for a wide variety of conditions (Debby, 2014; HealthSpot, Inc., 2014). For example, Kaiser Permanente is a large health care system in California that utilizes VPCs for patient check-in and prescription refills. Kaiser Permanente also offers a great example of the fourth level of virtual care, in which virtual healthcare components are added onto an existing system.

Virtual add-ons. Virtual add-ons to an existing healthcare system have been identified as the fourth level in the virtual healthcare model. At this stage, existing healthcare systems like Kaiser Permanente, the Cleveland Clinic in Ohio, and Sisters of Mercy Health System all have virtual healthcare add-ons. Kaiser Permanente has had close to 10.5 million virtual visits in 2013 and estimates are that by 2016 virtual visits will exceed in-person visits at Northern California facilities (Rath, 2014). The Cleveland Clinic is ranked fifth across the country for its healthcare

services and first in the state of Ohio and greater Cleveland for its cardiology and heart surgeries (Harder, 2015), as well as pediatric specialties. Their virtual healthcare system is called MyCare Online, which allows patients to be seen by a provider for \$49 and can be accessed 24 hours a day for minor complaints such as colds, flu symptoms, and minor infections (Zeltner, 2015). Cleveland Clinic's MyCare Online can be accessed via computer or through their mobile application. Additionally, they have partnered with HealthSpot to expand their virtual healthcare services into the community with private walk-in medical kiosks that enable patients to access any Cleveland Clinic provider (HealthSpot, Inc., 2014). The Sisters of Mercy Healthcare system has taken the expansion of virtual health services one step further by opening the world's first virtual care center (Kullmann, 2015).

Mercy's Virtual Care Center is the first facility dedicated entirely to virtual healthcare services; it functions like a hospital, but only houses medical providers and top of the line health IT instead of hospital beds and patients. The center is a \$54-million-dollar investment. It includes Mercy's previously established telehealth programs including Mercy SafeWatch, which virtually monitors patients' vital signs in 30 intensive care units (ICUs) across five states. In addition to Telestroke, which provides immediate virtual access to neurologists for patients who come into the ER with stroke symptoms, and home monitoring, which continuously monitors chronically ill patients at their homes after their discharge (Kullmann, 2015). It appears that Mercy's new Virtual Care Center functions like that of a complete virtual healthcare system, which is the fifth level in the virtual healthcare model.

Virtual system of healthcare service. The most integrated approach to virtual healthcare services is that of a completely virtual system of healthcare services that provides: a rich source health education available online for providers and patients, the ability to talk with a healthcare

provider and get personalized answers about health, the ability to exchange emails or have real-time virtual visits with a provider, and access via computer or mobile devices to medical consultations or health monitoring. HealthTap has been identified as a complete virtual system of healthcare as it provides several levels of medical services and triage with over 71,000 providers, but is not attached to a healthcare system (Kim et al., 2015). HealthTap is a private social healthcare network based in California that has a network of board certified doctors and licensed physicians who provide free health care information in real-time and through asynchronous means, but unlike virtual healthcare add-ons, providers decide how much virtual care they provide and what hours they work. For patients, being able to access a physician at any time via their phone or computer for free is a bonus, and doctors can provide their services while also competing with fellow practitioners and building a public reputation (Stross, 2012).

The VA in contrast, is establishing a virtual center for healthcare similar to Sister of Mercy Healthcare system—the VA Virtual Medical Center at the VA’s National Simulation Center in Orlando Florida, which will be part of the VA’s Orlando Medical Center in Lake Nona. The virtual medical center will be a complete virtual hospital that will use simulation training, telehealth, and modern-day gaming technology and graphics that are familiar to today’s service members and veterans. Veterans will be able to access their medical records, search for medical information, have real-time consultations with healthcare providers, and even engage in group sessions with providers (Miller, 2015).

Mapping Virtual Health Services. Advancements in cloud computing and wireless technologies further push the innovations of virtual healthcare practices. While there are reports on the practice of virtual healthcare services across the United States, these reports frequently analyze which services are covered by Medicare, Medicaid, and private insurance. As a result, it

is difficult to identify areas of impact and prevalence of the various virtual healthcare models across the United States. The American Telemedicine Association released a report in May 2015 that captured the complexity of virtual health/telemedicine policies. In each of the 50 states there are 50 varying virtual health coverage and reimbursement standards. For example, of the 50 states, 16 states and Washington, D.C. have policies that do not have provider or technology restrictions; however, only five maintain the highest composite score for virtual healthcare services, indicating that these five states support provider resources and reimburse for virtual healthcare. The varying policies significantly affect the implementation and adoption of virtual healthcare models because of parity laws (Thomas & Capistrant, 2015), which are intended to stop the restriction or limitation of treatment for mental health and medical conditions (U.S. Department of Labor, 2010). For virtual healthcare, parity laws prevent the restriction, limitation, or denial of services provided via telehealth methods.

The advancement of technologies in healthcare provide a number of options on which to focus, such as remote patient monitoring, e-health patient services sites, telenursing, video counseling, and mHealth, to name just a few. Of all these options, mHealth is the most attractive because of its growing popularity among consumers, patients, and providers. mHealth applications and programs have become a popular point of access to healthcare. The continued evolution of virtual healthcare demonstrates the need for guidance on best practices, particularly for the healthcare industry, which has copious laws and regulations. For the purpose of this dissertation, the primary focus will be on the best practices for establishing an mHealth program within the U.S. healthcare system.

Mobile Health

Mobile health is popularly known as mHealth; over 100,000 mHealth applications for Apple and Android smartphones were available in 2014 (Miller, 2014). The adoption of mHealth has been accepted more rapidly and widely than any other virtual healthcare strategy because of the ease with which mHealth can be adopted into the workflow for healthcare providers. In a 2012 survey conducted by Health Information and Management Systems Society (HiMSS), 79% of clinicians expressed an interest in using mobile technology and 89% were already using mobile communication devices like the iPad and smartphones (Vecchione, 2012). It is not just clinicians that are adopting mHealth, but healthcare systems as well, as indicated by a 2012 survey, which found that one third of healthcare organizations provide patients access to health information via mobile devices (Congdon, 2013).

As with other virtual healthcare terms, mHealth has a number of definitions with shared characteristics that include the use of mobile devices and access to health services. According to Varshney (2009; as cited by Varshney, 2014) mHealth is “healthcare to anyone, anytime, and anywhere by removing locational and temporal constraints while increasing both the coverage and quality of healthcare” (p. 20). More specifically the National Institutes of Health (NIH, 2013) stated that mHealth is “the use of mobile and wireless devices (cellphones, tables, etc.) to improve health outcomes, healthcare services and research” (part 2, section 1, para 1.). This definition has been adopted by the U.S. Department of Health and Human Services (HHS) and Health Resources and Services Administration (HRSA), which oversee the improvements of access to healthcare, especially those who are geographically isolated and economically or medically vulnerable in the United States. While the NIH definition is simple, its addition of wireless devices allows for the inclusion of innovative devices such as personal patient

monitoring devices used to monitor health objectives from a distance. This is important, as there are advancements in how mHealth can be used to improve health and healthcare services.

Types of mHealth applications and devices. With clinicians and healthcare systems adopting mHealth technologies, an increasing number of hospitals and healthcare systems are creating their own mHealth applications for patients and providers to use in conjunction with the hospitals' HIT networks. Cleveland Clinic was recognized as one of the hospitals that added a virtual system to their existing services, including the MyCare Online system, which allows patients to access a provider online for \$49. They also developed a mobile application for adult cancer patients and treating clinicians to find clinical trials based on type of cancer, stage of cancer, and hospital locations. Likewise, a nurse practitioner at Emory University's School of Nursing developed the PediaBP application, which clinicians can use to detect hypertension in children and adults (Jayanthi, 2014). Clearly, no one-size-fits-all model for creating an mHealth application exists, but there are specifics to consider when designing an mHealth application that will make accessing healthcare seamless.

mHealth design. The design of mHealth applications involves more than just connecting personal health data or video chatting with a physician. A report from Deloitte—a British multinational professional auditing, consultant, and risk management firm with headquarters in New York—found that a successful mHealth application or intervention must address four dimensions in order for it to be effective. Dr. Harry Greenspun, senior advisor for Deloitte, defined the four Ps for effective mHealth development: people, places, purpose, and payment (Comstock, 2014). The *people* component for effective development refers to tailoring the technology for particular demographics, how they access technology, and their technological preferences. The needs of healthy men will be different than those of women with cancer. *Places*

refers to more to infrastructure rather than actually location. Greenspun stressed how important accessible and available wireless and cellular services were to scaling and implementing any mHealth technologies. *Purpose* deals with the mHealth intervention, indicating that applications or technologies that focus on a particular disease, health issue, or problem, as well as its complexities for managing the condition, are the most effective for interventions. *Payment* is the business side of mHealth and refers to reimbursements from Medicare, Medicaid, and insurance. Payment has been the biggest challenge for mHealth technologies, as reimbursement models depend largely on patient involvement and medical models that guide new and alternative delivery of care. Patients are willing to pay out of pocket for their healthcare services if mHealth technologies offer quality services and better access patients are willing to pay for this value. This consumer empowerment and engagement drives and helps evolve medical models, including payment models (PricewaterhouseCoopers, 2012). However, public and private insurers are the primary payers, and patients with coverage have less of an impact since they can get traditional coverage in already established payment models. Although these four dimensions provide guidance on structuring mHealth technologies, they are not the only criteria being used to determine effectiveness. *Global Health Science and Practices* (GHSP), a free, open-access peer-reviewed online journal aimed at improving health practices in low and middle income countries, established a visual framework for common uses for mHealth technology.

Despite the hype regarding the benefits of mHealth platforms, providing concrete evidence of its benefits lends credibility to why it should be considered an essential healthcare intervention, and is key in overcoming fear of failure or system instability (Labrique, Vasudevan, Kochi, Fabricant, & Mehl, 2013). Focusing on public health initiatives or health interventions instead of the mHealth technologies helps establish goals for the mHealth platform that can be

evaluated, and provide justification for mHealth investments. Having a shared framework makes it easier to explain mHealth innovations and helps mainstream it as a medical service to insurers and stakeholders in the healthcare field. The GHSP framework aims to address previously identified challenges in mHealth by further defining the health initiative and its relationship to the 12 common applications (Labrique et al., 2013). The following mHealth and ICT applications are not ranked by importance and have been vetted by a wide group of mHealth stakeholders including academic researchers and policy implementers.

Client education and behavior change communication. Client education, also known as patient education, is the process of teaching and learning positive behaviors that improve a patient's health (Dreeben-Irimia, 2010). Behavior change communication (BCC) is interactive interventions designed to promote positive behaviors that will improve health, and are used frequently when discussing reproductive health, STD prevention, and gender-related issues (United Nations Populations Fund, 2002). Entertainment education is a common approach that uses multiple media outlets to promote BCC through creative and informative storylines. A great example of this is the Mobile Alliance for Maternal Action (MAMA), winner of the 2012 Fast Company Innovation by Design Award, which provides weekly health information and reminders to pregnant women and new mothers in low-resource areas via text message (USAID, 2012). Additional supporting mHealth platforms include multimedia messaging services or MMS, interactive voice response or IVR, audio clips, video clips, and images.

Sensors and point of care diagnostics. Virtual points-of-contacts were previously identified as a single electronic health service that can be integrated into a healthcare system and used in real-time or asynchronously. Sensor and point of contact diagnostics is taken one step further by allowing providers to diagnose from any location. Sensor technologies that conduct,

store, and transmit diagnostic information via mobile phones are still in their infancy, but such technology is critical when the patient and provider are geographically distant from each other (Labrique et al., 2013). Sensor technology has the ability to measure and store vital signs, and trigger an alert when anomalies are detected. Point-of-care diagnostics allow providers to diagnose patients wherever they are—whether in the hospital, an ambulance, or at home—in a timely fashion, resulting in rapid treatment and care (National Institutes of Health, 2013). An example would be the U.S.’s AliveCor, a clinical grade 2-lead ECG that is tethered to a mobile phone and allows patients to view and access cardiac health at the point-of-care. The supporting mHealth platform would include mobile phone cameras, tethered accessory sensors, and built-in accelerometers (Labrique et al., 2013).

Registries and vital event tracking. Registration and vital event tracking through mobile phones allow patients to be identified and counted for specific services that match up with their health information, vital events, and vital signs (Knowledge for Health, n.d.). Mobile phone-based registration facilitates this identification process and increases accountability for providing complete and timely care (Labrique et al., 2013). The supporting mHealth platforms are text messaging, voice communication, and digital forms.

Data collection and reporting. Moving from paper-based system of rosters and ledgers to digital collection allows the almost instantaneous ability to collect and report patient data. Collecting accurate and complete data—including race, ethnicity, language, and socioeconomic status—results in improved quality of care and address health disparities in care. There are national-level systems, such as the District Health Information System 2 (DHIS2), which is an open-source system used in 47 countries for health data collection and reporting (District Health

Information System 2, n.d.; Labrique et al., 2013). The supporting mHealth platforms are text messages, digital forms, and voice communications.

Electronic health records. EHR platforms are a hot topic of conversation for U.S. healthcare systems and policymakers, and have been a national healthcare initiative under the HITECH Act. At their inception, EHRs could only be accessed at a fixed location from a dedicated computer terminal. While access to EHRs have expanded, mHealth has redefine again redefined accessibility so that providers can access and submit health data from the point-of-location, update records, and continue with care from a distance (Labrique et al., 2013). OpenMRS is a popular EHR system for mHealth technologies that allows healthcare providers in the field to access and store information in real time. The supporting mHealth platforms are digital forms and mobile web browsers.

Electronic decision supports: Information, protocols, algorithms, checklist. Electronic decision supports were previously discussed in the identification of HIT applications that support virtual healthcare systems. CDSSs and other electronic decision support tools help ensure that providers adhere to care guidelines and protocols. This protocol is particularly important during times when tasks are shifted from clinicians to support healthcare workers who have limited training. Electronic decision supports provide support and guidance to keep healthcare services in line (Labrique et al., 2013). MHealth accessibility, especially when combined with point-of-contact decision tools, can identify and prioritize high-risk patients, target health interventions, and reduce clinical errors. An example is the e-IMCI (electronic Integrated Management of Childhood Diseases), a mobile phone-based system that provides community health workers with step-by-step support to triage and treat common childhood diseases according to WHO

protocols (Labrique et al., 2013). The supporting mHealth platforms are mobile web browsers, apps that store health information, and IVR.

Provider-to-provider communications: User groups, consultation. Walsh et al. (2014) noted that literature and studies discussing the impact of provider-to-provider electronic communication were sparse, and those available focused on provider usage, but not on effectiveness. Voice communication via mobile phones is the most transformative as it allows providers to communicate with one another regardless of technical expertise (Labrique et al., 2013), and it can be done in real-time or through voice messages. mHealth technologies also allow providers to engage in a more advanced level of communication, such as using the sounds of digital auscultations from an electronic stethoscope during a remote consultation. The supporting mHealth platforms are text messages, multimedia messages, and mobile phone cameras.

Provider working, planning, and scheduling. Planning and scheduling tools keep healthcare providers up-to-date and on schedule by providing scheduled reminders of upcoming or due services, which promotes accountability and prioritizing (Labrique et al., 2013). A number of software products on the market help healthcare systems establish a working system. The addition of an mHealth system works to facilitate scheduling and planning services for out-based or remote workers to receive mobile phone alerts on a variety of health events, such as scheduling postnatal care visits, missed appointments and vaccinations, and reduced compliance to medication treatment. The system also works to alert patients of appointments and health care regimens to which they should adhere. An example is TxtAlert, a free text messaging service from South Africa that sends personalized messages to patients with HIV/AIDS in order to increase patient compliance with antiviral treatments (Center for Health Market Innovations,

n.d.). The supporting mHealth platforms are include interactive electronic client lists, text message alerts, and mobile phone calendar.

Provider training and education. Continuing medical education (CME) has been a critical factor in quality of care in high-income areas. MHealth applications and platforms now provide an access point for providers to receive ongoing training and education to support the work done onsite at healthcare facilities, as well as work done remotely. It also allows providers to receive clinical education and skills monitoring through case-based learning. An example is Uganda's eMOCHA mobile application, which allows frontline healthcare providers to stream videos and access updated health education information to aid in prevention, detection, and care of certain conditions. The supporting mHealth platforms are text messaging, multimedia messaging, IVR, voice communication, audio/video clips, and images (Labrique et al., 2013).

Human resource management. Remote and community healthcare providers and workers often fail to get direct supervision or support. MHealth systems like UNICEF's Rapid SMS allow supervisors to monitor text message exchanges among remote workers and the healthcare system central servers (Labrique et al., 2013). Such a support system allows supervisors to provide support to staff who are behind in their performance and recognize those who are exceptional. The supporting mHealth platforms include web-based performance dashboards, GPS, text messaging, and voice communications.

Supply chain management. Management of supplies and stock is important in any business and is essential for the healthcare sector. As discussed previously, the pharmaceutical industry pioneered the use of computer automation in the 1960s to keep track of inventory and cut costs. Today mHealth applications and systems are able to support the inventory and stocking needs of remote clinics and pharmacies by tracking and requesting medical supplies and

medications (Labrique et al., 2013). A number of nations have implemented and adopted this strategy, including Tanzania, which has 5,100 trained facilities doing weekly reporting for the SMS for Life system (Novartis, n.d.). The supporting mHealth platforms are web-based supply dashboards, GPS, digital forms, and text messaging.

Financial transaction and incentives. The convergence of mHealth and mFinance allow for payment and reimbursement of health care, supplies, and medication, as well as making incentive schemes easier to deploy and scale. MHealth developers are also testing novel ways to incentivize providers to provide a higher quality of care. The goal is to decrease the financial barriers to providing care for patients. The supporting mHealth platforms are mobile banking, money transfer services, and airtime minutes transfer.

Accessibility. MHealth applications and systems are tools that are easy to use and are accessible to anyone with a mobile phone, especially when accounting for remote and rural communities that have limited resources, healthcare professionals, and access to broadband and IT services. Many opportunities are available to increase access and quality of care, regardless of location. Nevertheless, barriers continue to plague the planning, implementation, and adoption of virtual healthcare and mHealth systems.

Gaps in the Research

Meachael et al. (2010) identified several gaps in mHealth research worldwide, with a primary focus on low and middle income countries. The most prevalent gaps are the use of mobile technologies for treatment compliance, the use of mobile technologies in data collection and disease surveillance, the use of mobile technologies in information and support tools for health professionals, the use of mobile technologies for disease prevention and health promotion, and the use of mobile technologies in emergencies. Disease management via mobile technologies

is known as mAdherence. mAdherence has the potential to facilitate better treatment compliance, but recent studies continue to show mixed results (Hamine et al., 2015). A randomized controlled trial of 27 studies showed that 56% observed a noticeable improvement in treatment compliance, while another 39% had significant improved disease surveillance and health promotion. Short message services (SMS) or text messaging is the most commonly used mAdherence tool. Nevertheless, barriers such as usability, feasibility and patient preference for mHealth tools and mAdherence interventions still need to be researched (Hamine et al., 2015) for improved mHealth capabilities and knowledge.

The gaps in mHealth knowledge are due to the limited scale and scope of mHealth implement and evaluation. Copious amounts of mHealth tools are available, but documentation on mHealth implementation, adoption, and evaluations are limited. There is a growing interest in studying the cost-benefits of mHealth value and health outcomes, which will focus more on the health side of mHealth instead of the technology. Current studies published on the health cost and benefits primarily focus on low-to-middle income countries. A large number of the studies and publications on mHealth are associated with computer science and the technologies behind mHealth, not with the health benefits or outcomes (Machael et al., 2010; Comstock, 2014). Technology giants like IBM and Apple have realized the benefits of mobile healthcare and have designed their mobile phones and other products to work with a healthcare provider's existing infrastructure (Pelino, 2014). This makes it difficult to educate and influence government, policy makers, providers, and industry partners on investing resources in national mHealth initiatives when health is not the primary focus.

Barriers in mHealth

Increased cost, national shortage of physicians and nurses, and increased demand for services sparked reform of the U.S. healthcare system. The ACA and HITECH Act are laws enacted to improve the U.S. healthcare system by offering affordable healthcare to millions of previously uninsured citizens. They also established guidelines to improve access to and quality of care through EHRs and other health IT systems, including mHealth. The benefits of mHealth are plentiful, but only if barriers in policy and regulations, security and privacy, payment and reimbursement, and interoperability are addressed.

Policies and regulations. A 2012 study found that developing nations were quicker to accept and adopt mHealth as a method to increase access to healthcare versus developed countries like the United States, which faces with resistance from providers and numerous regulations (Wicklund, 2012). The HITECH Act was created to help promote the implementation and adoption of virtual healthcare technologies in the United States, to reap similar benefits seen in developing countries. Doing so would change the way patients, clinicians, and healthcare professionals interact with the healthcare system and how health data are accessed, as well as how healthcare services are delivered. Overseeing this reform is the Health IT Policy Committee, which was created as part of the American Recovery and Reinvestment Act of 2009 and advises the National Coordinator for Health IT (ONC) in the creating health IT infrastructures for the nation. However, standardized policies and regulations are far and few between. The creation and enforcement of regulations and policy by the Federal Drug Administration (FDA), Federal Trade Commission (FTC), and Federal Communication Commission adds another layer of complexity. The Federal Drug Administration (FDA) has been tasked with the responsibility for regulating mHealth applications—software and hardware—with support from the FTC and FCC.

Federal Drug Administration. The FDA Safety and Innovations Act (FDASIA) of 2012 gave the FDA the ability to create regulations for what the agency classifies as digital health (U.S. Food and Drug Administration [FDA], 2012). Digital health is used in a broad sense to include mHealth, health IT, wearable devices, telehealth/telemedicine, and personalized medicine. With an estimated 500 million smartphone users using mHealth applications in some capacity to manage their own health and obtain health information (FDA, 2015), the challenge of standardizing and enforcing regulations on all mHealth application is astronomical, especially in the face of continuous change and development of mHealth applications and devices.

The FDA will not enforce compliance with regulatory mHealth or digital health standards on those applications, devices, or systems that are communication devices, as they determined they do not pose a threat to the public (Center for Connected Health Policy, n.d.; FDA, 2015). The FDA instead is taking a tailored, risk-based approach on mHealth application and will only impose regulations on devices that pose more than a minimal risk to patients and consumers (FDA, 2015). While this allows room for mHealth application developers to be creative, there is also a significant potential danger in not regulating any software or device that collects medical information because it is categorized as a communication device (Vodafone Global Enterprise, 2013). The FDASIA provides guidance on what can be identified as a medical device, and if it is a medical device that it must be registered. In addition, they regulate the software used for telehealth and virtual healthcare services. The difficult part is determining when an mHealth application is a medical device, given the constant influx of new mHealth innovations that can be categorized as both a medical device and a communication device. For example, AliveCor (n.d.) is an mHealth application for smartphones and tablets that uses an ECG attachment to view and access cardiac health data at the point-of-care, which can be shared with healthcare providers.

The phone now functions as a medical device in collecting data for diagnostics and treatment; however, it also serves as a communication device that uses telecommunication networks to transmit data. In such cases it is likely a best-case scenario that both the FDA and FCC would both be responsible for regulation (Center for Connected Health Policy, n.d.).

Federal Communications Commission. The FDA has intentionally limited what they will enforce and are using a tailored-risk approach in regulating mHealth applications that meet the regulatory definition of a medical device (FDA, 2015). The FCC is working with the FDD on creating a risk-based regulatory framework that avoids regulatory duplication and creates a framework for mHealth application and digital health (Federal Communications Commission [FCC], n.d.). The FDA and FCC have a Memorandum of Understanding to address overlapping jurisdictions in which they would work together in their respected areas of expertise. While the FCC is the government agency that regulates communication devices such as mobile phones and tablets and is working with the FDA on health IT and digital health regulations, it does not enforce regulations on items classified as medical devices (Center for Connected Health Policy, n.d., FDA, 2015). Conversely, the FCC recognizes that medical devices, such as those used for remote health monitoring, require telecommunication and broadband networks in order to manage and monitor health conditions. In support of healthcare mandates and in collaboration with the FDA, the FCC is developing policies to support the implementation and adoption of broadband-enabled health IT solutions that support mHealth technologies (FCC, n.d.). The FCC already has several rules and policies related to improving health IT activities that use interstate and international communication lines. For example, the FCC is working to further expand network accessibility for HIT systems and add flexibility for medical body area network devices (i.e., blood pressure sensors, ECG monitors, pacemakers, etc.) to meet technical standards (FCC,

2014). The overarching problem in health IT implementation is that no standardized guidelines or regulations exist. This affects interoperability, which brings up a related problem of sharing and transmitting health data across broadband Internet.

Federal Trade Commission (FTC). The FTC has authority over health data breaches for entities that are not covered by the Health Insurance Portability and Accountability Act (HIPAA), with regard to mHealth applications and systems. This policy has allowed the FTC to go after mHealth developers who do not meet FTC regulations or appear to be engaging in unfair or deceptive acts. There continues to be large gray areas on how software and hardware are monitored and regulated for mHealth purposes. Although government regulations can be complex and at times create additional barriers, they also provide clarity and guidance that streamline the process. Another gray area is how to address security and privacy with mHealth.

Security and privacy. Of the many concerns regarding barriers to mHealth, the biggest has to be privacy and security. The protection of private health information is a constant issue around the globe for governments, policymakers, developers, healthcare providers, and patients. A data breach doesn't just impact the views of the system or platform; it leaves a negative outlook for the entire mHealth sector and breaks the trust that has been established (Congdon, 2013). The U.S. Department of Health and Human Services has set forth priorities that include ensuring adequate privacy and security of private health information, under the guidance of the HITECH Act. Per the HITECH Act, one of the main goals is to strengthen the public's trust in health IT and electronic information by ensuring their privacy and security. The challenge with this, again, is the fact that governments and regulatory bodies are constantly in flux and move much slower than technological innovations and development. Also, mHealth technologies are not homogenous, as discussed previously in the identification of the most common mHealth

designs. Additionally, mHealth technology, by virtue of being remote, has no geographic boundaries across the globe. The lack of a standardized protocol on how healthcare providers and facilities can safely share health data from ONC (whose job is to provide guidance to hospitals and clinical practices for adopting health IT and telehealth practices) contributes to the barriers in mHealth. Compounding the barriers even further is the inability of HIPPA- approved providers and facilities to share data across health IT systems with other organizations.

Payment and reimbursement. One of the biggest barriers to mHealth and virtual healthcare services as a whole is the various policies on payment and reimbursement. While the Affordable Care Act outlines the benefits of digital healthcare services, and Medicare has established some standards for reimbursement, there remains a large gap and many inconsistencies on how payment and reimbursement should be provided. A report from the Public Health Institute Center for Connected Health Policy (2015) focused on eleven specific telehealth reimbursement policies and laws for public health insurance programs, and found that no two states in the United States were alike in how they defined telehealth or regulated the services. For example, Iowa, Massachusetts, and Rhode Island are the only three states that do not have established reimbursement policies for related telehealth services. Similarly, the District of Columbia did not have a written policy for reimbursement for any type of telehealth services until 2014 when a law went into effect requiring DC to reimburse medical providers for services that are delivered via live video.

The variations among the states on reimbursement for telehealth and digital health services are due largely to the fact that each state can define Medicaid parameters for their healthcare systems; therefore, each state has taken a different route on how telehealth policies are governed. Some states follow the reimbursement standards established by the Centers for

Medicare & Medicaid Services and others develop their own protocols as it relates to their public health insurance services. For example, the majority of the states stipulate that telehealth services must be provided in real time to qualify for payment and reimbursements. This effectively excludes asynchronous healthcare services like consulting on lab images, viewing video exam clips and patient data exchanges. Alaska, Arizona, California, Illinois, Minnesota, Mississippi, New Mexico, Oklahoma, and Virginia are the only states that have set standards for reimbursing asynchronous or store and forward telehealth related services. New York began reimbursement for store and forward telehealth services related to home telehealth programs in January 2016 (CCHPCA, 2015).

Interoperability. The ability for health IT systems to share data across organizational boundaries in order to foster advancement and effective healthcare is known as *interoperability* (Healthcare Information and Management Systems Society [HIMSS], 2013). The ONC found that six out of ten hospitals had a barrier with interoperability that could be traced to the organization not having a system in place to received health information, or their system did not have the capability to receive electronic information from other organizations (Monegain, 2015). This in effect limits the number of exchange partners, and curbs efforts to provide cost-effective healthcare if health data from one provider cannot be shared with another provider who is treating the same patient. The same is true if patients are not able to share their own PHRs with providers.

Best Practices

Many healthcare organizations are using the wait and see method to avoid fallout from failures with advanced health IT systems that could jeopardize their patients' health, health information, and the organizations' reputations. For those organizations that are stepping up as

leaders and implementing mHealth technology practices into their health IT systems, widely accepted best practices are available to ensure effective implementation. One of the first measures is to have buy-in and a voice from all key individuals who are responsible for the implementation and adoption of mHealth technologies. Healthcare organizations should establish a multidisciplinary committee that represents executives as well as clinical leaders and tech-savvy healthcare providers who can review mHealth and health IT initiatives being considered by the organization (Congdon, 2013). The committee should also test proposed mHealth solutions, and establish clear policies and usage parameters that can be leveraged by the intended users.

Next, healthcare organizations should be up-to-date on changing mobile technologies, and plan accordingly to stay current with system upgrades as well as policy changes (Congdon, 2013). There is likely no need to go out and purchase every new phone or device that hits the market, but it is smart to be aware of the capabilities and limitations associated with upgrading technology. In turn, that information can be shared with patients and providers who utilize mHealth applications and technologies associated with the healthcare organization. The FCC (2014) has several recommendations on implementing and adopting advanced health IT systems as a whole, including mHealth technologies. While a number of these recommendations are addressed at the federal government level, they are worth mentioning since they speak to what hinders best practice efforts within the healthcare sector. To improve health IT solutions, the FCC (2014) has made the following recommendations, which can be found in detail in chapter 10 of its report.

Create appropriate incentives for health IT. Additional studies should be conducted around the type of incentives that should be made available to encourage the adoption and

meaningful use of mHealth and health information technologies would aid in identifying appropriate incentives for adoption for health IT. To do this, coordination between the public and private sectors is needed to identify incentive structures and rules for meaningful engagements (Mechael et al., 2010). Congress and the Secretary of Health and Human Services (HHS) should develop a strategy that documents the proven value of e-care technologies, proposes reimbursement reforms that incentivize their meaningful use, and charts a path for widespread adoption (FCC, 2014). Proposed methods should include demonstrating how mHealth and associated health IT systems make work easier and more meaningful for the medical community, how it facilitates two-way communication, and how mHealth and health IT systems can be an effective human resources tool to reward excellence and identify weaknesses to improve quality of care (Mechael et al., 2010). In a report from Deloitte (Comstock, 2014), another proposed incentive method is to capitalize on the social capabilities of mobile technologies that encourage adoption and meaningful use. By creating competitive-based apps and utilizing gamification principles, financial, cash-equivalent, or reward based incentives can be used to encourage users of mHealth app to meet their goals. This type of behavior can be seen with fitness mobile apps that track user activity and reward badges as users progress, as well as encourage users to post their improved results on social networks. Additional strategies to increase appropriate incentives include having the HHS prioritize e-care applications that warrant reimbursement incentives, and having CMS proactively reimburse e-care or telehealth services under the current payment models by collaborating with healthcare providers, vendors, and stakeholders to design pilots that will provide system-wide cost reduction under the fee-for-service model (FCC, 2014).

Modernize regulations to enable health IT adoption. Congress, states, and the Centers for Medicare and Medicaid Services (CMS) should consider reducing regulatory barriers that

inhibit adoption of health IT solutions. The FCC and the Food and Drug Administration (FDA) should clarify regulatory requirements and the approval process for converged communications and health care devices (FCC, 2014). The barriers created by the variations in regulations has successfully prevented proper reimbursement and payment for those healthcare providers that are using health IT and virtual healthcare tools to provide better care at a reduced cost. For example, if Congress and states lifted the restriction that limits broader acceptance of e-prescriptions, it would eliminate over 2 million adverse drug reactions events, prevent 190,000 hospitalizations, and save the U.S. healthcare system \$44 billion per year (Center for Information, Technology, Leadership 2009, as cited by FCC, 2014). To further push for best practices, it is recommended that states should revise licensing requirements to better enable telehealth services, because state-by-state licensing limits a practitioner's ability to treat across state lines, further hindering access to care.

Unlock data. The ONC should establish common standards and protocols for sharing administrative, research, and clinical data, and provide incentives for their use. Congress should consider providing consumers access to—and control over—all their digital healthcare data in machine-readable formats, in a timely manner, and at a reasonable cost (FCC, 2014). Currently the *Blue Button* is a system that lets patients securely access and download their personal health information to their computer, tablet, or mobile phones by clicking on a “Blue Button” logo or icon (U.S. Department of Health and Human Services, 2013). The blue button is predominately used by the U.S. Department of Veteran Affairs health IT systems called My HealtheVet, and provides veterans access to their personal health information. Klein et al. (2015) found that in order for patient information to be shared among providers, particularly between VA and non-VA health professionals, the sharing relied on the patient’s ability to understand how to utilize

the Blue Button. Those veterans who did use the Blue Button did so to access lab results, which healthcare providers valued and expressed interest in being able to share information electronically across different settings. Unfortunately, Blue Button is not widely practiced or available to healthcare systems and providers outside the VA healthcare system. By unlocking data and educating more consumers on the use of health data sharing, patients can successfully facilitate sharing their health information with providers in different healthcare systems for improved healthcare services.

Close the health IT broadband connectivity gap. Congress should consider providing consumers access to—and control over—all their digital healthcare data in machine-readable formats, in a timely manner and at a reasonable cost. The FCC should replace the existing Internet Access Fund with a Health Care Broadband Access Fund. The FCC should establish a Health Care Broadband Infrastructure Fund to subsidize network deployment to health care delivery locations where existing networks are insufficient. The FCC should authorize participation in the Health Care Broadband Funds by long-term care facilities, off-site administrative offices, data centers, and other similar locations. Congress should consider providing support for for-profit institutions that serve particularly vulnerable populations. To protect against waste, fraud, and abuse in the Rural Health Care Program, the FCC should require participating institutions to meet outcomes-based performance measures to qualify for USF subsidies, such as HHS’s meaningful use criteria. Congress should consider providing an incremental sum (up to \$29 million per year) for the Indian Health Service for the purpose of upgrading its broadband service to meet connectivity requirements. The FCC should periodically publish a Health Care Broadband Status Report (FCC, 2014, pp. 209–217).

Summary

Healthcare systems have been in existence since the mid 1800s when the first health insurance company was established. They have grown and changed to meet the demands of a changing nation, and in the 21st century it is critical the U.S. healthcare system reform to meet the changing needs of population, which includes coming into digital age. The increasing amount of health IT applications has spawned a healthcare revolution that continues to expand and change how healthcare products and services are delivered. Health IT applications and related technologies have made a tremendous impact in redistributing care to underserved and remote communities that have a shortage of specialists and limited access to quality care (Medical Device Network, 2010). Impeding progress are the barriers to mHealth and virtual health as a whole.

The regulations of mHealth and virtual health services is largely a gray area with limited standardized policies and regulations. This leaves regulating agencies like the FCC, FTC, and FDA tasked with creating and enforcing regulations on mobile and virtual health. Because mHealth and health IT systems are not homogenous, they are not necessarily bound by geographic boundaries and are remote in nature. The medical community needs a way to safely share private health information in a manner that does not violate privacy or data encryption laws. This problem is twofold, first in that standardize protocols for sharing private health information and the established guidelines healthcare organizations and states have for sharing information do not allow for sharing of protected health information with other HIPAA providers. This is because HIPAA-approved provider has a health IT system that is not up to date, or they haven't established a system that allows for data exchange. Secondly, reliance on U.S. government agencies is a problem because they are constantly in flux and move much

slower than technological innovations and development. Devising solutions to these barriers not only meets the demands of a growing population, but also makes healthcare accessible and affordable in urban and rural areas.

Chapter 3: Methodology

This study will utilize a qualitative research design to obtain insights and knowledge from senior health IT professionals regarding the implementation and adoption of mHealth programs in the expansive practice of virtual healthcare systems. Using a phenomenological approach, the study seeks to understand the challenges and successes senior health IT professionals have experienced in implementing and managing mHealth programs as part of the new healthcare initiatives within the United States healthcare system. The goal is to identify what factors contribute to a successful mHealth program by identifying similarities among the strategies and practices used by senior health IT professionals.

The changing landscape of healthcare in the United States has created a host of challenges for healthcare professions. Senior health IT professionals are responsible for planning, coordinating, and managing healthcare services and must stay up to date on changes associated with laws, regulations, and technology that affect the healthcare sector. They have the added responsibility of clearly explaining complex regulations and technical matters to their staff in layperson's terms. With virtual healthcare systems gaining momentum in United States and mHealth applications being utilized with increased frequency, it is important to gather valuable insight from senior health IT professionals on strategies for tackling challenges and implementing best practices for success. Since the objective is to understand the experiences CIOs have faced in managing mHealth programs, it is appropriate to use qualitative inquiry to capture their lived experiences.

Qualitative research allows the study to view the social, political, or cultural contexts from the research participants' points of view and get the essence of their lived experiences. For

this study, qualitative research inquiry allows the study to examine the phenomenon of mHealth from the perspectives of the individuals in charge of implementation and adoption strategies and practices. This exploration allows for a more detailed and personal interpretation of the practices and complexities of mHealth programs within the U.S. healthcare system. From the information and data gathered, an inductive analysis can be completed to find common themes and develop a theory that best captures the complexity of the mHealth trend. This chapter will provide further rationale for research design, describe the research setting, and describe the process used for data collection and analysis.

Nature of the Study

In order to better understand how mHealth programs are implemented and adopted, examining how senior health IT professionals handle the challenges and accomplishments associated with managing a virtual healthcare system was vital. Qualitative research is uniquely designed to examine how participants are affected by specific situations from their point of view. The participants' practices, statements, behaviors, and appearances collected lend themselves to interpretation about participants' thoughts, feelings, and experiences in dealing with the given phenomenon (Ebrahim & Sullivan, 1995). Creswell (2009) identified several common characters among the qualitative design that capture both traditional perspectives and newer advocacy and self-reflective perspectives:

- **Natural Setting.** Collecting data for qualitative research means interacting with real people in the real world, wherever they are. A natural setting generally refers to doing research in the field, instead of having participants go to a lab or other unrelated setting to collect data (Creswell, 2009). The field can represent a variety

of real world settings relevant to participants where data can be collected via interviews, videos, and documents (Yin, 2011).

- **Researcher as key instrument.** The researcher is the primary source of data collection and a research instrument may be used to collect data; however, there is no use of questionnaire or instruments developed by other researchers (Creswell, 2009).
- **Multiple source of data.** Rather than rely on one source for data, information is gathered by researcher via observations, document examination, and/or interviews. This data is analyzed and organized into themes.
- **Inductive data analysis.** Patterns, themes, and theories are built from the ground up by organizing all the gathered data into increasingly more abstract units of information. This analysis is done by working back and forth between the themes and data until a concise set of themes are established.
- **Participants' meaning.** Throughout the process the researcher is looking to learn the meanings behind the participants' thoughts regarding the problem, rather than any meanings the research brings to the study or what is gathered from the literature.
- **Emergent design.** Since qualitative research is emergent, the initial research plan, such as the questions, that data collection methods, or the individuals selected for participation could change or shift after the researcher enters the field and begins to gather data.
- **Theoretical lens.** A study may be organized around a theoretical lens or through a social, political, or historical context of the problem.
- **Interpretive.** Researchers make an interpretation about what they observe, hear, and understand and these interpretations cannot be separated from his or her own background,

history, or prior understand. This is also true for readers of the published research study and participants, who offer another interpretation.

- **Holistic account.** Qualitative research tries to develop a complex picture of the issue being studied, and will include multiple perspectives and many factors to paint a larger picture of what is emerging within the study.

Research Questions

The following research questions were addressed with corresponding interview questions for participants who manage mHealth programs for healthcare facilities in the United States.

1. What strategies and practices do CIOs employ in the implementation and adoption of mHealth technologies?
2. What challenges do CIOs face when implementing best practices for mHealth technologies?
3. How do CIOs measure their success in implementing their best practices?
4. What recommendations do CIOs have for future mHealth providers that want to implement mHealth technologies?

Methodology

A number of inquiry approaches are used with qualitative research, including narrative inquiry, grounded theory, case studies, action research, and phenomenology (Creswell, 2007). This study focused on the viewpoint of CIOs and the growing phenomenon of mHealth as a part of the U.S. healthcare system. The phenomenological approach begins with the researcher obtaining descriptions of experiences from subjects during the interview process regarding what they experienced by living in the phenomenon and what they learned from any failures (Giorgi & Giorgi, as cited in Nelson, 2012). The interviews are transcribed verbatim and studied to obtain

an overall impression of content, at which point the transcripts are analyzed for meaningful units or moments. The meaningful units are divided into units for analysis or thematic descriptions before being further analyzed and coded to capture the lived experience of the participants (Nelson, 2012). This inductive approach place emphasis on the richness, texture, and feeling of raw data collection (Neuman, 2006).

Phenomenological Approach

Clark Moustakas is considered the founder of phenomenological research, having taken a stance that research should focus on the wholeness of experiences and the meanings of those experiences (Simon, 2011). Apelgren (2010) described two different schools of phenomenology, one empirical in nature and the other existential. The hermeneutic (empirical) phenomenology approach is interpretive and descriptive, like that of an empirical design where researchers are detached in their observation. That is to say there are no preconceived notions about what the participants are experiencing. The participants' thoughts and experiences are the main focus. In contrast, the Husserlian (existential) phenomenology approach contends that researchers cannot separate themselves from being in the world of the subject. The central research question will focus on the lived experiences surrounding a specific phenomenon or the meanings of the lived experience within the phenomenon by the subject (Simon, 2011). This is true within all the schools of phenomenological research. Moustakas (1994) contended that the phenomenological process includes:

- Immersion—The researcher become involved in the subject's world.
- Incubation—A space for awareness, intuitive/tacit insight, and understanding
- Illumination—The active process of expanding the understanding of the experience
- Explication—Engaging in reflective actions

- Creative synthesis – A bringing together to show the patterns and relationships.

Appropriateness of phenomenological approach. The initial intention was to conduct a Delphi study with a panel of experts regarding mHealth and the best practices associated with successful implementation of mHealth within the healthcare structure. The Delphi method is flexible and would allow for the anonymous collection of data. It is often used when seeking data on technology related subjects and body of knowledge. However, this approach is more appropriate when seeking more information about a phenomenon, or when knowledge of a subject is incomplete. There are still many unknowns about mHealth, namely, how does mHealth affect the delivery of healthcare services, what are the protocols and regulations regarding mHealth, and what are the challenges associated with mHealth? As such it is more appropriate to first focus on the lived experience of professionals who implement and manage mHealth programs within a healthcare setting. Phenomenology allows for the exploration of past experiences that can be studied later and further examined through a Delphi method approach.

Research Design

Purposive sampling. The goal of this study was to obtain insight and authentic descriptions on of the mHealth phenomenon with the United States healthcare system from senior health IT professionals—particularly in light of the recent healthcare reforms and health IT initiatives. Because this is a unique experience, purposive sampling was utilized to recruit participants who have the best insight into this trend. Purposive sampling is strategic and attempts to establish a connection between the research questions and the sampling (Bryman, 2008). Purposive sampling is also known as expert sampling and involves recruiting participants

who can logically be assumed to represent the population (Battaglia, 2008). Participants in this study were identified based on specific criteria to yield the most relevant data.

Participant selection/source of data. A lot of pre-existing data exists about mHealth programs implemented in countries outside of the United States. Many are developing countries have a number of remote, low-income communities. While these data are reflective of the potential of mHealth, they are not representative of the structure of the United States healthcare system or its regulating government bodies. The concerns around security of data, privacy, interoperability, and regulation are universal, but more precise and accurate information can be drawn by obtaining data from the representative expert sample. The representative sample will be identified based on the inclusion criteria and be invited to participate in an interview via telephone or online video conference meeting following IRB approved recruitment procedures.

To identify potential research participants, the following primary criteria for inclusion were included: the individual holds a senior or executive position in Health IT; is responsible for the adoptions, implementation, and/or management of mHealth services within the hospital's information and technology system; and is located within the United States, its territories or the District of Columbia. The criteria for exclusion include health IT or technology professionals whose primary duties are associated with monitoring or maintenance of computer networks, databases or system administrative functions; senior or executive health IT professionals who are not located in the United States, its territories, or the District of Columbia; and senior health IT professionals in the United States who do not work in a healthcare system or hospital.

Becker Hospital Review, a leading industry trade publication, has identified 100 health IT executives in the United States that work for a hospital or healthcare system. The top 100 hospitals and health system CIOs to know for 2015 was published on February 9, 2015, and is

readily available for free to the general public. This list was created using an editorial review process of identified CIOs who demonstrated excellence in leadership based on their ability to manage health IT challenges and implement innovative programs. This list is being utilized as the initial population for sampling because it has identified executive health IT professionals in the United States. *Becker Hospital Review* routinely publishes such lists, including the 50 leaders in health IT, the top 24 female hospital and health system CIOs to know, and the top 100 hospital and health system CIOs to know in 2014. The researcher will apply the primary criteria for inclusion and exclusion to the list to reduce the list to eligible individuals. A secondary set of criteria for exclusion will be utilized by crossing checking the list of 100 CIOs with their healthcare organizations and eliminating all CIOs whose facilities does not support or maintains an mHealth application or program. Information regarding mHealth systems for each CIO's healthcare organization is available to the general public via the healthcare organization's website.

For maximum variation, the researcher will group eligible participants by the four U.S. regions (West, Midwest, South, and Northeast). Individuals were initially selected based on two additional dimensions, gender and 10 years of experience. This provided 16 possible categories, as shown in Table 1.

Table 1

Maximum Variation

	<u>FEMALES (A)</u>		<u>MALES (B)</u>	
	<u>10+ YEARS EXPERIENCE (C)</u>		<u>10+ YEARS EXPERIENCE (C)</u>	
	<u>>10 YEARS EXPERIENCE (D)</u>		<u>>10 YEARS EXPERIENCE (D)</u>	
<u>WEST (W)</u>	ACW	ADW	BCW	BDW
<u>MIDWEST (MW)</u>	ACMW	ADMW	BCMw	BDMW
<u>NORTHEAST (NE)</u>	ACNE	ADNE	BCNE	BDNE
<u>SOUTH (S)</u>	ACS	ADS	BCS	BDS

This sampling frame identified the CIOs by geographic region, years of experience, and gender for balance. This will allow for a broad range of diversity using location, experience, and gender. The sample population started out with 22 women and 78 men, so there is a possibility that more men will meet the criteria selection than women.

Protection of Human Subjects

This study was conducted in accordance with Pepperdine University IRB considerations for respect for human subjects. Guidelines were followed that provide participants with the following: description and purpose of the study, informed consent, voluntary participation with option to withdraw, permission to interview, and point of contact information. In accordance with Title 45, part 46 of the U.S. Code of Federal Regulations Protection of Human Subjects, this study obtained approval from IRB (see Appendix A), whose job is to ensure the rights and welfare of all participants and make sure all research is conducted in accordance with federal,

institutional, and ethical regulations (FDA, 2014). IRB approval is an integral part of the study, establishing ethical protocols in order to minimize risk from physical, emotional, and psychological harm (Yin, 2011). According to the National Research Council (2003),

Progress in understanding people and society and in bettering the human conditions depends on people's willingness to participate in research. In turn, involving people as research participants carries ethical obligations to respect their autonomy, minimize their risk, maximize their benefits, and treat them fairly. (p. 9)

In addition to the protection of human subjects, data management, confidentiality, and privacy protocols were followed. Since participants can be identified from video and audio recordings, all recordings were maintained in a locked file cabinet in a locked storage area until transcribed, at which point they were destroyed. Transcriptions used identification codes to identify participants instead of names, job locations, or any other identifying markers. Participants were solicited using a recruitment script and given an Informed Consent (see Appendix C) form based on Pepperdine University's Informed Consent for Participation in Research Activity guidelines. Scripts and consent were only used with participants after approval of these procedures had been received from the university's Institutional Review Board (IRB).

Data collection. Interviewing has the advantage of being able to probe complex issues and get clarification on ideas, obtain detailed accounts of experiences, and discover new relevant information (Ebrahim & Sullivan, 1995). Interviewing can rely on a fixed questionnaire with a rigorously designed interviewing protocol known as a structured interview, or it can be predominantly unscripted with a mental framework of open-ended questions that encourages a flow of conversation (Yin, 2011). Each has weak and strong points, but qualitative interviews encourage participants to use their own words rather than those defined by the researcher.

Recording interviews allows the researcher to transcribe and analyze the conversation for ideas, expressions, viewpoints, and experiences that become the unit of analysis (Ebrahim & Sullivan, 1995).

The data collection followed specific guidelines that include contacting each qualified participant via email. Following an IRB approved script (see Appendix B), participants were invited to participate in the study. Upon acceptance, the researcher scheduled an interview during the month of March 2016 that was conducted via telephone call. Prior to interviews, participants were given an Informed Consent form that was reviewed again prior to the interview. All interviews were recorded and transcribed by the researcher. From the transcriptions the researcher analyzed the data and produced a tables and figures with identified themes.

Interview Protocol and Techniques

When interviewing research participants, how the questions are presented sets the tone for the interview. The researcher's job was to establish a protocol that would elicit responses that are on topic and relevant to the study. Opening the interview with ice-breaker questions helped establish a relationship and invited the participant feel more comfortable with the interview process. This was followed by asking nine specific questions related to the study before ending the interview with a summary question. All responses, pauses, and any other notable behaviors are noted.

Creating a comfortable space for the research participants is important for online and face-to-face interviews (Hine, 2005). As the interviews for this study were conducted via telephone, the research scheduled one-on-one interviews with that participants at a time that was convenient for them. It was important to use social graces with an open and friendly approach so the participants were comfortable enough to be candid in their conversations. The researcher also

needs to be prepared to hear information or feedback that might not be positive or could possibly be offensive, accepted the reality that this is part of the data collection, and determined to not outright reject it (Whorton, 2016). Kavel (1996, as cited by Bryman, 2008) established several criteria for being a successful interviewer, which include:

- Being knowledgeable and familiar with the focus of the interview.
- Providing structure to the interview by establishing a start, a finish, and checking to see if the participant has any questions.
- Limiting jargon and asking clear, simple, and short questions.
- Being an active listener who hears what is said and how it is said.
- Demonstrating flexibility and openness by responding to what the participant identifies as important.
- Clarifying and extending meaning to what participants state without imposing other meanings.

In addition, setting up a pre-interview routine was important. This included preparing a location for the interview ahead of time that was private and free of distractions. Having a quality digital audio recorder, a secure telephone for telephone interviews as well as a notebook to capture descriptive notes were all secured prior to interview. While the interview was being recorded, documenting observations and thoughts that can't be captured by an audio recorder was important. If a conference line was used, it was set up in advance, and the number and access code was forwarded to the participant two days in advance. With video interviews, a quality video conference program that was easy for both the participant and the researcher was used. The researcher inquired about the online webhosting video program most familiar to the participant and established a web link that was forwarded to the participant two days prior to the

scheduled interview. The researcher tested the lighting, sound, and picture quality in professional attire, and conducted the interview in a distraction free and private area. Email reminders with date and time of interview were sent two days prior to scheduled interview. The email included web links, conference call numbers, and relevant information.

Instrumentation. The interview questions used for data collection were created by the researcher and based on the research questions. The final interview protocol for this study was reviewed by a preliminary review committee and approved and finalized by the dissertation committee. Traditionally, researcher-created instruments go through a feasibility test, or a pilot study, to validate their effectiveness and ability to elicit the right information in practice (Kim, 2011). However, since this instrument was designed for a specific one-time usage, traditional methods of establishing reliability of the instrument were not applicable here.

The interview questions were open-ended, based on the study's focus on gathering specific information for comparison, yet still allowing participants to tell their stories. Flick (2002) stated that using semi-structured interviews allows for greater creativity and flexibility during the data gathering process because participants can give more details. Each interview was one hour long and conducted via phone or videoconference. Recorded interviews were transcribed, and identifying information was redacted.

Validity and Reliability

The key quality control measure of any research study is the validity of the study and its findings (Yin 2011). A study is valid when all data have been properly collected and interpreted, and the findings reflect accurately what was studied. Studies such as this one, that involve a small number of participants, run the risk of having the phenomenon distorted by participant biases (Ebrahim & Sullivan, 1995). Techniques such as member checking, which allow the

participants the chance to change errors of facts or interpretation, as well as triangulation of information, work to further establish validity (Simon, 2011). Equally important is the reliability or dependability of the information collected. The following recommendations have been made to establish reliability (Gibbs, 2007, as cited by Creswell, 2009):

- Check transcripts for mistakes that could have been made during the transcription process.
- Ensure there is not a shift or change in the meaning of the codes during the coding process. This can be done by constantly comparing the data with the codes and writing memos about the codes.
- Cross check codes if different researchers developed them by comparing results that are independently derived.
- Find another person who can cross check the researcher's code for intercoder reliability.

While there is no expectation that this study will be replicated, establishing qualitative validity is important to ensure the accuracy of the findings (Creswell, 2009). The validity of the instrument was established using the following techniques to ensure that the interview questions adequately addressed the constructs in the research questions. This helped to establish trustworthiness, authenticity, and credibility of the data gathered and the findings.

Prima facie validity. Based on the literature, purpose statement, and problem statement, the interview questions were designed to gather information that best addressed the initial research questions. Thus, the questions *look like* they measure what they are supposed to measure (Nester & Schulr, 2014). The question then goes through two other validity processes.

Peer review validity. Peer review validity is an external check in which a peer asks questions about the study and makes recommendations so that the study resonates with people other than the researcher (Creswell, 2009). This was completed by using a two-step validation process; first, a table was constructed to show the relationship between the interview questions and the corresponding research questions. Next the table was reviewed by a preliminary panel of reviewers consisting of three researchers who are current doctoral students in the Organizational Leadership/Learning Technologies programs at Pepperdine University. These students are conducting their doctoral dissertation at Pepperdine University and employing a similar methodology in their own research. The panel members have completed a series of doctoral level courses in quantitative and qualitative research methods and data analysis. The panel was given a package that included a summary statement of this research paper, a copy of Table 2, and the following set of instructions to assess if the interview questions adequately addressed the constructs investigated in the research questions.

Instructions: Please review the summary statement attached to familiarize yourself with the purpose and goals of the study. Next, refer to the table below and read each research question carefully. Next, review the corresponding interview questions. If you determine that the interview question is directly relevant to the corresponding research questions, indicate this by marking, “The question is directly relevant to research questions 1—keep as stated. If you find the interview questions irrelevant to the corresponding research questions, mark, “The question is irrelevant to research question 1—delete it.” Finally, if you determine that to be relevant to the research questions, the interview questions must be modified, mark, “The questions should be modified as suggested.” and in the blank

space provide recommendations for modification. There is also space provided for you to recommended additional interview questions for each research questions.

Expert panel. The results of the preliminary review panel were then presented to the dissertation committee, consisting of three faculty members. Recommendations of the preliminary review panel were examined and approved or modified by the dissertation committee. In any instances where a majority did not agree on the recommended modifications, the committee chair had the final voice. Table 2 offers an overview of the final interview questions that correspond with the study’s research questions.

Table 2

Crosswalk of Research Questions and Interview Questions

Research Questions	Corresponding Interview Questions
RQ 1: What strategies and practices do CIOs employ in the implementation and adoption of mHealth technologies?	IQ 1: What internal and external factors influenced the development of the mHealth program?
	IQ 2: What protocols did you use to implement mHealth technologies?
	IQ 3: How do you manage data exchange from other HIPAA providers or patients?
RQ 2: What challenges do CIOs face when implementing best practices within a virtual healthcare system?	IQ 4: How do you address the needs of unique users (non-tech savvy, older adults, visually impaired, voice command users?)
	IQ 5: Did you experience any “technology” challenges and how did you overcome them?
	IQ 6: How do regulations such as HIPAA, Affordable Healthcare Act (ACA) and HITECH affect the mHealth services you offer?

(continued)

Research Questions	Corresponding Interview Questions
RQ 3: How do CIOs measure their success in implementing best practices?	IQ 7: What criteria do you use to measure overall success of the mHealth program?
RQ 4: What recommendations do senior health IT professionals have for healthcare organizations that want to implement mHealth technologies as part of their health IT system?	IQ 8: How do you bill or obtain revenue for mHealth programs? IQ 9: What steps would you recommend to an organization thinking about developing or implementing a mHealth program?

Statement of Personal Bias

Prior to research collection, it was important to do bracketing to identify biases and prejudgments that could influence the research and its findings. Identifying the researcher's personal experiences helps to limit biased conclusions a researcher may have before talking with participants about their experience (Creswell, 2007). The researcher recognized and acknowledged that her passion for technology and quality healthcare services could unintentionally impact the data collection process. Her personal experience with mHealth technologies provides her with basic knowledge about the functionality of such products, but does not provide any information on the real world experience of the implementation and adoption of such technologies to enhance the quality of healthcare delivery. Developing a log of personal experiences, judgments, and ideas about the phenomenon provided the researcher with a way to keep biases in check so as to embrace the lived experience of the research participants.

Great care was taken during the participant selection process to ensure that participants were chosen for the study on the basis of inclusion. Doing so helped to minimize bias based on the researcher's judgment of who is an expert. In this way, the researcher collected data that has the potential to establish new insight into a field that needs empirical evidence on what actually happens when mHealth technologies are implemented, instead of what is supposed to happen.

The data collection methods, which included interviewing and content analysis, had standardized protocols to minimize the researcher's ability to influence how participants answered questions.

Data Analysis

Qualitative data analysis (QDA) involves processing text that includes images, instead of numbers, that support or disconfirm a hypothesis. as it does for quantitative data analysis. QDA is about transforming text into findings; this can be a challenge, since there is no standard formula, but there are steps to make the process concise. Yin (2011) described five steps of a complete data analysis: compiling, disassembling, reassembling, interpreting, and concluding.

- **Compiling:** The data analysis process starts with compiling and sorting field notes in a logical order, along with any other documents that were collected during the process. Ideally, the researcher should make it a practice to frequently compile field notes.
- **Disassembling:** The second phase consist of taking the compiled data and breaking it down into smaller pieces, and if applicable, start assigning code to these fragmented sections. This process is repeated frequently in the search for the most appropriate codes.
- **Reassembling:** The third phase is reassembling the initial coded fragment data. The coded data is assembled into a cluster of codes in order to disassemble them into a different sequence of fragmented sections. Reassembling allows for new combinations of codes that accurately depict the sections. The process of compiling/disassembling and disassembling/reassembling is a two-way exchange.
- **Interpreting:** The fourth step of the QDA is interpreting the reassembled data, as initial interpretations and codes may need a new interpretation. They can be disassembled or reassembled as deemed necessary.

- **Concluding:** In the last step, a conclusion is made using the findings from the entire study. These findings are based on the interpretation of the data analyzed.

Interrater reliability/validity. Interrater reliability is a verification tool commonly used in quantitative research and applicable to phenomenological research studies where the researcher is the main instrument. This characteristic makes it more difficult to eliminate personal bias from the study. For a qualitative study, inter-rater reliability is used as a solidification tool where the inter-raters, who have no prior connection to the study, can validate of the research findings if they display a similar or basic understanding of the research topic (Marques & McCall, 2005). A three-step process will be used for this study:

1. The data is coded by the researcher.
2. The results are discussed with two peer reviewers (doctoral students) who can demonstrate a basic understanding of the topic from the findings.
3. Expert panel review, in which the dissertation committee reviews the findings and make comments and recommendations.

Summary

The general design features of qualitative research, as outlined previously, are more applicable in conveying its purpose than a fixed definition. Qualitative research begins with an assumption, a worldview, and the study of the research problem using a specific inquiry approach to understand the problem (Creswell, 2007). The overall purpose is to make sense of a complex situation that has various data sources and changing phenomena. Data is collected in the natural setting, allowing the researcher to learn how participants experience the phenomena, what meaning they place on it, and how they interpret what they experience. This study explicitly involves gathering the real life experience of senior health IT professionals who are in

the midst of a shift in healthcare delivery that requires them to participate in the implementation and adoption of mHealth technologies. The process is less rigid than quantitative research, and multiple sources of data can be used for analysis in establishing patterns or themes. Through analyzing and coding the data, the researcher hopes to provide new insights on best practices for implementing mHealth technologies.

Chapter 4: Findings

Introduction

MHealth is comprised of multiple layers, all geared toward improving access to quality care. To do that mHealth providers have to implement successful practices that will make it possible to design and implement mHealth services that are compatible with the mission of the healthcare facility as well as sustainable. This study examined what challenges CIOs experience while implementing their best practices for mHealth services, how they measure their success and what recommendations they have for future mHealth providers. In order to do so the study used qualitative inquiry to address the following research questions:

1. What strategies and practices do CIOs employ in the implementation and adoption of mHealth services?
2. What challenges do CIOs face when implementing best practices within a healthcare system?
3. How do CIOs measure their success in implementing best practices?
4. What recommendations do CIOs have for future mHealth that want to implement mHealth as part of their health IT system?

These questions were answered by asked the participants nine interview questions with the intent of identifying common themes within the data that related to success practices and strategies. The findings from the interviews with the participants are presented with supporting statements and graphs.

Participant Recruitment

The participants for this study were identified as chief information officers or vice presidents of health information at hospitals or healthcare organizations across United States.

They were identified from *Becker's Hospital Review* publication, in which each participant had been identified as one of the top 100 CIOs in the healthcare industry during 2015. Using criteria for inclusion, exclusion, and maximum variation sampling, a list of 23 finalists was generated for recruitment that represented the Southern, Midwest, Northeast and West Coast regions of the United States. Of the 23 CIOs, 14 were selected and contacted via LinkedIn email and one was contacted via work email. The initial response rate from using LinkedIn was 0%, as none of the individuals responded, in contrast the CIO contacted via work email who responded and agreed to participate. The researcher then used public forums and hospital websites to locate work emails for the 14 eligible participants who did not respond using LinkedIn, and sent a second invitation. This yielded mixed results with four agreeing to participate, three declining due to scheduling conflicts, and the remaining seven proving unresponsive, resulting in an overall response rate of 50% from the second invitation. As the sample size for this study was set at 15, the researcher consulted with the dissertation committee on how to proceed. It was decided that an additional round of invitations would be sent the eight remaining CIOs that had been identified by maximum variation sampling. Thus a third set of invitations were sent via email. This third round of invitations yielded two agreements, one auto-reply advising that the CIO was no longer with the organization, and five non-responses. Follow-up calls were placed to the non-responsive recruits, however, no additional individuals were recruited. Upon conferring with the dissertation committee, it was suggested that the sample population be reframed to include mobile health clinics, as they are likely connected to a healthcare organization and would require similar virtual health information systems to function. While researching this possibility, the researcher located an additional set of individuals who met the criteria for inclusion/exclusion using the Health Information and Management Systems Society's (HiMSS) public list of

hospitals, recognized as having reached stage 7 in their adoption of the Electronic Medical Record Adoption Model. The fourth round of invitations was sent to 26 health information systems managers and CIOs who worked for health care organizations. These facilities were all recognized as having the highest level of electronic medical records adoptions and now function as an environment where paper charts are no longer used. Several names on the list had previously received an invitation; as such, only those individuals who had not received a previous invitation were included this time. This fourth round of invitations yielded two acceptances, one decline, and twenty-three non-replies.

Following the fourth round of recruitments, a total of eight CIOs agreed to participate in this study, resulting in a smaller sample size than originally planned. Just prior to a scheduled interview, a participant was no longer able to participate in the study, resulting a final total of seven—three women and four men. The following table is a summary of participants.

Table 3

Participant Demographics

Participant Number	U.S. Region	Type of Healthcare Organization
Participant #1	Ohio (Midwest)	academic medical center/multiple locations
Participant #2	California (West)	non-profit healthcare system/multiple locations
Participant #3	Massachusetts (Northeast)	non-profit teaching hospital
Participant #4	New York (Northeast)	academic medical center/multiple locations
Participant #5	Iowa (Midwest)	non-denominational hospital/multiple states
Participant #6	North Carolina (South)	non-profit healthcare network/multiple states
Participant #7	Ohio (Midwest)	non-profit medical network/multiple locations

Demographics. All participants in the study held an executive position as chief information officer or vice president of information systems at their respective healthcare organizations. All participants had a degree in higher education, with one (14.3%) having a bachelor's degree, five (71.4%) having a master's degree, and one (14.3%) having a doctorate degree. All the participants have worked in health information systems and technology for over 20 years in some capacity. Two of the participants have worked in the position of CIO for five or more years and the remaining five held CIO or VP positions in healthcare for 20 or more years. All of them have intimate knowledge and experience in maintaining and protecting health information data, making their insight valuable.

Sample Population. At the start of this research study, one of the identified limitations was the use of a purposive sample size in order to focus on a selective group of individuals who could best answer the research questions. By limiting the sample size, the selection criteria for research participants was limited to CIOs and other senior health information professionals who worked for healthcare organizations. This also meant the data gathered from these participants could not be generalized to other organizations or facilities outside of healthcare organizations in the United States. This left the researcher with a small, selective population with which to work, but as the research study is qualitative, a small sample size is not necessarily an issue.

The researcher was advised that reframing the sample population to include mobile health clinics might increase pool of participants. Mobile health clinics, also known as mobile health units, play a critical role in providing high-quality, low-cost healthcare to low-income and vulnerable populations (Hill et al., 2014). Mobile health units function as a kind of moving medical clinic and require a method to store and protect health information data. Some preliminary research was done and the researcher ultimately decided not to expand the sample

population to include mobile health units. The most prevalent reason was that a significant amount of research is still required on mobile health units. Contrary to popular belief, mobile health units are not necessarily associated with any specific hospital or healthcare facility. According to the *American Journal of Managed Care* (AJMC), only 25% of mobile health clinics are associated with hospitals, 45% are independent entities, the remaining 30% are associated community clinics or academic medical centers (AJMC, 2014). For the majority of mobile health units, funding comes primarily from philanthropic entities, but government programs and insurance companies also provide some funding.

Another study by the Bureau of Primary Health Care, Health Resources and Services Administration and U.S. Department of Health and Human Services found that mobile health units have a number of technical and health information management challenges. Equipment breakdown put mobile health clinics out of commission for weeks or even months at a time due to power problems, generator disruption of wireless communication, and poor Internet connections (Post, 2007). In addition, installation of an up-to-date electronic medical records (EMR) system can be very costly, as the Clinica Sierra Vista Homeless Mobile and Respite Services found it would cost \$90,000 to have an EMR installed in their mobile health unit, a cost they could not manage since they are not connected to a larger funding source. A 2013 study with mobile health providers in the United States by several health service agencies, including VA Boston Healthcare System, Boston Medical Center, and Harvard Medical School found that although interest in information technology is evident, mobile health clinics, especially those not associated with a hospital, have less institutional support and are less likely to utilize these health information systems (Farwell, 2013). The high level of complexity involved in the management of mobile health units and digital health records suggested it would benefit from being a separate

research study. Nevertheless, the researcher's decision to not expand the sample population did not make the information gathered inconsequential.

Sample Size. The sample size for qualitative research is generally smaller than that of a quantitative study because qualitative data is concerned with the meaning behind the data instead of quantifying data-sets since no hypothesis statement needs to be made (Fugard & Potts, 2015; Mason, 2010). Qualitative research can also be labor intensive, so analysis of a large sample size is not only time consuming but considered impractical (Mason, 2010). It's a delicate balance between ensuring the sample size is large enough that perceptions on the topic are uncovered but not so large that the data becomes repetitive. Knowing when enough interviews have been conducted to reach data saturation is a concern for those conducting qualitative research. According to Morse (2000), several factors should be considered when estimating if a research has the right number of participants in a study. They include the scope of the study, the topic, the quality of the data received, the study design, and any shadow data received.

- The scope of the study. The scope of the study helps define the parameters of the study, giving a clear idea of what will be included and what will not (Simon & Goes, 2013). This study had a narrow scope that focused exclusively on mHealth platforms as one of the emerging alternative health care models used to improve access to healthcare. This focused approach meant that data saturation could be reached faster with less people.
- The nature of the topic—When a topic is clear and obvious, it is easier to get information during the interviews, thus requiring fewer participants. For obscure or less than obvious topics, more participants are required to get meaning from of the data. When the topic is clear and easy for the participants to talk about, then fewer

people are needed to reach saturation (Morse, 2000). mHealth is a narrow, yet very popular, topic within the vast world of virtual healthcare. Those in a senior or executive position in healthcare settings have the challenge of bringing their respective healthcare organizations up to code with legislation, while at the same time educating providers and patients on this service. This makes mHealth a hot topic among top health information professionals.

- The quality of the data—Just as it was important to have the scope of the study be narrow yet relevant, it was also important to recognize that some of the data participants provide would vary in its depth and relevance (Moore, 2000). Appropriate questions to target the scope was important, as well as identifying a sample population that could provide valid and reliable answers to those questions so the researcher could obtain quality data. The more articulate, in-depth, and experiential information, the less number of interviews needed to be conducted to obtain quality, meaningful data (Moore, 2000).
- The study design—The design of the study greatly affects the number of participants that are available to be interviewed. Studies that are conducting pre- and post-interventions, or longitudinal studies, produce more data because they have a grouped unit of analysis that shares the experience. In contrast, when interview participants fit a study's criteria, as with this study, the number of participants for recruitment will likely be lower.
- The use of shadowed data—Participants in the study share their experiences while also talking about the experiences of others. This kind of sharing is important because

shadowed data allows the researcher to get an idea on the range of a particular phenomena beyond the participant's personal experiences.

Morse (2000), Mason (2010), and Fusch & Nelson (2015) all agree it is actually better to overestimate the sample size when designing a qualitative study, and later explain how the study came to be a different sample size. The initial sample size for this study was 15; however, after four rounds totaling sixty-three invitation sent to CIOs in charge of health information systems across the United States, the final sample size was seven. While the sample size was smaller than predicted, this did not lessen the impact of the data gathered. In light of the new laws and regulations in the United States regarding healthcare and the increased proliferation of health related technology, the purpose of this study was to identify strategies used and challenges faced in implementing mHealth technologies within a healthcare organization. The data gathered from the interviews showed a pattern that required no additional coding or themes, and provided details on strategies and challenges associated with mHealth implementation and adoptions as seen in the data analysis.

Data Collection

The data for the study was collected by conducting one-on-one, semi-structured interviews by the researcher's use of open-ended questions. Interviewing allowed for the collection of more in-depth data, using a set of clear questions that were prepared ahead of time so as to guide the interview but not limit the participants' responses. Using this style also has the added benefit of allowing the researcher to ask for clarifications or emphasis on information that is relevant. Following the established interview protocol, interview questions were sent to participants a minimum of two days prior to the scheduled interview so participants could familiarize themselves with the topic and prepare for the interview. The interview questions

(Appendix D) went through a two-step peer review validation process and were modified by the research based on feedback and recommendations. The IRB approved consent form was also sent in advance to participants. Interviews were conducted via phone, during which the researcher thanked the participant for his or her time and requested verbal permission to record interviews using a digital recorder, to which each participant agreed. The researcher engaged participants using conversational dialogue to conduct the interview, giving ample time for participants to elaborate on answers. Interviews concluded with the researcher thanking the participant via phone, as well as sending a follow up email to thank him or her for their time. The following interview questions were asked of each participants:

1. What internal and external factors influenced the development of the mHealth services?
2. What protocols did you use to implement mHealth?
3. How do you manage data exchange from other HIPAA providers or patients?
4. How do you address the needs of unique users (non-tech savvy, older adults, visually impaired, voice command users?)
5. Did you experience any “technology” challenges and how did you overcome them?
6. How do regulations such as HIPAA, Affordable Healthcare Act (ACA) and HITECH affect the mHealth services you offer?
7. What criteria do you use to measure overall success of the mHealth services?
8. How do you bill or obtain revenue for mHealth?
9. What steps would you recommended to a healthcare organization trying to develop or implement mHealth services?

The interview process allowed for the collection of qualitative data regarding the practices mHealth technology and tools within the healthcare industry in the United States. Using a semi-structured interview approach allowed the researcher to develop a casual rapport with the participant and created an environment the participant had the freedom to provide detailed responses. This method provides narrative data that is rich and thick in details (Creswell, 2009).

Data Analysis

According to Creswell (2009), the process of data analysis can have several components that include making meaning of the text and image data, organizing the data for analysis, using multiple layers to analyze data, getting a better understanding of the data, and understanding the larger meaning of the data. The researcher employed manually coding and inductive coding methods to analyze the data instead of using CAQDA, or pre-set themes. Manual coding allows the researcher to become more familiar with data and get a fresh perspective when multiple pages of printed and handwritten notes are viewed as a whole with the eye (Saldaña, 2009). The data can be observed and manipulated in a manner that is not possible on a computer screen. Additionally, doing inductive coding creates a clear connection between the codes and themes derived from the raw data and is an efficient method to analyze qualitative data (Thomas, 2006). The following protocol was adopted to complete the data analysis:

1. The researcher organized and prepared the data for analysis by uploading all digital recordings into Express Scribe transcription software. This software gave the researcher the ability to manage audio files and control audio playback using keyboard hotkeys for better transcription. After each interview was transcribed, it was saved as a PDF file on a password protected USB drive.

2. After all interviews were completed, the researcher read over the transcripts twice to be familiar with the information. The first reading checked for any transcription errors. During the second reading the data was coded by highlighting meaning words and phrases. After reviewing of the raw data, preliminary codes for each interview were created.
3. The preliminary codes for all interviews were then grouped together in a table by interview questions on a piece of paper so the researcher could look for related phrases and words that could be themed. The themes and corresponding preliminary codes were organized in a Word document and sent to two external reviewers to cross check the researcher's codes in a three-step process for inter-coder validity and reliability.
4. The research did all the initial coding and created a Word document listing all interview questions and corresponding codes.
5. Any feedback, comments, and suggestions on codes were noted by researcher and addressed during the third round of coding, in which the final codes were created.
6. The researcher then reorganized the coded interview questions into clusters around the research questions. New interpretations were made to generate the final master codes based on an analysis and inter-code validity and reliability exam of all the data for the study.

The data analysis found that CIOs believed knowing the business needs of the healthcare organization as well as maintain open communication with patients and providers were very important strategies. They frequently made references to engaging in discussions with mHealth users to gather their feedback, as well as identifying business needs that are connected to

mHealth strategies. The technology piece behind mHealth services appears to be secondary. The primary focus is on identifying needs, then brainstorming solutions to address that need, and finally evaluating how the proposed solution addresses the problem. For example, one participant advised as an example that if there is a problem with patients frequently missing appointments due to transportation, one proposed solution could be to have virtual visits where patients can meet with their doctor over video conferences via their smartphones or desktop computers. Such strategies speak to the meaningful use of electronic health information. The HITECT Act mandates the meaningful use of electronic health information that advance clinical processes (Office of the National Coordinator for Health Information Technology, 2013), but there are no national or international mandates or guidelines that stipulates all healthcare systems must use the same designs or systems (DigitalEurope, 2015). The following section will detail the findings from the interviews with the participants.

Interrater Reliability and Validity

According to Creswell (2009) having data checked by another person helps in determining the accuracy and quality of the findings. Similarly, peer debriefing enhances the accuracy of findings and adds validity (Creswell, 2009; Yin 2010). In order to assess the reliability and validity of the data, the researcher first coded the data and created an excel spreadsheet to check codes against transcripts for accuracy. Next the researcher prepared a data log with the interview questions and initial corresponding codes and shared it with two external reviewers for cross checking. The external reviewers have completed a series of doctoral level courses in quantitative and qualitative research methods and are conducting their own doctoral dissertation. After answering any questions and obtaining feedback on codes and emerging themes, the codes and themes were reorganized and revised until a consensus was reached.

Data Display

The data was organized by interview questions with the final results of the study grouped together according to the research questions. Through detailed analysis, the data yielded thirteen key practices/strategies for implementation of mHealth technologies. The themes that emerged from the data were supported with excerpts from the participant interviews. These themes are displayed by interview questions with a corresponding graph showing the frequency. Since confidentiality was guaranteed, the participant's name and the name of their workplace have been removed. The seven participants are known as P1 through P7, as labeled in Table 3 (p. 91).

Research Question 1

Research question one asked, "What strategies and practices do CIOs employ in the implementation and adoption of mHealth technologies?" This questions sought to discover best strategies, practices and resources used CIOs during that would benefit future mHealth providers. Analysis of the interview questions generated a series of themes (see figure 4). Three interview questions were asked of the participants.

IQ 1: What internal and external factors influence the development of mHealth services?

IQ 2: What protocols did you use to implement mHealth technologies?

IQ 3: How do you manage data exchange with other HIPAA providers or patients?

Interview Question 1. What internal and external factors influenced the development of mHealth services? This question yielded three themes: (a) people, (b) processes, and (c) legal and social climate (see figure 1). The internal factors were people and processes, the external factors were technology and legal and social

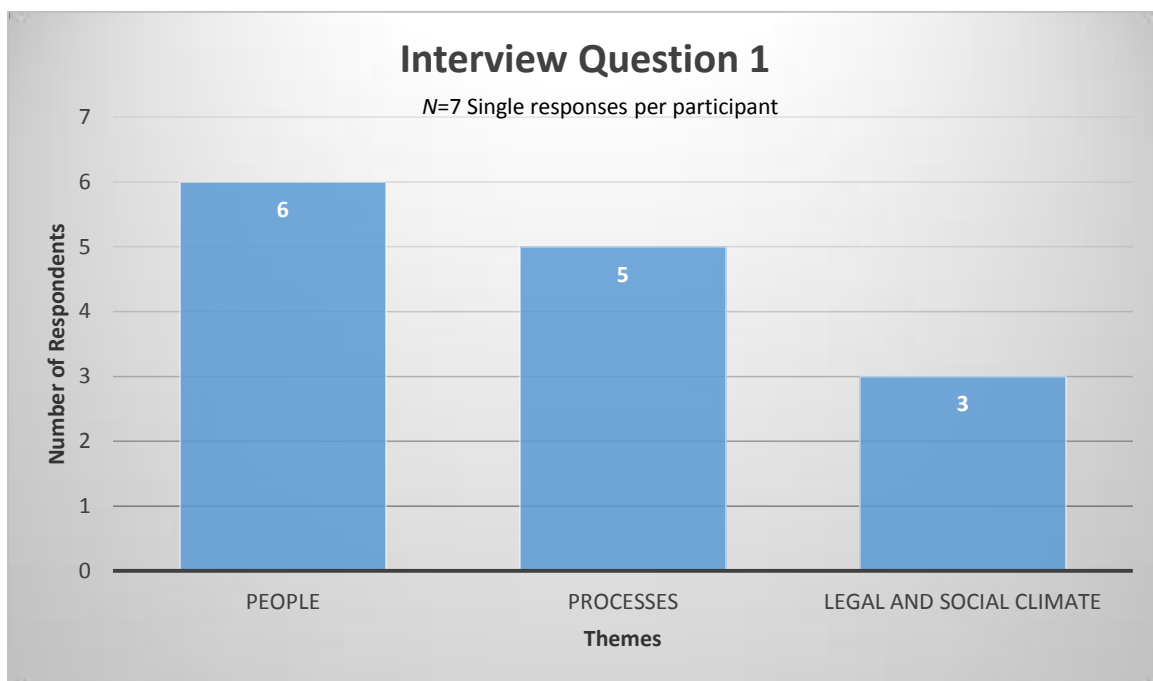


Figure 1. Interview Question 1—Internal and external factors that influence mHealth.

People. The data showed that people were the biggest influences as six (85%) CIOs cited the needs of patients, medical providers, employees, and stakeholders as an important factor in how they design their mHealth strategies. P3 explained, “We have several facilities, so it is important for us that patients and medical providers have a way to access health records. For patients, that means providing them with a secure, private, and consistent method of accessing health information. For medical providers, its allows them the ability to be mobile and engage with patients in various way” (personal communication, March 22, 2016). P6 talked about the importance of supportive employees, “Internally, having the right people on board who understand how to work with others and be a change agent is key when you are talking about changing the entire structure of health information management” (personal communication, March 28, 2016).

Processes. Internal processes were cited by five (71%) of CIOs as an influence on mHealth services development. Processes are those steps or actions required to meet a successful end. They include connectivity functions that connect users to mHealth services, accessibility of electronic health records, affordability of supporting products and services, and integration of new tools into existing systems. P5 stated, “We wanted to have an integrated EHR system that could be used to improve care coordination as well as manage health records. That required us to look at compatibility functions in order to integrate it into our existing system, and how we could secure the system without compromising accessibility and usability” (personal communication, March 25, 2016). P2 echoed those sentiments by saying, “We ask ourselves a series of questions like, ‘Does it offer convenience? Is it efficient? How do you connect to it?’ These conversations are put into the context of the industry and our objectives as an organization” (personal communication, March 19, 2016).

Legal and Social Climate. Three (42%) of CIOs cited the legal and social climate as an influence on mHealth development. The legal and social climate around mHealth has shaped the raising cost of healthcare, the proliferation of technology, and the changes in the healthcare mandates. “The changes in the law over the last several years have obviously been a huge influence, and this [*sic*] allows us to move outside of our existing borders into offering virtual care” (P6, personal communication, March 28, 2016). “I could have the users needs nailed, the best solution nailed, but if it violates HIPAA laws then it doesn't work” (P1, personal communication, March 15, 2016).

Other statements were made regarding internal and external factors. “I’d be remiss if I didn’t mention the power of social media. We look at the functionality and development tools on things like Facebook, Twitter, and YouTube so we can try to embed these tools or similar

functions into our design for user familiarity” (P5, personal communication, March 25, 2016). “For us to do anything without knowing what we what to accomplish is the wrong thing. So that's where you start—understand needs from the business perspective. I don't want to know your IT needs—that's kind of dumb. I want to know the business needs, and we'll work to figure out the best IT solutions, and that's hard for a lot of people. I try to understand the business need that's driving the tech discussion before getting too far into the technology discussion. So that's the first order of thing.” (P1, personal communication, March 15, 2016).

Interview question 2. Interview question two asked, “What protocols did you use to implement mHealth?” The data yielded three themes: (a) business processes, (b) technology criteria, and (c) collaborations, as seen in figure 2.

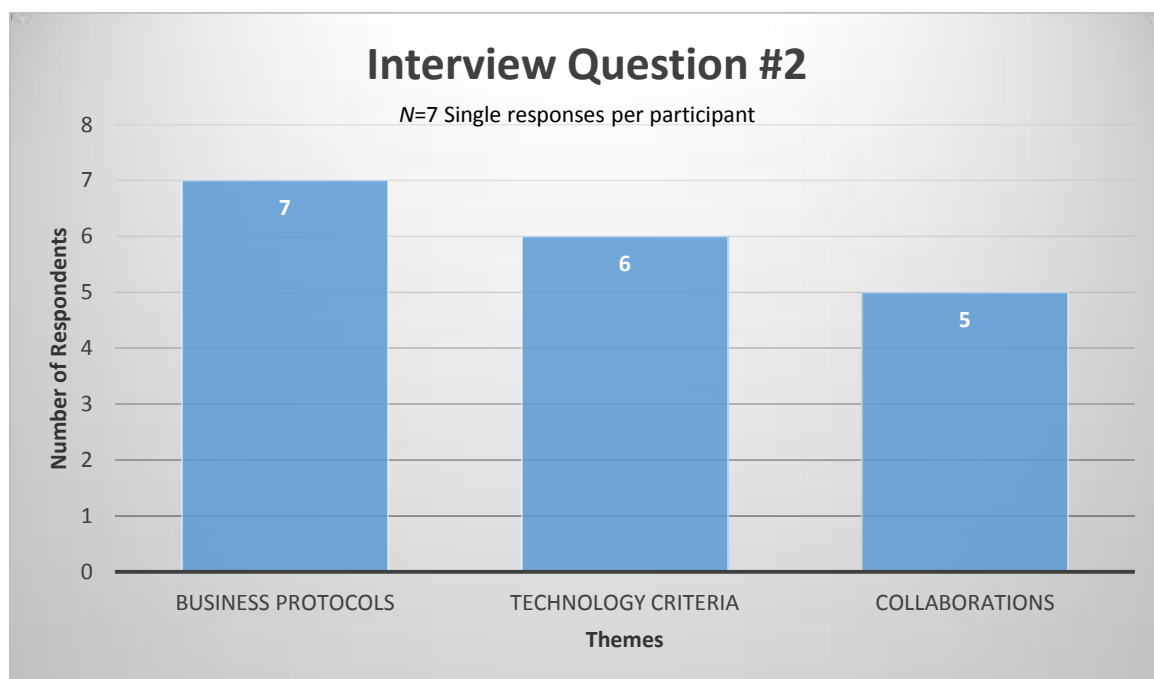


Figure 2. Interview Question 2—Protocols used for implementing mHealth.

Business Protocols. Business protocols which included industry standards and business procedures were cited by all seven (100%) CIOs making it the top protocol when implementing MHealth. P2 explained,

Most ideas get brought up from the organization, front line doctors, nurses, or even patients. They then get filtered through a business process to determine its ability to advance mission objectives. They then get filtered through a business process to determine its ability to advance mission objectives. (personal communication, March 19, 2016)

P5 talked about the importance of using industry standards.

We spent a number of years implementing protocols that would qualify us at the HiMSS Stage 7 level, which is the highest level of achievement for electronic medical records and systems. Using HiMSS standards we were able to have a business strategy in place to develop a system that would make it more accessible and secure for patients and providers to use the mHealth tools we provided. (personal communication, March 25, 2016)

Technology. Patient portals, responsive web designs and internal system development were mentioned by six (85%) CIOs, as part of their technology protocol. P4 explained,

The protocol we've chosen to use is to buy off-the-shelf when possible and use standardized tools. There are more and more cases for mobile health now so we are doing more development in our own shop so we can give those tools to our patient so they can have access to their data. (personal communication, March 20, 2016)

P1 talked about the the importance of having a digital presence for non-patients as well as new patients.

We, like almost any healthcare system now, do a significant body of work around patients before they even have a have a digital EHR account with us. Our digital presence includes our website, social media presence, those kinds of things, those would be offered to the patient referring physicians, and external stakeholders like family in a way that's mobile friendly. One of the big mobile properties that we have is user responsiveness concept, which means that we built once using responsive layouts. The tools then adjust to the user's devices and displays the information in a way that friendly, be it by mobile phone or desktop computer. (personal communication, March 15, 2016)

Collaborations. Collaborations were mentioned by five (71%) CIOs who reported partnering with patients, mHealth technology experts, focus groups, and health information exchange (HIE) developers. P4 explained,

We've had a patient portal for more than seven or eight years that could be used to access health records. We've been doing this before the technology became more advanced so a lot of what we've done is developed in business partnerships with Microsoft. (personal communication, March 20, 2016)

P3 talked about how they came to the decision to collaborate.

You have to look at what your resources are as well as who your intended users are. Then determine if you build your own system, buy something commercial, or do a combination of things. For us, we found that the best method was to partner with EPIC and have MyChart® as part of our hospital's patient portal. (personal communication, March 22, 2016)

Interview Question 3. Interview question three asked, "How do you manage data exchange from other HIPAA providers and patients?" According to all seven (100%) CIOs, HIE

partners are the most frequently used method for data exchange of health information.

Traditional methods like hard copy files and electronic private exchange systems were cited by only one (14%) of the CIOs (see figure 3).

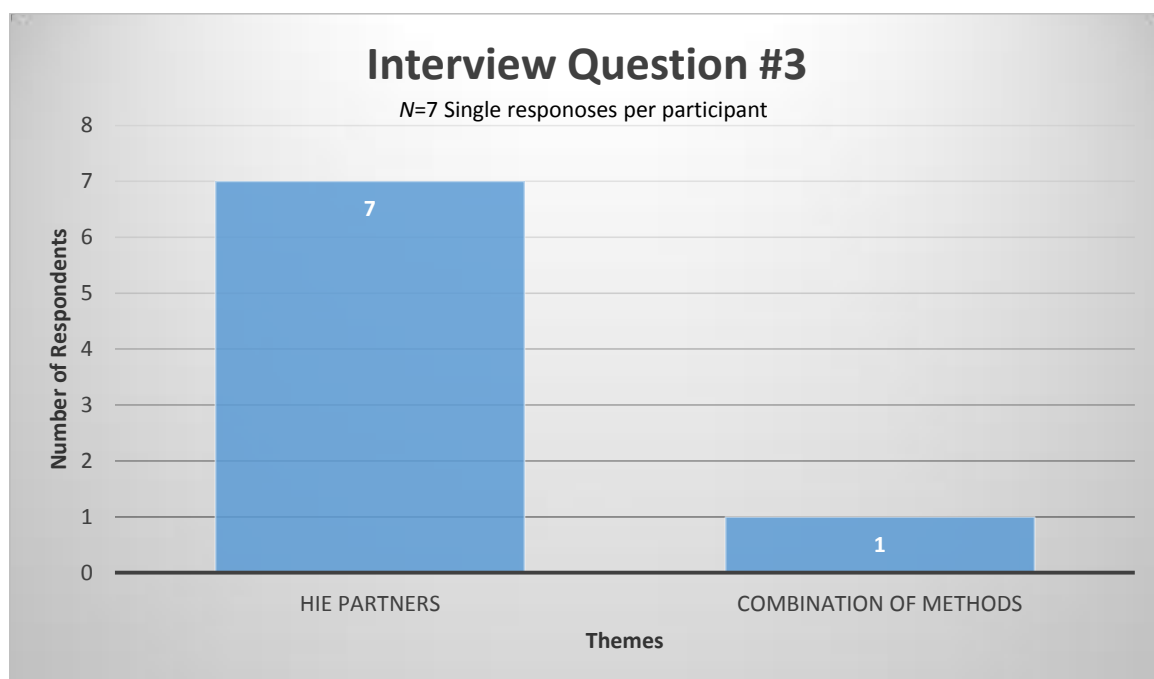


Figure 3. Interview Question 3— Data exchange with mHealth.

HIE Partners. HIE partners allow the organization to expand its reach and broaden its influences in providing mHealth services. P3 stated, “A large part of us partnering with EPIC was because of their interoperability. This is vital for regulation compliance, so that data can be exchanged with other providers as our patients move to other facilities” (personal communication, March 22, 2016). P6 discussed using several partners for data exchange.

We run on Cerner but some of the hospitals also run on EPIC as well as McKesson. We work to tie these different systems together to create easier accessibility to health information as well as patient health records. There’s a lot of different systems that need

to be pulled together. We've partnered with several companies, but health information exchange is a big part of our strategy." (personal communication, March 28, 2016)

Combination. P3 was the only CIO that discussed using HIE partners, private exchange networks, as well as taking health information directly from patients.

We have several ways for patients to get us their information. We take it directly from the patient, we get it electronically through patient portal exchanges, but otherwise, there are few ways for patients to input their own data. We do a better job exchanging information with providers in the area—we're a member of the Healthix and there are tens of thousands of patient records. They are managed mostly through continuity of care documents and that's compatible with other providers and health systems as well.

(personal communication, April 4, 2016)

Research Question 1 Summary. Research question one asked, "What strategies and practices do CIOs employ in the implementation and adoption of mHealth technologies?" Three interview questions were asked of participants; the first looked at internal and external factors that influenced mHealth development, the second explored protocols for implementing mHealth, and the third investigated data exchange practices. Through detailed analysis, the data yielded four key practices for implementation and adoption of mHealth technologies: business process, partnerships, information technology standards, and stakeholder engagement (see figure 4).

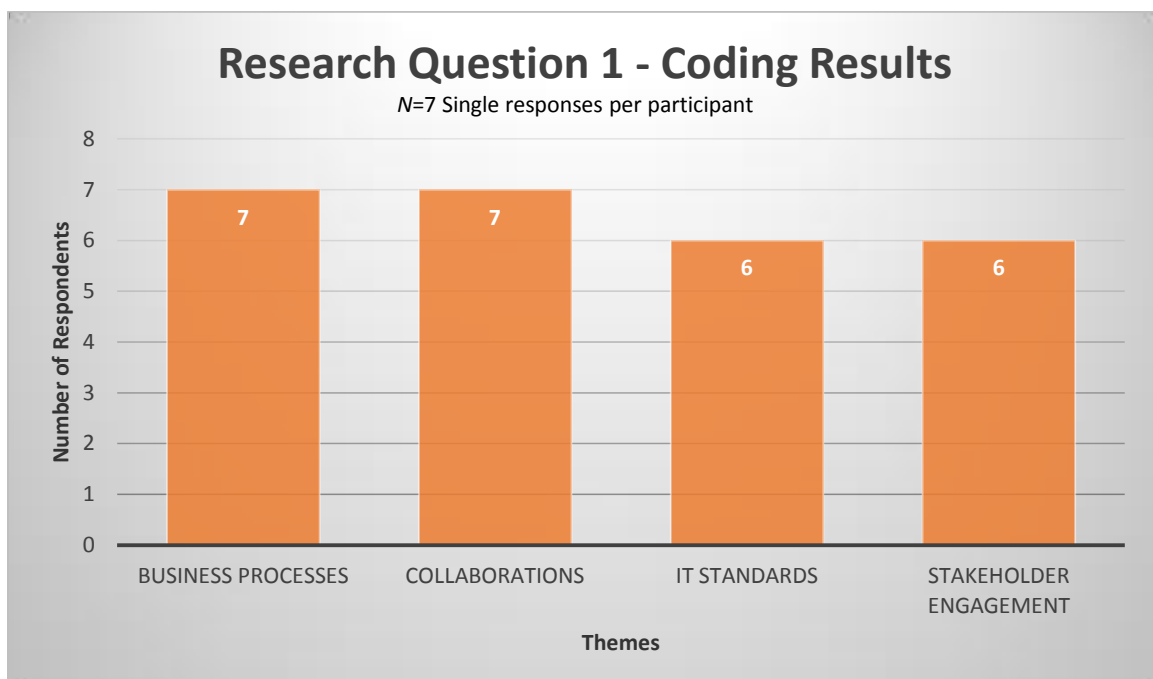


Figure 4. Research Question 1—Emerging themes for mHealth development.

Research Question 2

Research question two asked, “What challenges do CIOs face when implementing best practices for mHealth technologies?” To answer this question, the participants were asked three interview questions that looked at challenges associated with mHealth.

IQ 4: How do you address the needs of the unique user (non-tech savvy, senior adults, visually impaired, voice command users, etc.)?

IQ 5: Did you have any “technology” challenges and how did you overcome them?

IQ 6: How do regulations such as HIPAA, Affordable Healthcare Act (ACA) and HITECH Act affect the mHealth services you offer?

Interview question 4. Interview question four asked, “How do you address the needs of unique users (non-tech savvy, senior adults, visually impaired, voice command users, etc.)?” The data yielded two themes: (a) product assistance, and (b) personal assistance (see figure 5).

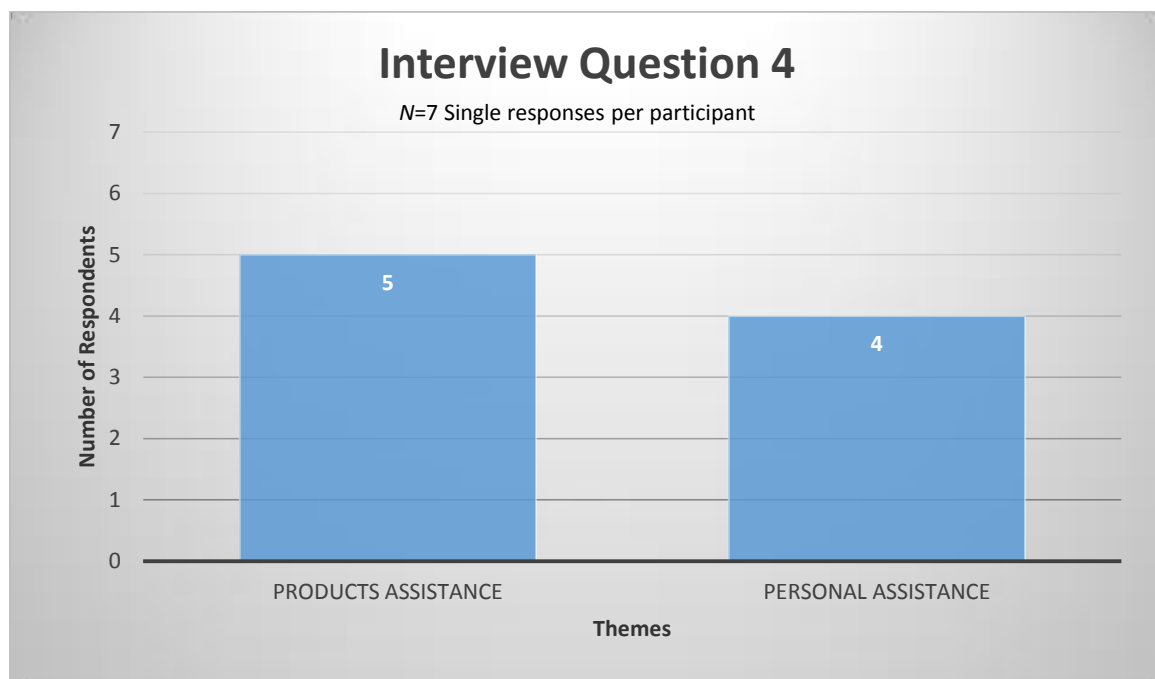


Figure 5. Interview Question 4— Addressing unique user needs in mHealth.

Product Assistance. CIOs discussed using specific American with Disability Act (ADA) compliant data management systems, responsive web pages, and capitalizing on built-on accessible features that come with mobile devices. P2 explained,

We did this research a while back and recognized that exactly zero of the existing portals were ADA compliant at the time of our research. We decided to address this by writing our own portal. The first barrier we were asked to address from the user community was language. We currently support 12 languages on our application. We also conducted focus groups with the user community to introduce design elements to them to see what resonated and what didn't. The simple answer is that we found the work had already been done by companies like Facebook, and we utilize a significant amount of work already done by Facebook on our mobile and web applications. We also utilize the full range of

accessibility features available on the phones—voice, contrast, magnification to name a few. Is it perfect? Not yet. (personal communication, March 19, 2016)

P4's statements were similar.

Early on we didn't have the ability for special classes of patients to be able to use our tools. It was a generic. In our latest tool development, we made it so it was completely ADA compliant so patients with auditory or sight impairments would be able to use our tools with full access. We worked with a third party so those patients would have full access. (March 20, 2016)

Personal Assistance. In addition to using various technical products, four participants (57%) cited having patient proxies, access groups, and user trainings to aid patients in accessing their mHealth services. P3 explained the decision to have multiple methods of access.

As patients have increasing access to their electronic information, providers will have to develop communications that help patients understand how to keep their electronic information secure. It's not just our patient users that may have issues, it is also our medical providers. For our staff, we do user training and education because the way we use technology in our personal lives is a lot more loose compared to how we use technology in our work life—this is especially true when talking about private health information for your patients. We also made our website responsive, so it can be accessed from any devices and can be used with accessible software a user might have. (personal communication, March 22, 2016)

P7 stated, “We have usability folks who provided input to design a more open and accessible system. But we also provide help functions online as well as the ability to call the service desk for additional assistance” (personal communication, April 4, 2016).

Interview Question 5. Interview question five asked, “Did you experience any challenges and how did you overcome them?” The data yielded two themes: (a) technical difficulties, and (b) user error (see figure 6).

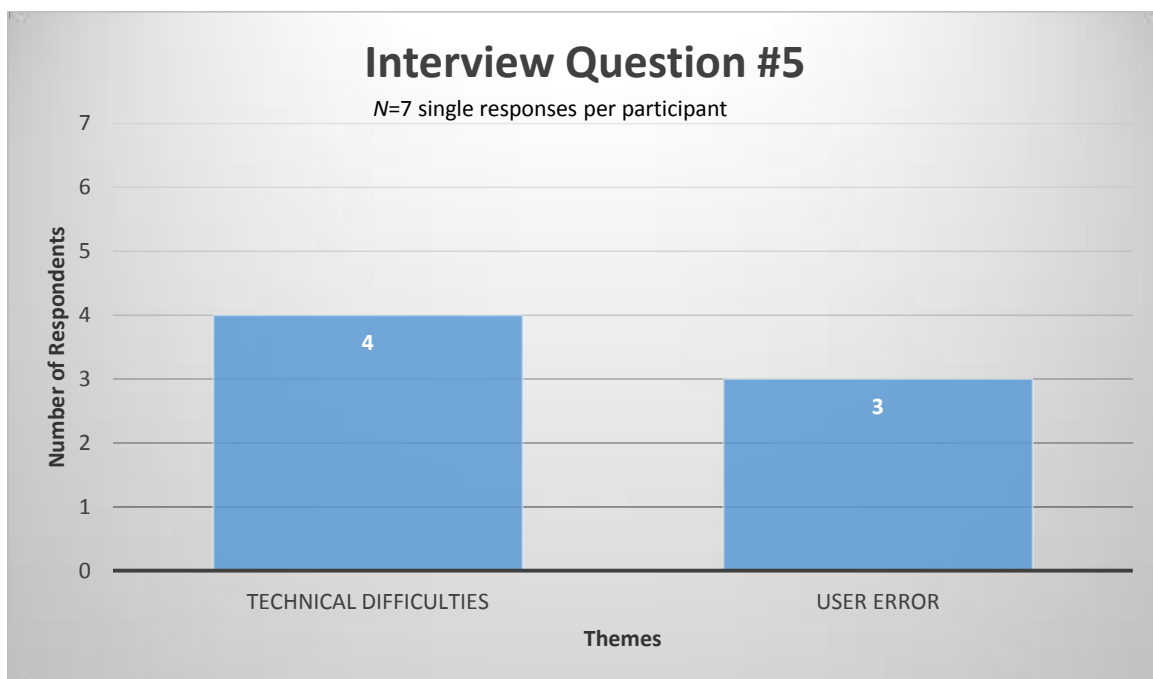


Figure 6. Interview Question 5—Challenges associated with mHealth.

Technical difficulties. Four (57%) CIOs identified data breaches and secure integrations of systems as challenges they experienced. P7 stated, “Creating a single platform to merge vendor supplied and internally developed applications was challenging, but an essential piece to have one ‘doorway’ into our online services.” (personal communication, April 4, 2016). P5 goes on to further state that, “It’s a continuous challenge to have interoperability when the industry doesn’t have solid data standards that ensure security as well” (personal communication, March 25, 2016).

User Error. Three (43%) CIOs cited user error as a challenges they've experience. User error are those mistakes made by individuals using a computer system, such as entering data into the wrong chart or misinterpreting the information from the system. P6 explained,

Every day there seems to be a new challenge presenting itself. The biggest piece for us is more related to human interaction then the actually technology. We have to help our medical providers with understand how predictive analysis works to their benefits in understand what's happening to their patient population. We are moving away from individual episodic care and into managing populations, which is a very different way of looking at it health care. (personal communication, March 28, 2016)

Interview Question 6. Finally, interview question six asked, "How do regulations like HIPAA, Affordable Healthcare Act (ACA), and HITECH Act affect the hospital's mHealth services?" Two themes emerged: (a) standardized measures, and (b) new processes (see figure 7).

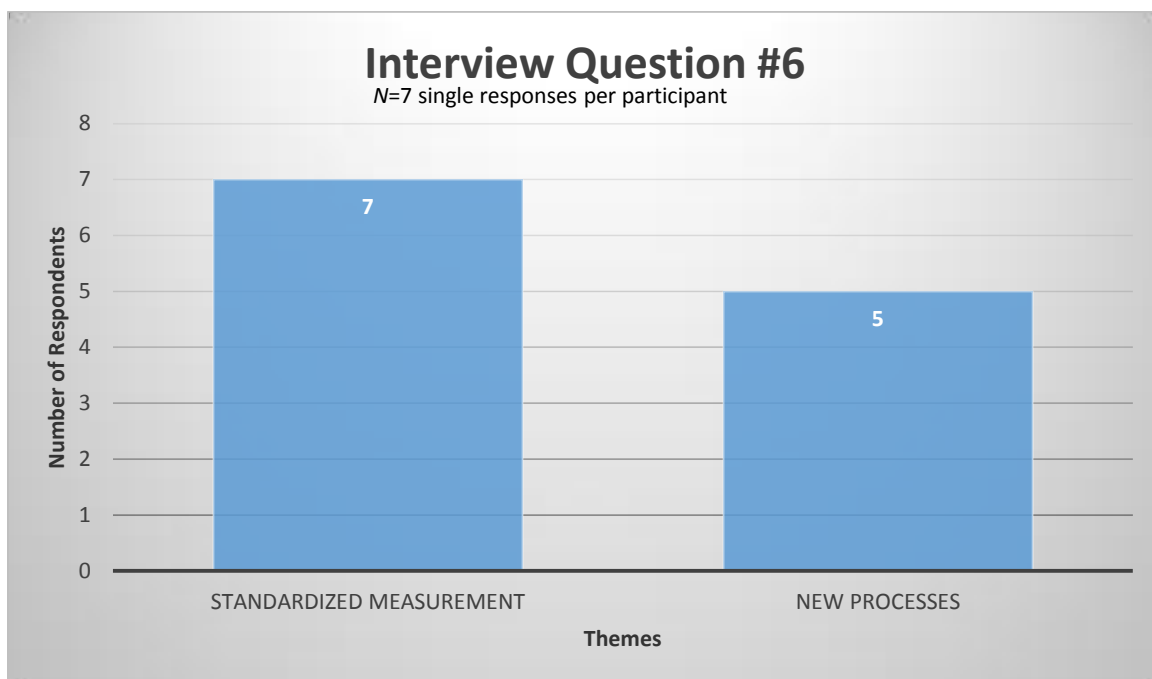


Figure 7. Interview Question 6—Regulation effects on mHealth.

Standardize Measurements. The development of standardized measurements was cited by all seven (100%) CIOs. P7 stated, “HITECH has helped raise the awareness and importance of this type of technology in our institution. HIPAA has not been as much of an issue as our state laws regarding privacy, which are stricter than HIPAA” (personal communication, April 4, 2016). P6 further elaborated by saying,

The HITECH is probably the regulation that all organizations struggle to meet.

Nevertheless, it made it possible for many healthcare systems to catch up and be on par with the rest of the modern digital work and devise creative solutions for improving data exchange and interoperability. However more and more, it’s becoming apparent there is a disconnect between what the regulations require and what the healthcare industry can actually deliver, and this has caused lots of headaches. (personal communication, March 28, 2016)

New Processes. Government regulations on healthcare, particular the HITECH Act, were also noted to have provided guidance to help achieve meaningful use standards for improved mHealth designs and receive monetary incentives. P1 explained,

That's a big piece. We use some of the mobile services to make it easier to comply with meaningful uses. We tried to put some functionality for our providers within the mobile devices but it's hard because a lot of it doesn't lend itself to mobile screen format. So most of the impact of regulations related to mobile solutions is in that security space, and we had to create guidelines on how to manage that. So we have to enforce PINS and tell doctors they can't take off the PIN and if they do take it off, we have to take off all access. They don't like that we are in their space but it's a necessary part of the whole.
(personal communication, March 15, 2016)

Research Question 2 Summary. Research question two asked, "What challenges do CIOs face when implementing best practices for mHealth technologies?" Two interview questions were asked of participants that looked at people and technical challenges. Through detailed analysis, the data yielded three categories or themes: (a) data security, (b) compatibility and (c) user needs (see figure 8).

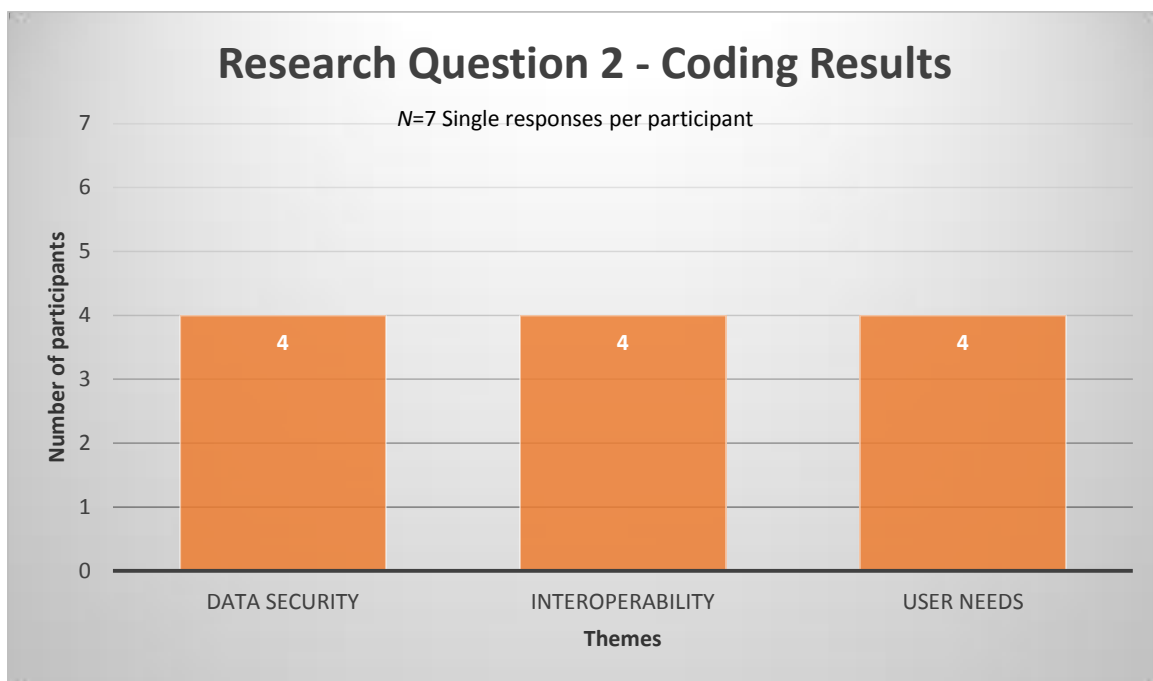


Figure 8. Research Question 2—Emerging themes related to challenges in mHealth.

Research Question 3

Research question three asked, “How do senior health IT professionals measure their success in implementing mHealth practices?” Two interview questions were asked of participants to detail how they measure their mHealth strategies and how (if) they obtain revenue for successful practices. Through detailed analysis, the data yielded three categories of measurements: product use, incentives, and people power.

IQ 7: What criteria do you use to measure overall success of mHealth?

IQ 8: How do you bill or obtain revenue for mHealth services?

Interview question seven asked, “What criteria do you use to measure overall success of the hospital’s mHealth services?” The data yielded two themes: (a) quantitative, and (b) qualitative (see figure 9).

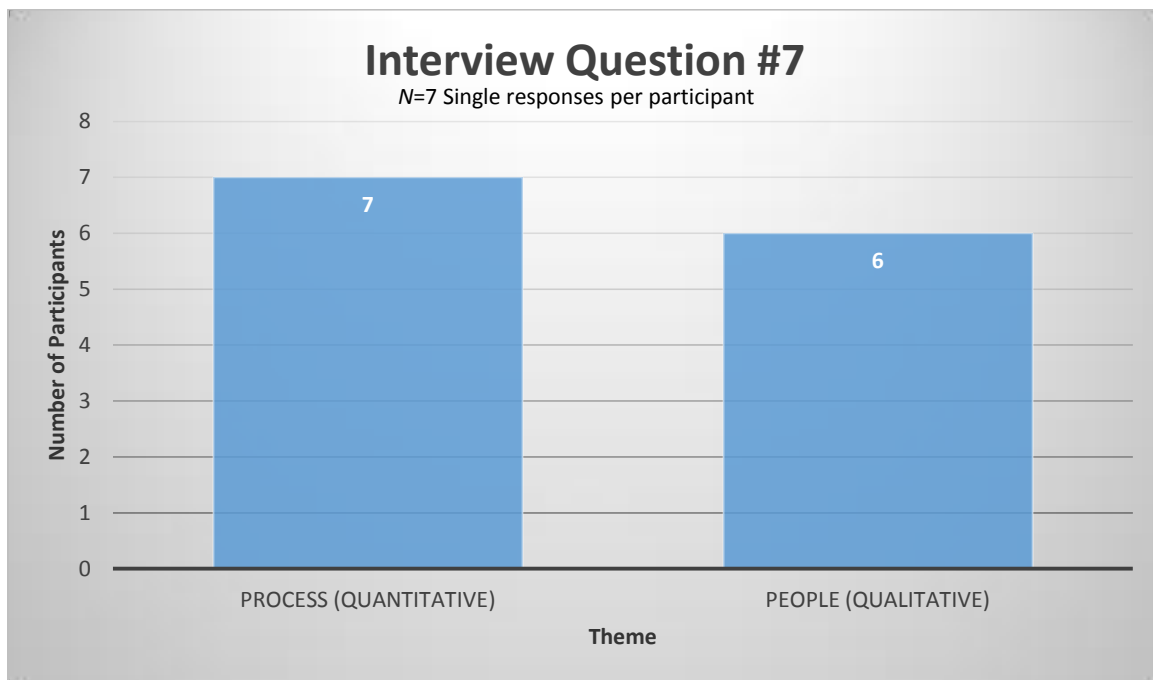


Figure 9. Interview Question 7—Criteria for measuring mHealth.

Quantitative. The CIOs discussed using a variety of methods to measure their success, including checking against benchmarks, looking at usage rate, and hospital surveys. All seven (100%) CIOs had some quantitative methods for measuring their mHealth services. P4 explained,

Right now we are measuring the number of unique patients that are using the portal; we measure those that are registered and how many download the mobile app, and we measure of the number of patients that communication exchanges back and forth with their physician. (personal communication, March 20, 2016)

P3’s team looked at security of the patient portals and EHR used by staff.

We look at the risk assessments and compliance plans we have in place and check it [*sic*] against safety records. We also look at the number of successful log-ins and errors, and the access method most used by our patients and providers. (personal communication, March 22, 2016).

Qualitative. In addition to quantitative measures, six (85%) of CIOs identified qualitative measures. P7 advised that their plans included “looking at usage statistics but we also gather good information from feedback surveys” (personal communication, April 4, 2016).

P1 offered insight on the importance of seeking understanding a user’s needs:

We are in the middle of doing another survey of our customers— particular patients—on their satisfaction with MyChart, ‘specially as that’s our biggest mobile product for patients, so we survey them about that. We also survey users of our websites, which has a lot of unique users, and get an understand [*sic*] with customer satisfaction data. We take suggestions and we have a focus group of patient MyChart users that [*sic*] we ask for ideas. We also look at patient satisfaction with the care provided, and that’s reported nationally to CMS, which gets us paid. We want to know how users are using the tools, but also if it’s improving their care. This is much more difficult to measure because things could be things happening with the patient health wise that has a negative impact, but they are still satisfied with the level of care they received even though they are still ill. (personal communication, March 15, 2016)

Interview questions eight asked, “How do you bill or obtain revenue for mHealth services?” The data yielded two themes: (a) non-monetary incentives, and (b) financial compensation (see figure 10).

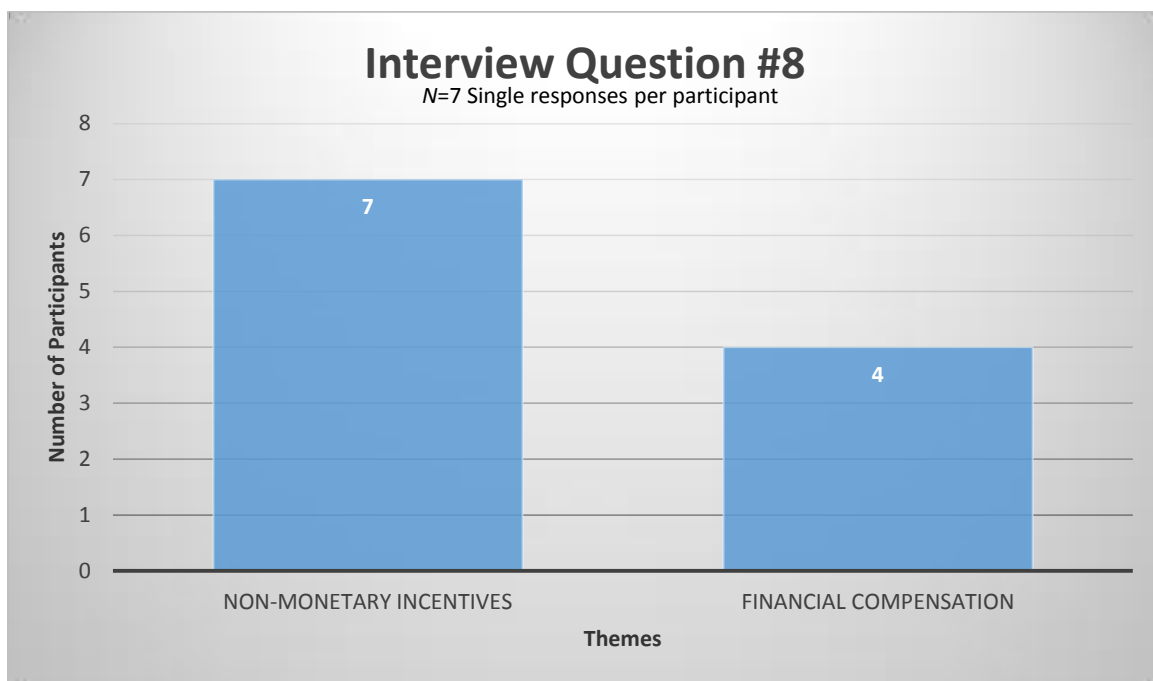


Figure 10. Interview Question 8—Compensation for mHealth.

The data showed that non-monetary incentives relates to the social justice concept, and all seven (100%) CIOs cited the social responsibility of the healthcare organizations in providing mHealth services to the communities they serve. P4 explained,

There are very few cases today where mobile health is revenue positive. It's mostly revenue neutral or revenue negative. So we don't do it for the positive ROI [return on investment]; we do it because it's better for the overall care of the patients. (personal communication, March 20, 2016)

P3 stated,

We don't currently generate any revenue from mHealth per se, but by abiding to standards in the HITECH Act we obtain incentive pay and avoid penalties. So right now, its more about having an additional method for patients and providers to manage health

information. In the future it will be more prevalent to bill for additional mHealth services like e-visits and video consultations. (personal communication, March 22, 2016)

P6 echoed these statements,

As it stands, it's more about how the mobile tools we provide help with healthcare savings cost than actually generating revenue. Being able to have our patients and providers engage in e-health and get reimbursement for that is still a work in progress.

There are services we can get reimbursed for through CMS, but at this stage, the costs are more revenue neutral. (personal communication, March 28, 2016)

Obtaining financial compensation for mHealth services was mentioned by four (57%) CIOs, who discussed monetary rewards in combination with non-monetary sentiments. P1 explained,

A portion of revenue, particular patient usage portal, has a direct measurement tied into meaningful use. So you can make the connection from that, if you don't have a certain portion of your patient population using the portal you're going to miss the meaningful use numbers and you're are not going to get your meaningful use payment. (personal communication, March 15, 2016)

P5 similar stated, "The fees and revenue that can be generated from mHealth are those that come from CMS codes that have identified particular healthcare procedures that we, as a provider, can still bill for if it is done via e-health methods" (personal communication, March 25, 2016). P2 echoed both statements,

In some cases, we bill. In some cases, it's efficiency gains. In some cases, it's incentives gained or penalty avoidance. But in all cases, because we are a ministry, it is about

whether it provides a better level of care for the community we serve. (personal communication, March 19, 2016)

Research Question 3 Summary. Research question three asked, “How do CIOs measure their success in implementing best practices?” Two interview questions were asked of the participants. The first looked at criteria used to measure mHealth services, and the second looked at incentives associated with successful implementation. Through detailed analysis, the data yielded three themes related to measurement of success: (a) incentives, (b) product use, and (c) people (see figure 11).

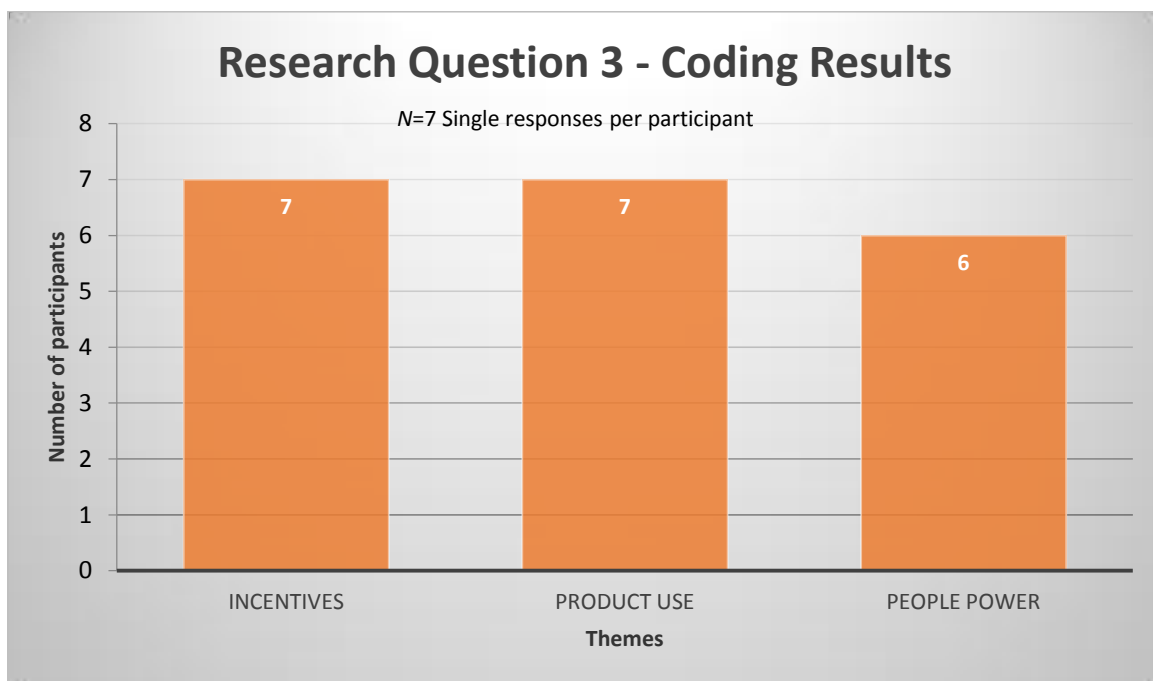


Figure 11. Research Question 3—Emerging themes related to successful implementation.

Research Question 4

Research question four asked, “What recommendations do CIOs have for future mHealth that want to implement mHealth technologies?” One interview question (IQ 9) asked participants what recommendations they had for health IT professionals and healthcare

organizations who were in the initial phases of developing and implementing new mHealth technologies. The data yielded three themes: (a) procedural steps, (b) technology tips, and (c) people power (see figure 12).

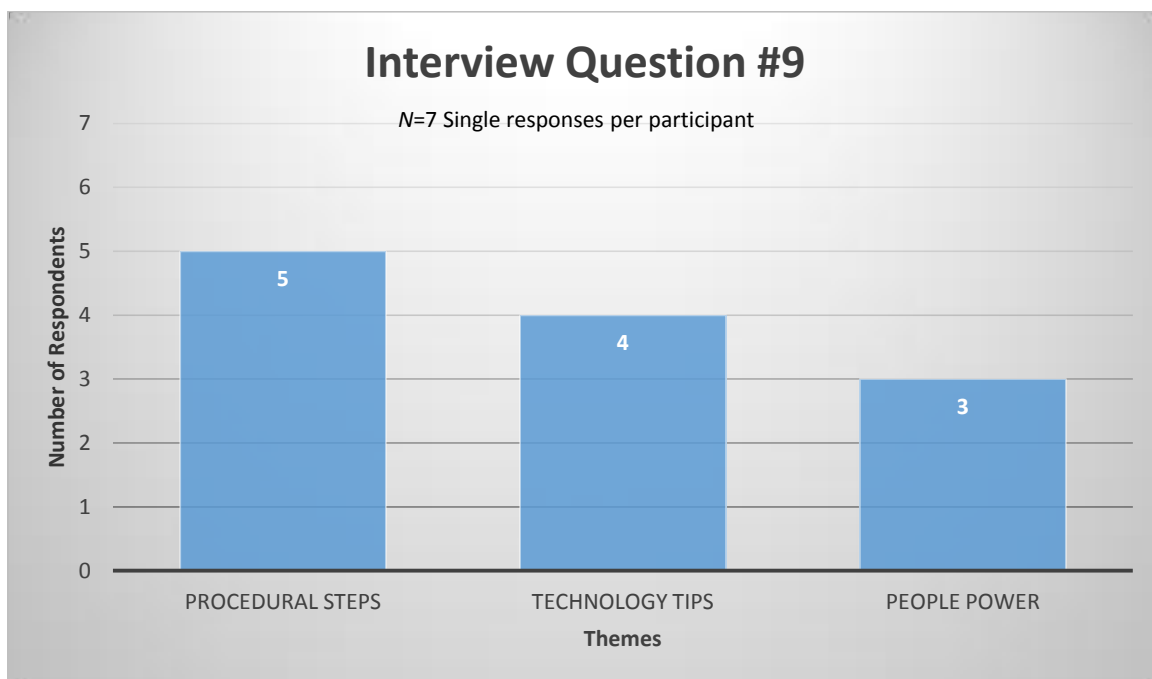


Figure 12. Interview Question 9— Recommendations for new mHealth Providers.

The CIOs named a variety of recommendations that overlapped, the most repeated being to start small, with all seven (100%) recommending the use some procedure or process. P6 stated,

Look at the process of how mHealth works, it's not the technology that gives the most challenges, it's the processes involved. Processes for encryptions, process for data security and integrity, processes for system compatibility. These are ongoing challenges, so become familiar with them from the start so you can effectively deal with it. (personal communication, March 28, 2016)

P1 recommended knowing the business needs.

There's so much going on in this space that you can't possible do it all, no matter how big you are. Don't try and do it all. So my recommendation to start is to get into some of your business needs, then pick a few things, two or three, to start that you can quickly acquire the capabilities to do really well. (personal communication, March 15, 2016)

P3 recommended having risk assessment procedures.

I'd say that as a provider you have to ensure that patient information is kept secure and have a plan that ensures there is vigilance and close collaboration among a number of provider departments. This will require you to conduct and keep current risk assessments and to carefully implement risk mitigation approaches suggested from the risk assessment process. (personal communication, March 22, 2016)

In addition to starting small and having established processes, technology tips were provided by five (71%) of the CIOs. P4 stated,

The best advice I can give is to maximize the use of embedded tools. If a hospital or health system has an electronic health medical records that has embedded patient portals or native tools that are associated with records, start there. Don't go off and try to purchase or create its own tools. They should leverage everything that they can. (personal communication, March 20, 2016)

P6 echoed this statement, "Start out small and look at what systems and processes you have in place, as it's not always necessary to replace a system that may be working but just needs some creative solutions to improve its functionality" (personal communication, March 28, 2016). P7 stated,

Plan for a fairly long lead time as technologies are not always compatible. Keep the needs of your customers in mind and how they will deal with multiple mHealth platforms from

a variety of organizations - have a long term strategy in mind for handling technology hiccups. (personal communications, April 4, 2016)

Finally, three (42%) CIOs recommended using a consumer-based model for design and implementation of new mHealth services. P6 stressed the importance of knowing your people.

It's important to have the right people on board who understand how to work with others and to bring the best system and solutions together. When you have the right people on board, they become invested and share a common goal in building successful mHealth strategies. (personal communication, March 28, 2016)

P7 echoes P6's sentiments, "Start with a smaller audience (perhaps your own employees) and learn from them so you don't alienate your broader audience with an immature platform"

(personal communication, April 4, 2016). P2 also recommended adding experts, "When you have processes around governance, data sharing, data analytics, and digital channels, make sure to add some expertise at the analyst level to identify the best solutions for your community"

(personal communication, March 19, 2016)

Additional recommendations from CIOs included:

I would say to realize that there is no one solution that takes care of everything, so look at your greatest needs. What can you provide your consumers to make managing their health information easy? Trying to do it all is impossible and just not practical. (P5, personal communication, March 25, 2016)

If you're trying to build the granddaddy of all mHealth strategies and do all this crazy stuff, you're never going to get out of the gate. All the technology strategies are in-depth so before you start talking about what cool tools you can use and how you can use them,

first ask, what business problem is this tool going to solve? (P1, personal communication, March 15, 2016).

Research Question 4 Summary. Research question four asked, “What recommendations do senior health IT professionals have for healthcare organizations that want to implement mHealth technologies as part of their health IT systems?” Participants were asked one interview question to provide suggestions or recommendations based on their experiences with implementing mHealth platforms at the healthcare facilities. While many of the suggestions overlapped, a through detailed analysis yielded three areas of focus: (a) it’s a process, (b) tech tips, and (c) expert knowledge (see figure 13).

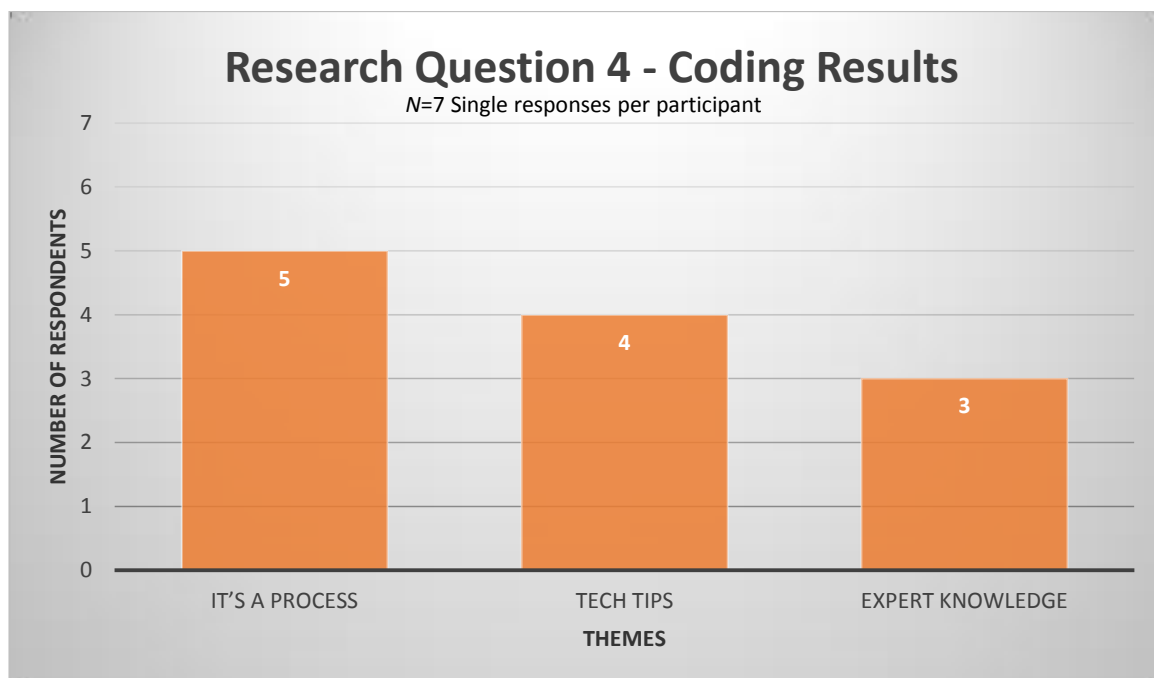


Figure 13. Research Question 4—Emerging themes related to future recommendations.

Summary

This was a qualitative study that explored the perceptions and insights held by executive health information technology professionals who work for healthcare organizations throughout the United States. The phenomenological approach allowed the researcher to engage participants in a semi-structured interview with open-ended questions to understand the social, legal, and cultural contexts of their lived experience within the mHealth phenomenon.

Criteria to participate in this study was limited to senior health IT professionals who worked in a healthcare setting in the United States, individuals have been recognized as experts in the field of mHealth and their healthcare organization has offers mHealth services. These strict criteria offered the study the best opportunity to get participants with rich work histories in health information technologies and mHealth. It also restricted the sample size to a selective group of individuals. Using *Becker's Hospital Review*, a publication widely accepted as the industry leader on business and legal issues that affect healthcare sector, the researcher selected candidates who were featured on the annual list of 100 CIOs recognized as individuals who have made significant contributions in health information technology. The list initially generated 49 eligible candidates who fit the criteria for inclusion and all 49 were invited to participate after the first two rounds of invitations yielded a very low response rate. In total, 63 invitations were sent and eight individuals accepted. However, only 7 participants were interviewed as one participant was no longer available to participate.

While the number of participants was less than anticipated, the researcher believed there was enough quality data available for analysis. Qualitative data is concerned with the meaning behind the data instead of quantifying data-sets since no hypothesis statement needs to be made. As such, it is possible to get significant results when quality data is obtained. The codes

generated from each interview question were sent to two reviewers to cross check the researcher's codes for inter-coder validity and reliability. With a consensus reached, the coded data was reorganized with its corresponding research question to produce the findings. Based on those findings, recommendations for future research and a final conclusion are presented in the following chapter.

Chapter 5: Findings and Recommendations

Introduction

The increased use of mHealth applications and virtual health communities reinforces the need to understand what the best practices are for successful implementation of mHealth technologies in the healthcare industry. The purpose of this study was to identify best practices and strategies used by executive health IT professionals in implementing mHealth technologies, identified how healthcare reform affect mHealth implementation and obtain recommendations for future mHealth providers. A study on best practices for mHealth found four dimensions: (a) people, (b) payment, (c) places and (d) purpose needs to be considered when designing and implementation mHealth solutions (Comstock, 2014). For this study a total of 13 best practices were identified from interviews with seven CIOs and they touch on each of the four dimensions.

The field of mHealth is large but only one aspect within virtual healthcare models. Stanford University and University of California San Francisco found there are five different levels to virtual health models (Kim et al., 2015). mHealth has been more widely accepted because it can be implemented into the clinical workflow of a healthcare organization with more ease (Vecchione, 2012). The researcher's intent was to define what a successful implementation of mHealth services looked like, specifically for healthcare providers in the United States. By doing so the study aimed to extend the body of knowledge on implementation practices for mHealth services and identify best practices that can be used by future mHealth providers. An emphasis was placed on the United States healthcare sector primarily due to the passing of the 2010 Affordable Healthcare Act, which revolutionized the American healthcare system. It now required that all Americans buy healthcare, it made healthcare available 16 million people who were previously without coverage, it expanded Medicare coverage, more people are being

diagnoses with illness that were previous left untreated and it increased the wait time to be seen by a medical provider thus raising the ER visits (Whitman, 2015). It also expanded on the President Bush's 1994 EHR Adoptions Initiative by creating the 2009 HITECH Act which requires healthcare providers to promote and adopt the "meaningful use" of electronic health records (Mullin, 2011). This chapter will discuss the findings of the study, provide recommendations for future researchers, and closes with a general conclusion related to the phenomenon investigation.

Summary of Findings

Healthcare organizations are challenged with implementing a new healthcare delivery model that uses virtual health technologies. May et al. (as cited by Ross, Stevenson, Lau & Murray, 2015) completed a systematic review of challenges associated with mHealth and found that problems related to health IT system compatibility as well as problems with associated with mHealth technologies affect on the healthcare organizations structure and goals. The review emphasized the need for proper resources, including financial support, administrative support, policy support, developing of standards and interoperability. Using a phenomenology approach allowed the researcher to interview participants using open-ended questions that focused on obtaining authentic descriptions about what it's like working within the mHealth phenomenon, and what they learned from any challenges and failures. The focus of this dissertation was to identify the best practices and strategies for successful implementation of mHealth technologies. The researcher did the initial coding and had two external reviewers check that data for reliability and validity. Recommendations were reviewed, revisions were made, and the final master codes were created.

The following are the 13 identified best practices for mHealth implementation as identified by CIOs in this study:

1. Standardize business processes—focus on the procedures, industry standards, and evaluation methods employed to achieve a desired outcome
2. Collaboration—Partnerships with healthcare organizations, mHealth expert, and intended users are a significant component when designing and implementing mHealth services.
3. Incentives—Providing mHealth is part of the social and ethical responsibility of the healthcare organizations. Successful mHealth services are able to provide quality services that satisfy users and meet meaning use standards for incentive payments.
4. Product use—Refers to the number of mHealth products downloaded, used, or accessed by patients and medical providers.
5. Information Technology standards—Standardization ensures that business operations are efficient and productive so mHealth providers can save money, access new markets, and improve customer satisfaction.
6. Stakeholder engagement—People are at the center of the healthcare revolution, so it is vital to keep patients, providers, family members, and staff involved in mHealth discussions.
7. People power—Only users can tell mHealth providers if they are satisfied with the services offered to them, so keep the lines of communication open to receive feedback.
8. Prioritize data security—Protection of data among the various types of technologies also protects patients, and ensures they are provided with the best care possible.

9. Understand interoperability—Refers to the technical challenges associated with establishing and maintaining digital compatibility that allows health IT systems to share across various systems.
10. User needs—Understanding the functional and emotional needs of the user is key to designing a mHealth platform that provides the right information to users in understandable and interactive ways.
11. It's a process—Understand that mHealth is a service and there are processes and procedures to follow to ensure the service is viable.
12. Tech tip—technology advice on moving mHealth forward and what pitfalls to avoid in mHealth design
13. Expert knowledge—Leverage the knowledge of others to your advantage.

Findings

Through review and analysis of the data, the following strategies have been identified by CIOs as successful practices when designing and implementing mHealth services within a healthcare setting. These best practices are ranked from highest to lowest.

Standardize business processes. The business processes focus on the procedures, industry standards, and evaluation methods employed to achieve a desired outcome. All seven (100%) CIOs cited the Health Information and Management System Society (HiMSS) as a measure tool for achieving and sustaining a successful mHealth platforms within a healthcare setting. New mandates and legislation in healthcare and health information technology require healthcare organizations to have solid procedures in place to accommodate these changes and continue to provide care to the community. Future mHealth providers will need to familiarize themselves

with industry standards and remain educated on changes that are likely to affect their mHealth platforms.

Collaborations. The second strategy identified by seven (100%) CIOs was to collaborate with experts in the industry including software developers, data security experts, other health information professionals, as well as the intended users. A lot of ideas and suggestions come for those who are directly affected by any mHealth services the organization offers, and their input and insight are vital for developing a user-friendly system. Collaborations among healthcare organizations, telecommunications companies, non-government organizations, and software developers are a significant driving force in developing countries and have helped advanced innovative mHealth products that improve the health and well-being of the people (Curioso & Mechael, 2010).

Incentives. Seven (100%) CIOs identified incentives as a measurement of success. As a whole, incentives primarily refer to the healthcare organization's efforts to obtain financial compensation, as well as avoid punitive measures related to implementation of mHealth technologies. Each participant made references of their efforts to having their mHealth platforms meet "meaningful use" requirements set forth by CMS. In order for healthcare providers to receive this incentive payment, they have to meet certain criteria within a certain time line, including recording patient information as structured data and exchanging patient care records (ONC, n.d.). Each unsuccessful attempt to meet meaningful use standards results in disqualification for monetary payment and increasing monetary penalties, which result in reductions in Medicare payment (Hurt, 2014). Future mHealth providers should make it a practice to understand how incentives are tied to mHealth services.

Product Use. Seven (100%) CIOs identified keeping track of the mHealth products and services they utilize as part of the organizations business model. This includes measuring the number of unique user-to-mHealth interactions, which can include the number of mobile application downloads, number of data uploads, number of patient-provider in-system interactions, and log-in attempts. Having analytics on mHealth services the being offered allows the mHealth provider to identify which products are being used, track increases and decrease in usage, and learn which products add value to the mHealth services being offered.

Information Technology Standards. Six (86%) CIOs advised they utilize information technology standards as part of their practice. Standardizations ensure that business operations are efficient and productive so they can save money, access new markets, and improve customer satisfaction (International Organization for Standardization, 2016). IT standards allow technology platforms and products to be more accessible and compatible with other existing systems. For the healthcare industry, security and privacy of electronic health records and patient information is a top priority. It is vital that health information professional and future mHealth providers stay current on all the changes that affect their digital data and health information systems.

Stakeholder Engagement. Six (86%) CIOs stressed the importance of engaging with various stakeholder groups that are affected by a healthcare organization's decision. Very often patients, providers and employees have many suggestions, feedback, and insights that can make a hospital's mHealth system more effective. Thus, it is important for mHealth providers to establish a line of communication and engage in discussions with the different stakeholder groups. Focus groups, website visitor surveys, and pilot test groups all provide valuable feedback.

Power to The People. Six (86%) CIOs identified the importance of user satisfaction and how it plays into the success of mHealth products and services offered by their healthcare provider. Participants indicated that while meeting metric marks helps with standardization, having the community they serve be satisfied and engaged with the mHealth technologies is equally important. Such non-monetary benefits, such as having users identify mHealth services as user-friendly, convenient, or accessible, can be connected back to financial compensation as well. mHealth providers frequently gather patient and provider satisfaction surveys to get feedback on meeting user expectations, but this information is also used in conjunction with statistical data reported nationally to third party insurers like CMS to meet Medicare reimbursement requirements, is not connected to the meaningful use payments.

It's A Process. Five (71%) CIOs believe it is important to understand that mHealth is services, and like all services, a process is involved. Participants stressed the importance of starting out small and to avoid the need to create for creation's sake. Instead, understand the needs of the organization and design a mHealth system that addresses those particular needs. By identifying the needs first and implementing just a few strategies, health IT professionals and future mHealth providers can acquire the skills and capacity to do those strategies very well and meet the organization's needs to services its community better.

Prioritize Data Security. Four (57%) CIOs identified data security as a priority in the mHealth practice. Data security refers to protection of data among the various types of technologies, including virtual private networks (VPN), virtual databases, and cloud services that healthcare industries use for their mHealth platforms. The American Telemedicine Association (ATA) provide guidelines on meeting HIPAA standards and state the technologies such as VPNs and network systems that use internet transmissions must protect health information using

accessible and authentic protocols to safeguard against data breaches (Luxton, Kayl, & Mishkind, 2012). While this does reduce a number of errors, it also introduces a new set of problems. Reports of usability issues and errors in interoperability and internal system corruptions were reported by 32 hospitals in Iowa (Herrick, Gorman & Goodman, 2010).

Data security remains at the forefront as a continuous challenge because with every new safeguard put in place, there are new methods of hacking into a system and compromising data security. Data breaches are very serious incidents that can compromise medical care for patients, as well as destroy the reputation of a healthcare organizations and cause significant financial damage. Another cause for alarm is also the real possibility of ransomware, where hackers and cybercriminals take hold of a business IT system and demand ransom money for it. In 2015 companies paid \$25 million dollars in ransom; it is expected to reach upwards of \$200 million dollars in 2016 (Hallam-Baker, 2016). Healthcare organizations find they have to remain proactive to guard against data breaches while working towards interoperability, the third challenge associated with mHealth.

Understand Interoperability. Four (57%) CIOs identified understanding interoperability as a part of their strategy for managing mHealth services. Interoperability refers to the technical challenges associated with establishing and maintaining digital compatibility that allows health IT systems to share across various systems. Reports from the Office of National Coordination for Health IT Information found that six out of ten hospitals in the United States didn't have the necessary equipment systems, or the systems in place were not compatible with other healthcare providers for sharing information (Monegain, 2015). These technical challenges are likely just one reason why collaborations with experts are becoming more prevalent; however, this does not guarantee compatibility. Future mHealth providers need to understand why meeting

interoperability guidelines is a challenge and how to design a system that minimizes the challenges.

User Needs. User needs are a constant challenge and four (57%) CIOs believed the best way to counter this challenge is to make it a practice to understand the functional and emotional needs of the users in order to design a mHealth platform that provides the right information to users in understandable and interactive ways. Their needs vary greatly, from needing alternative accessible methods to access patient portals to wanting mHealth functions that are familiar to them. Data errors occur when medical providers and hospital employees accidentally put health information in the wrong file, or when pre-populated forms and templates are missing items due to data delivery method (White, 2014).

Tech Tips. Four (57%) CIOs recommend that future mHealth providers guard against getting any type of new technology before knowing the true capacity of their health IT systems. An abundance of mobile and health-related technology programs, hardware, software, and platforms available from which to choose. In fact, there are so many choices that it is easy to get caught up in the hype about all the wonderful and innovative things they can help a healthcare organization do. Instead, participants recommended that future mHealth providers maximize the use of their current systems and build from there. By maximizing the use of native tools, embedded tools, and buying off-the-shelf products, future mHealth providers can match user and business needs with the technology, instead of forcing the intended user and business organization to conform to the technology.

Expert Knowledge. Three (42%) CIOs recommend future mHealth providers practice leveraging expert knowledge. No matter how knowledgeable health IT executives and VPs are, they can't know everything. Having experts on the team is essential to being better educated

about products and services so an informed decision can be made about what mHealth strategies fit with the healthcare organization's mission and business needs. Expert knowledge isn't restricted to IT governance or technology professionals. It is important to engage patients, providers, and hospital employees in the discussion surrounding mHealth development. They are the intended users and bring a perspective that can be missed by mHealth developers.

These findings match some of the recent reports coming out from Deloitte, a global consulting company headquartered in the United Kingdom. They found that the people, payment, places, and purpose were the four major components that needed to be included for successful mHealth development. People is in reference to understand your targeted demographics' needs and preferences. Payment refers to tying the organization's business needs to value-based pricing to maximize incentives and reimbursements. Places refers to infrastructure rather than physical locations. Connectivity and the availability of cellular networks are required for mHealth technologies to be implemented. Developers need to take this into account for functionality. The final component is purpose. In a nut shell, what purpose does the mHealth platform serve? MHealth services that are focused, such as those that provide disease management or patient education, have a better chance of being effective.

Implications of the Study

In identifying the best practices for mHealth implementation, this study intended to contribute insights on how healthcare organizations can design successful mHealth services that can offer patients alternative ways to accessing their care providers and health information, as well as offering providers another methods of managing patient care. The conclusion of this study offered insight on how important the human side of mHealth is. All of the participants discussed having an open line of communication with the patients, medical providers, and

hospital staff. P7 advised that one of the strategies used to work with experts as well as focus groups on designing and testing the accessibility and usability of their mHealth technologies prior to launch (P7, personal communication, April 4, 2016). They believe that collaborating with experts, engaging with consumer interest groups, and creating test and focus groups aided them in understanding how mHealth affects the intended user. P6 discussed partnering with several companies to pull together a system that meet the needs of the patient as patient portals were represent a big part of their mHealth strategic plan (P6, personal communication, March 28, 2016). They recognized the healthcare community as a tremendous asset, and stand firm on using a consumer-based model that identifies the needs of the consumer.

The study also found that mHealth is seen as an ethical practice that adds to the overall value and mission of the hospital. While mHealth generate billions in revenue, for healthcare organizations mHealth is largely revenue neutral or even revenue negative when in its infancy. Reimbursement for mHealth services is developing, and still requires a lot of redesigning so that the benefits and services provided through mHealth can be reimbursed at reasonable costs to the patients and insurers. In the meantime, mHealth providers should establish solid mHealth strategies to meet business and patient needs. P2 explained, “The Sisters make it clear that we are a ministry at every turn. When we start to talk business terms they remind us of our mission and values. If it’s the right thing to do for the community, we are encouraged to do it regardless of the bottom line. In our cynical world this may not ring true to many but in the past four years I have seen it lived out over and over again.” (personal communication, March 19, 2016).

Another implication stressed by all the participants of the study is keeping it simple with regards to to engaging with technology. Multiple technologies for mHealth design and implementation are available, but compatibility, security, and data integrity are ongoing

challenges. The best approach is to start from within and take inventory of the systems in place and evaluate how native tools can be added to those existing systems. Plan for long lead times to accommodate for testing, technical problems and installments of mHealth strategies. P4 stated, “So much of the work on the technology side for making this work is the interfaces to make access feasible to data available. If the data is a secured and it has a portal or embedded tools its better to use that, even if its not perfect, because its the system that probably going work best as more resources and tools become available.” (personal communication, March 20, 2016). Its also important to maximize the organization’s digital presence by have a responsive website that can be viewed on any device and using social networks like Facebook, YouTube, Twitter, and LinkedIn to showcase the organization’s dedication to providing quality healthcare. A strong digital presence increases visibility and helps establish or maintain a rapport with the target audience (Barron, 2015).

Recommendations for Future Study

This study was limited to senior and executive healthcare professionals who work for healthcare organizations in the United States. While the United States has over 5,600 registered hospitals (American Hospital Association, 2016), a number of them were not represented in this study. This includes psychiatric facilities, long term care, and federal government hospitals. Participants were selected based on their established track record implementing or sustaining mHealth services for a healthcare organization or hospital. These individuals represented non-profit, state, and academic healthcare facilities. It would be beneficial for future studies to expanded the sample population to include all healthcare organizations and hospitals that are mHealth providers, including government facilities and rehabilitation/psychiatric hospitals. According to a 2014 HIMSS study, more than 50% of the hospitals in the United States use

smartphones and tablets in their clinical and administrative workflow and 69% of medical providers use computers or a mobile device to access data (Mottl, 2015). This would generate a much larger sample size from which to gather qualitative and quantitative data. Other opportunities for research include exploration of mHealth strategies utilized by frontline health workers and community health workers in the low-resourced, remote and rural regions of developing countries. A larger sample size means the possibility of identifying more challenges that affect all mHealth providers, as well as establishing standards for best practices among mHealth providers in healthcare settings.

Similarly, a future study on a single mHealth services, such as virtual medical visits, would be beneficial, to identify the best practices and resources associated with successful implementation and adoption. There are a limited number of published reports on the effectiveness of mHealth strategies in health care settings. The closest effort is a 2015 report from Accenture Consulting, which looked specifically at hospital app for iPhone and Android smartphones. The findings showed that hospital apps failed to connect the user's expectations with the capabilities of the app, and instead developed an app based on what patients presumably wanted (Kalis, Froehlich, Burke, & Warren, 2015). This Accenture report stresses what was found in this study, that using a consumer-based model is important in mHealth design and implementation.

Final Thoughts

Healthcare organizations are investing much time and effort into utilizing alternative healthcare models that can better serve the community and are cost effective. The participants in this study talked very passionately about how important people are to the mHealth movement, and that technology is really just a tool to helping people access healthcare. They gave the

impression they feel proud to be part of a healthcare system or hospital that constantly strives to offer the best care possible, rather than just a technology expert helping a hospital move into the 21st century.

The research for this dissertation educated the researcher on the global demand for mHealth services, and reinforced how important it is to collaborate with others. Countries like Israel, India, and Kenya are world leaders in mHealth development, and have so much to offer countries like the United States and Europe. This research and the findings associated with this study is a testament that much more remained to be learned about mHealth technologies and services. Aspiring mHealth professionals would do well to find one aspect they are passionate about and follow the recommended best practices to grow and make an impact in the community they serve.

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APPENDIX A

Approval of Exempt Application



Pepperdine University
24255 Pacific Coast Highway
Malibu, CA 90263
TEL: 310-508-4000

NOTICE OF APPROVAL FOR HUMAN RESEARCH

Date: February 26, 2016

Protocol Investigator Name: Kathy Andrews

:

Project Title: Best Practices To Establish A Mobile Health Program

School: Graduate School of Education and Psychology

Dear Kathy Andrews:

Thank you for submitting your application for exempt review to Pepperdine University's Institutional Review Board (IRB). We appreciate the work you have done on your proposal. The IRB has reviewed your submitted IRB application and all ancillary materials. Upon review, the IRB has determined that the above entitled project meets the requirements for exemption under the federal regulations 45 CFR 46.101 that govern the protections of human subjects.

Your research must be conducted according to the proposal that was submitted to the IRB. If changes to the approved protocol occur, a revised protocol must be reviewed and approved by the IRB before implementation. For any proposed changes in your research protocol, please submit an amendment to the IRB. Since your study falls under exemption, there is no requirement for continuing IRB review of your project. Please be aware that changes to your protocol may prevent the research from qualifying for exemption from 45 CFR 46.101 and require submission of a new IRB application or other materials to the IRB.

A goal of the IRB is to prevent negative occurrences during any research study. However, despite the best intent, unforeseen circumstances or events may arise during the research. If an unexpected situation or adverse event happens during your investigation, please notify the IRB as soon as possible. We will ask for a complete written explanation of the event and your written response. Other actions also may be required depending on the nature of the event. Details regarding the timeframe in which adverse events must be reported to the IRB and documenting the adverse event can be found in the *Pepperdine University Protection of Human Participants in Research: Policies and Procedures Manual* at community.pepperdine.edu/irb.

Please refer to the protocol number denoted above in all communication or correspondence related to your application and this approval. Should you have additional questions or require clarification of the contents of this letter, please contact the IRB Office. On behalf of the IRB, I wish you success in this scholarly pursuit.

Sincerely,

Judy Ho, Ph.D., IRB Chairperson

cc: Dr. Lee Kats, Vice Provost for Research and Strategic Initiatives

APPENDIX B

Approved Recruitment Script

Hello. My name is Kathy Andrews and I am a doctoral student in the Learning Technologies doctoral program at Pepperdine University's Graduate School of Education and Psychology. As part of fulfilling my degree requirements, I am conducting a study on characteristics, challenges and strategies used by top senior health IT professionals who oversee mobile health applications as part of a hospital's health information system network.

I came across your name through Becker's Hospital review publication. You (_____) have been carefully selected to participate in my study. Participation in the study is voluntary and confidentiality will be maintained throughout the study. Participation entails a no longer than 60 minute interview. Questions asked in the interview and an informed consent form will be sent to you in advance of the interview. Your participation in this study will be extremely valuable to healthcare organizations that are using or considering using mobile health applications within the healthcare setting, as well as the healthcare community at large.

I would like to ask if you would be willing to be interviewed as part of this study.

Thank you in advance for your consideration,

Kat Andrews

APPENDIX C

Informed Consent Form

PEPPERDINE UNIVERSITY

Graduate School of Education and Psychology

INFORMED CONSENT FOR PARTICIPATION IN RESEARCH ACTIVITIES

Best Practices for Mobile Health

You are invited to participate in a research study conducted by Kathy Andrews, MS, CRC, doctoral candidate and supervised by faculty advisor Dr. Farzin Madjidi of the Education and Learning Technologies doctoral program at Pepperdine University. You have been carefully selected because of your exemplary practices and contributions to your field. Your participation is voluntary. You should read the information below, and ask questions about anything that you do not understand, before deciding whether to participate. Please take as much time as you need to read the consent form. You may also decide to discuss participation with your friends and family. If you decide to participate, you will be asked to sign this form. You will also be given a copy of this form for you records.

PURPOSE OF THE STUDY

The purpose of the study is to identify practices used and challenges faced, as well as gather any recommendations you have, regarding the implementation and adoption of mobile health (mHealth) technologies within a healthcare system setting.

STUDY PROCEDURES

If you volunteer to participate in this study, you will be asked to participate in an approximately 45-60 min interview via web conferencing or telephone that will be recorded for accuracy of responses. You may still participate in the interview if you prefer to not have interview recorded.

The following interview protocol will be used:

Interview Protocol

Ice breaker question

1. What internal and external factors influenced the development of the mHealth program?
2. What protocols did you use to implement mHealth technologies?
3. How do you manage data exchange from other HIPPA providers or patients?
4. How do you address the needs of unique users (non-tech savvy, older adults, visually impaired, voice command users?)
5. Did you experience any “technology” challenges and how did you overcome them?

6. How do regulations such as HIPPA, Affordable Healthcare Act (ACA) and HITECH affect the mHealth services you offer?
7. What criteria do you use to measure overall success of the mHealth program?
8. How do you bill or obtain revenue for mHealth programs?
9. What steps would you recommend to a healthcare organizations thinking about developing or implementing a mHealth program?

POTENTIAL RISKS AND DISCOMFORTS

Potential risk may include: concern for one's professional reputation, boredom, fatigue and discomfort over loss of time. The risk is no more than what a person would encounter in daily life activities.

POTENTIAL BENEFITS TO PARTICIPANTS AND/OR TO SOCIETY

While there are no direct benefits to the study participants, there are several anticipated benefits to society which include:

1. The compilation of results of the study will be beneficial to healthcare communities seeking more information on the implementation and management of mobile health applications within a healthcare setting.
2. Findings will inform providers, policy makers, consumers/patients, stakeholders and mHealth app developers on real-life challenges and successful strategies for implementing mHealth apps into a healthcare system.

In addition, upon your request, a completed copy of this study will be provided to you.

CONFIDENTIALITY

I will keep your records for this study confidential as far as permitted by law. However, if I am required to do so by law, I may be required to disclose information collected about you. Examples of the types of issues that would require me to break confidentiality are if you tell me about instances of child abuse and elder abuse. Pepperdine's University's Human Subjects Protection Program (HSPP) may also access the data collected. The HSPP occasionally reviews and monitors research studies to protect the rights and welfare of research subjects.

The data will be stored on a password protected computer in the principal investigators place of residence. The data will be stored for a minimum of three years. Any identifiable information obtained in connection with this study will remain confidential. Your responses will be coded with a pseudonym and transcript data will be maintained separately.

PARTICIPATION AND WITHDRAWAL

Your participation is voluntary. Your refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

ALTERNATIVES TO FULL PARTICIPATION

The alternative to participation in the study is not participating or completing only the items which you feel comfortable. Should you choose this alternative, your relationship with your employer will not be affected whether you participate or not in this study.

EMERGENCY CARE AND COMPENSATION FOR INJURY

If you are injured as a direct result of research procedures you will receive medical treatment; however, you or your insurance will be responsible for the cost. Pepperdine University does not provide any monetary compensation for injury

INVESTIGATOR'S CONTACT INFORMATION

I understand that the investigator is willing to answer any inquiries I may have concerning the research herein described. I understand that I may contact Kathy Andrews at xxx-xxx-xxxx if I have any other questions or concerns about this research.

RIGHTS OF RESEARCH PARTICIPANT – IRB CONTACT INFORMATION

If you have questions, concerns or complaints about your rights as a research participant or research in general please contact Dr. Judy Ho, Chairperson of the Graduate & Professional Schools Institutional Review Board at Pepperdine University 6100 Center Drive Suite 500 Los Angeles, CA 90045, 310-568-5753 or gpsirb@pepperdine.edu.

APPENDIX D

Interview Protocol

Best Practices for Mobile Health

Ice Breaker: Tell me a little about your career

1. What internal and external factors influenced the development of the mHealth services?
2. What protocols did you use to implement mHealth services?
3. How do you manage data exchange from other HIPAA providers or patients?
4. How do you address the needs of unique users (non-tech savvy, older adults, visually impaired, voice command users?)
5. Did you experience any “technology” challenges and how did you overcome them?
6. How do regulations such as HIPAA, Affordable Healthcare Act (ACA) and HITECH affect the mHealth services you offer?
7. What criteria do you use to measure overall success of the mHealth?
8. How do you bill or obtain revenue for mHealth?
9. What steps would you recommend to a healthcare organization trying to developing or implementing mHealth services?