EXAMINING THE INFLUENCE OF WEARABLE HEALTH MONITORS ON PATIENTS AND PHYSICIANS IN A FILIPINO COMMUNITY

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ABSTRACT

Considerable growth in the use of wearable health monitors, paired with calls for more patient engagement, lead one to question how the increased adoption of wearables can be leveraged to improve health outcomes overall. Individuals of Filipino descent are at an increased risk for chronic conditions. This suggests that this population in particular could benefit from interventions aimed at increasing physical activity (PA) and improving health overall. Some studies have investigated wearables' effectiveness at increasing an individual's PA, while others have looked at patient participation in medical visits as mechanisms through which patients engage in healthier behaviors. As more individuals adopt wearables, the health data generated by these devices could become integrated in physician-patient communication in ways that might improve health outcomes. Further, the impact of these devices on psychological aspects related to health, such as self-efficacy, may have indirect effects that extend to communication in office visits. However, we do not yet know enough about how individual patients, particularly those of Filipino descent, will adopt these devices and whether or how their experiences with wearables will enhance, or potentially detract, from communication between physicians and patients during healthcare encounters. Drawing on studies about physician-patient communication, health behavior change, information technologies, and public health, this study sought to investigate: (i) how the use of a wearable affected self-efficacy, and (ii) how the use of a wearable affected physician-patient communication in a rural, predominantly Filipino community.

This research employed a quasi-experimental field study with patient participants who were given Fitbit Flex devices and attended medical visits with their physicians. Patients were recruited from the private practices of a family doctor and an internal medicine physician in a rural, predominantly Filipino community in Oahu, Hawaii. The study incorporated multiple measurements and gathered data from questionnaires, recorded medical appointments, exported data from the wearable devices, phone interviews, and encounter notes. Results indicate that wearables show promise at enhancing physician-patient communication, but in unexpected ways. This study did not find significant relationships between wearable use and self-efficacy and/or patient participation in medical visits. However it found that, if incorporated into the conversation, wearables may help to improve physician-patient communication in medical encounters through other avenues, such as extending the conversation into lifestyle choices and providing a source of proof for patients to exhibit that they are following their doctors' orders. This study highlights challenges that patients in this population might face when it comes to adopting a wearable and suggests potential avenues of exploring those challenges further. Digital divide issues are present and extend beyond *access* to resources and into *usage* of digital resources. This may counter adoption and restrict efficacy-enhancing mechanisms of devices in populations such as the predominantly Filipino population studied here. This research proposes an extended research model that may help to inform future studies of this nature.

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CHAPTER 1: OVERVIEW

Calls for increased patient engagement and shared decision-making suggest that physician-patient communication can be improved. One avenue for improving this communication may lie in tapping into technologies that appeal to the enhancement of health behaviors. Considerable increases in the use of wearable health monitors (Zweig, Shen, & Jug, 2017), paired with calls for improved patient engagement (Barello, Graffigna, and Vegni, 2012), shared decision-making (Charles, Gafni, and Whelan, 1997), and improved physician-patient communication (Ong, De Haes, Hoos, & Lammes, 1995; Stewart, 1995), lead one to question how the increased adoption of wearables might be leveraged to improve health outcomes overall. Improving healthy behaviors at the individual level is important, and wearable health monitors, (henceforth "wearables") are designed to do this, but effective physician-patient communication is essential answering the calls to improve patient engagement and shared decision-making (Ong et al., 1995; Stewart, 1995). Not only is effective physician-patient communication associated with factors such as enhanced patient-centered care, improved patient satisfaction, increased shared decision-making, and improved patient engagement (Ong et al., 1995; Stewart, 1995), but it is also associated with better treatment adherence, enhanced understanding of medical advice, and improved information recall of physician instructions (Ong et al., 1995; Zolnierek & DiMatteo, 2009). These factors contribute to improved health outcomes. It is no surprise that there are calls for improving the physician-patient relationship through enhancing patient engagement, shared decision-making, and overall patient satisfaction.

At the same time, there is a growing trend for individuals to engage with their own health and fitness through the use of mobile consumer electronic devices such as physical activity trackers (e.g., Fitbit step trackers or Apple Health applications). Adoption rates of wearables are predicted to continue climbing rapidly (Zweng et al., 2017). These devices provide users with detailed biometric data, and some also provide healthy living tips and advice. These trends suggest wearables could help engage users in healthy behaviors and thus have the potential for improving health among the population of users. The evidence, albeit limited, for short- and long-term health benefits from wearables and their adoption is lacking, however, and adoption may prove to be a limited fad rather than a sustained healthy living social movement.

This study investigated whether wearables might be effective at improving individual and population health, and considered their integration with the larger context of healthcare as well as with personal health behavior. Physician-patient communication is a critical interface for this integration to occur.

Need for Healthcare Improvement

The United States is experiencing a growing healthcare crisis due to increases in chronic illnesses. The etiology of many chronic illnesses is linked to unhealthy behaviors such as smoking, alcohol intake, diet high in fat/low in fiber, sedentarism and physical inactivity (Golubic, 2013). Certain behaviors (e.g. high-fat diet/little-to-no regular physical activity) can place a person at risk for obesity/overweight and a sedentary life style (Golubic, 2013). Chronic diseases, such as heart disease, cancer, stroke, and diabetes, cause seven in 10 deaths each year in the United States (Centers for Disease Control and Prevention, 2009). Nearly half of the adults in the United States live with at least one chronic illness, and while these types of illnesses are the most common and costly of all health problems, they are also the most preventable (Centers for Disease Control and Prevention, 2009). When considering the ways in which behaviors are associated with health, one may also consider the ways in which these ailments can affect the socioeconomic statuses of various groups. For instance, health behaviors account, on average, for roughly 25% of socioeconomic status-related ethnic disparities in health (Pampel, Krueger, & Denney, 2010). Filipinos in particular may be at a greater risk when it comes to this exacerbating healthcare crisis. Filipinos have particularly high rates to chronic conditions, such as diabetes (Karter et al., 2012) and hypertension (Ye, Rust, Baltrust, & Daniels, 2009). However, as previous studies have suggested (dela Cruz et al., 2002), health research on this population is lacking. This suggests a need for more research on how to improve health behaviors in general, but for this population in particular.

Public health and healthcare officials promote PA through a variety of general and specific health education programs, because PA is linked to improvements in health such as personal fitness, reducing risk for chronic diseases and obsesity, and preventing unhealthy weight gain (U.S. Department of Health and Human Services, 2018). Although there is some evidence of a decline in inactivity, obesity rates have increased (Schoenborn, Adams, & Peregoy, 2013). This suggests that public health promotion campaigns, while helpful, are insufficient to generate the wide-scale changes in individuals' personal health behaviors that will be needed to address growing chronic disease rates.

To improve the health of individuals in this population, individuals must be willing and able to make relevant changes in their health-related behaviors. The U.S. federal government has made it a top priority to improve the health and well being of individuals and communities through the use of technology and health information (Office of the National Coordinator for Health Information Technology (ONC), 2015). The four goals of the Federal Health IT Plan for

2015 to 2020 are: (1) Advance person-centered and self-managed health, (2) transform health care delivery and community health, (3) foster research, scientific knowledge, and innovation, and (4) enhance the nation's health information technology (IT) infrastructure (ONC, 2015, p. 6). Although this plan addresses many complex issues, a central premise is the importance of engaging individuals in their own health and care.

Patient engagement, which Gruman et al. (2010) define as "actions individuals must take to obtain the greatest benefit from the health care services available to them" (p. 351), is essential to achieving the goals outlined in the Federal Health IT Plan. Patient engagement is related to consumer health informatics (CHI), which refers to the branch of medical informatics that analyzes consumer needs for information, studies and implements methods of making that information accessible to consumers/patients, and integrates consumer/patient preferences into medical information systems (Eysenbach, 2000). The rapidly expanding field of CHI reflects the push in recent years from federal healthcare policymakers to put individuals at the center of health care decision-making and action (patient-centered care), and to improve the health care system through the use of health IT (ONC, 2015). This involves the patient taking control of both health information and health behaviors (Davidson, Østerlund, & Flaherty, 2015). According to the master policy plan, to improve their health behaviors, individuals need high-quality care that involves interventions focused on behavioral, social, and environmental determinants of health. They need a healthier population around them, with other individuals, families, clinicians and communities focused on prevention and wellness (ONC, 2015). They should also be engaged, which suggests they are active in managing their health and in partnering with their health care providers (ONC, 2015).

Tapping Into Wearables

Increasingly, healthcare funders, insurers, and healthcare providers, suggest patients to take control of their healthcare, which involves active participation in treatment choices, self-monitoring and self care, leading to a shared-decision-making approach (Institute of Medicine, 2001). At the same time, there are more patients actively seeking information on how to improve their health. A majority of adult Internet users, 72 percent, are turning to the Internet for information on a range of health issues (Fox & Duggan, 2013). Although the ubiquity of available health information introduces challenges of finding relevant and trustworthy information, there are still ways that patients can begin to filter the information in ways that they can apply to their own lifestyle. IT may help individuals to tailor information to their situations and may also give opportunities for them to monitor their own behaviors and progress towards their health improvement goals. Tailored information and/or information that appears to be a good fit for a given individual is more effective than non-tailored information at leading to behavior change (Kreuter & Wray, 2003). Further, web-based, tailored interventions have shown greater improvements in health outcomes as compared to non-tailored information (Lustria, Noar, Van Stee, Glueckauf, & Lee, 2013). Wearables offer other features, such as goal setting and activity monitoring, that may motivate users to continue to engage in behaviors associated with healthy outcomes (Croteau et al., 2007; Talbot et al., 2003; Wang et al., 2016). Health information provided from these wearables, such as the daily feedback regarding physical activity, may not provide enough motivation to engage individuals to sustain behavior change. Patel, Asch, and Volpp (2015) suggest that wearables have potential to facilitate behavior change, but cannot drive that behavior change through the devices alone. For wearables to be successful at facilitating this behavior change, they recommend implementing engagement strategies that combine individual encouragement, social competition and collaboration, and effective feedback loops. Many of the present-day wearables offer features with these capabilities. Consistent with the Patel et al. (2015) recommendations, DiFrancisco-Donoghue et al. (2018) found that when users combined a wearable with behavioral challenges, they had an increase in step count compared to wearing an activity tracker alone.

Professional advice and guidance from healthcare providers could be helpful. In the past, individuals went to healthcare providers primarily for acute illness or injury. Increasingly, individuals engage with healthcare providers for preventive care and to manage chronic diseases as well, or even more frequently than for acute illnesses. Managing chronic diseases may entail medication, but often also entails changing behaviors and complying with advice regarding behavior change. During serious health episodes involving chronic conditions, individuals often turn to trusted sources, such as clinicians, as a central resource for support and information (Fox & Duggan, 2013). Further, physicians remain the most highly trusted information source to patients overall (Hesse et al., 2005). Now and in the future, healthcare providers will be charged with engaging their patients in managing their health in ways that keep them healthier, both through preventative means as well as disease management (ONC, 2015).

Health system trends highlight important and related issues of interest in this dissertation. Some studies have investigated wearables' effectiveness at increasing an individual's physical activity (DiFrancisco et al., 2018; Finkelstein, 2016), while others have looked at patient participation in doctor visits and physician-patient communication as mechanisms through which patients engage in behaviors that lead to improved health outcomes (Cegala et al., 2007; Ong et al., 1995; Street, 2013; Zolnierek & DiMatteo, 2009). Previous studies have suggested that wearables can lead to increased PA and other improved health outcomes (Bravata et al., 2007;

DiFrancisco-Donaghue et al., 2018; Talbot et al., 2003). As more individuals adopt wearables (Zweig, 2017), the health data generated by these devices could become integrated in physician-patient communication in ways that might improve health outcomes. However, we do not yet know enough about how individual patients respond to data generated by wearables and whether and how their experiences with wearables will enhance, or potentially detract, from effective communication between physicians and patients during healthcare encounters. Individuals and organizations adopt the assumption that wearables are beneficial, with some insurers taking the step to require their use (Dans, 2018). This highlights an increasing need to explore how and whether wearables might influence individuals before investing limited healthcare dollars and mandating their use. In the following chapters, I will discuss how psychological factors related to health behavior change and the use of wearables might converge to improve physician-patient communication—and thus answer the calls to improving healthcare in the United States through enhanced patient engagement and shared decision-making.

CHAPTER 2: LITERATURE REVIEW

This chapter presents a review of the literature that informed this study's research questions and study design. It concludes with the motivation for this research project to examine the influence of wearables on physician-patient communication in a Filipino community. Table 1 outlines the main topics presented in this literature review: (i) physician-patient communication, (ii) factors related to health behavior change, and (iii) the functionalities and features of wearables in relation to health behavior.

Table 1

Literature Review Main Topics

Subject	View	View	View	View	Relevance
Physician-Patient Communication	Effective physician-patient communication is a major component for improving healthcare *Cegala et al. (2012); DiMatteo (1998); Kaplan et al. (1996); Ong et al. (1995); Street et al. (2007); Street (2013); Zolnierek & DiMatteo (2009)*	High participation from patients is associated with increased information provision from physicians *Cegala et al. (2001); Cegala et al. (2007); Cegala et al. (2012); Cegala et al. (2013); Griffin et al. (2004); Harrington et al. (2004); Kaplan et al. (1996); Street et al. (2007); Street (2013)*	Patients can be trained to improve the exchange *Cegala et al. (2001); Cegala et al. (2007); Cegala et al. (2012); Cegala et al. (2013); Griffin et al. (2004); Harrington et al. (2004); Street & Millay (2001)*	Effective physician-patient communication leads to improved health outcomes *DiMatteo (1998); Griffin et al. (2004); Ong et al. (1995); Kaplan et al. (1996); Kelley et al. (2014); Ong et al. (1995); Street (2013); Zolnierek & DiMatteo (2009)*	Patient training interventions in the past have been focused on direct effects and relied on patients putting forth effort to read manuals and attend training sessions. How can improvements to physician-patient communication be made through other means?
Health Behavior Change	Individual and social factors need to be addressed *Bandura (2004); Barkley (2008); McLeroy et al. (2008); Rogers (2003)*	Self-efficacy (and similar constructs) is one of the strongest factors related to health behavior change *Achterkamp et al. (2015); Ajzen (1991); Bandura (1977); Bandura (2004); Deci & Ryan (1985); Prochaska et al. (2008); Sheeran et al. (2016); Strecher et al. (1986)*	Self-efficacy can be manipulated; performance accomplishments are the best information source for enhancing efficacy expectations. *Bandura (1977); Bandura (2004); Kreausukon et al. (2012); Mouton & Roskam (2015); Sheeran et al. (2016)*	Self-efficacy can extend into related behaviors *Bandura (1977); Bandura (2004)*	How can individual-level self-efficacy interventions, such as PA, extend into broader contexts, such as communication in medical office visits?
Wearables	Wearables are growing in adoption rates *eMarketer (2015); International Data Corporation (2015); Zweig et al. (2017)*	Wearables allow users to connect to vast social networks *Mann (1997)*	Features of wearables are related to constructs that enhance self-efficacy *Bandura (1977); Deci & Ryan (1985); Donath (2007); Granovetter (1983); Ryan & Deci (2000)*	Wearables have been found to be effective at promoting health behavior change *Bravata et al. (2007); DiFrancisco-Donaghue et al. (2018); Talbot et al. (2003); Wang et al. (2016)*	If wearables can enhance self-efficacy in physical activity or other individual levels, can that self-efficacy lead to enhanced physician-patient communication?

Physician-Patient Communication

Physician-patient communication is at the heart of most medical encounters. During the medical interview, patients give physicians information about their medical history, symptoms, behaviors, and other relevant information to their health. This exchange serves three major purposes: exchanging information, making treatment-related decisions/plans, and creating an interpersonal relationship (Ong, De Haes, Hoos, & Lammes, 1995). With effective communication between patients and physicians, physicians may be more likely to provide more information to patients and to offer more patient-centered care (Cegala, Chisolm, & Nwomeh, 2012; Street, Gordon, & Haidet, 2007), while patients may be more likely to report satisfaction (DiMatteo, 1998; Kaplan et al., 1996) and to experience a higher likelihood of improved health outcomes overall (DiMatteo, 1998; Griffin et al., 2004; Kaplan et al., 1996; Kelley, Kraft-Todd, Schapira, Kossowsky, & Riess, 2014; Ong et al., 1995; Street, 2013; Zolnierek & DiMatteo, 2009). Street (2013) suggests that effective physician-patient communication may produce proximal outcomes, such as better patient understanding, that contribute to intermediate outcomes, such as better adherence, that thus result in improved outcomes of interest, such as reduced pain. Unsuccessful, or ineffective, physician-patient communication can result in the inverse: patient noncompliance, negative health outcomes, reduced patient access to medical information, and limited patient involvement in healthcare decisions (Barrier, Li, & Jensen, 2003; Griffin et al., 2004; DiMatteo, 1998).

Patient noncompliance, also called patient non-adherence, refers to patients' failure to adhere to physician recommendations for appropriate care, such as failure to take medication or the continuance of dangerous or unhealthy behaviors. In a meta-analysis of 569 studies reporting adherence to medical treatment, DiMatteo (2004) found that the average non-adherence rate was

24.8 percent. Adherence tended to be higher with circumscribed regimens, such as medications, and lower with other regimens, such as health behaviors (DiMatteo, 2004). Ineffective physician-patient communication may be a major contributing factor to non-adherence (DiMatteo, 2004), the results of which may include patients becoming sicker, incorrect diagnoses, and changing medications (DiMatteo, 1998). This supports the finding that physician communication is significantly and positively correlated with patient adherence (Zolnierek & DiMatteo, 2009).

The importance of improving physician-patient communication is heightened as individuals tend to move toward more patient centered care, which involves taking actions that strengthen the patient-clinician relationship, promote communication about things that matter, help patients to know more about their health, and facilitate patient involvement in their own care (Epstein & Street, 2011). Improving physician-patient communication contributes to enhancing the physician-patient relationship, which has been shown to have a statistically significant effect on healthcare outcomes (Kelley et al., 2014). Improving this exchange has become a focal point of much research and medical training (DiMatteo, 1998; Zolnierek & DiMatteo, 2009). Much of the focus for improving physician-patient communication has been training physicians and other healthcare providers to improve communication skills (Zolnierek & DiMatteo, 2009; Brown et al., 1999). However, over time, the effectiveness of communication skills training programs on providers' communication has been shown to decline (Brown et al., 1999), and the patient role in this training is often overlooked. Further, in Griffin et al.'s (2004) systematic review of randomized controlled trials aimed at patient-provider communication and health outcomes, they found that interventions aimed at physicians were sometimes associated with negative outcomes. On the contrary, those aimed at patients were associated only with positive outcomes (Griffin et al., 2004). Another issue is that physician-patient communication relies on patients' self-reports of activities, symptoms, and compliance outside the physician's office. As one survey found, 38 percent of patients lied or "stretched the truth" about compliance with doctors' orders, 32 percent lied about lifestyle behaviors, such as diet and exercise, and 22 percent lied about smoking (DeNoon, 2004). Still, physicians often have little else to rely on other than patient-provided information.

The importance and understanding of physician-patient communication has evolved as societal and professional views of healthcare have evolved to encourage mutuality, reciprocity, and relationships of shared decision-making between patients and their physicians (versus the "doctor knows best" approach of the past). Because physician-patient communication involves two parties, participation on the part of the patient can be just as essential as the role of a physician to a successful exchange (Cegala, Street, & Clinch, 2007; Griffin et al., 2004; Harrington, Noble & Newman, 2004; Street & Millay, 2001). Patient participation refers to the "extent to which patients produce verbal responses that have potential to significantly influence the content and structure of the interaction as well as the health care provider's beliefs and behaviors" (Street & Millay, p. 62, 2001). In other words, patient participation has to do with the extent to which a patient verbally communicates meaningful messages in a health care visit that affect the health care provider's response. The importance of the patient participation in this exchange has been highlighted by studies that have found physicians tended to display more patient-centered communication and had more favorable perceptions of patients they viewed as having more positive affect and being more involved (Street, Gordon, & Haidet, 2007). Physicians also tended to provide significantly more information to patients who participated highly in medical interviews compared to patients with low participation (Cegala, Chisolm, &

Nwomeh, 2012; Cegala, McClure, Marinelli, & Post, 2000; Cegala, Street, & Clinch, 2007) and exhibited more shared decision-making communication styles (Kaplan et al., 1996).

Scholars have researched ways in which patient participation can be improved. For instance, Cegala, Street, and Clinch (2007) explored improving patient participation through patient training via communication tools such as booklets or face-to-face training. They and other researchers found that patients who participated in training interventions not only received more information from their physicians, but also tended to have improved perceptions of control over their health, preferences for taking an active role in health, improved recall of information, improved compliance, and improved clinical outcomes (Cegala, Post, & McClure, 2001; Harrington et al., 2004). In other studies when patients were trained to ask more questions and encouraged to prepare their questions, concerns, and other items of discussion before the appointment, their perceptions that they were capable of engaging in successful exchanges with their physicians increased, and physicians also provided more information (Cegala, Chisolm, & Nwomeh, 2013; Cegala, Post, & McClure, 2001).

Most studies of physician-patient communication have examined the face-to-face setting of a formal health service delivery encounter (e.g., in-office visit). However, the use of various technologies is increasingly mediating the interactions of patients and their doctors. The telephone was one of the first. Initially, physicians viewed the telephone as a means for patients to intrude on their lives, however, eventually, they began using the technology to their advantage (Spielberg, 1998). Other technologies have also complemented the physician-patient relationship through communication. These include email, text messaging, and secure Web portals. Computer-mediated communication between physicians and patients has become routine, and technologies are playing an increasing role in physician-patient communication with more channels for communication to take place in more varied settings. Keeping in touch in between visits has shown positive effects on patient healthcare. For instance, Niksch, Rothman, Hodge, and Ranney (2014) found that with remote patient monitoring, physicians were able to make treatment decisions up to 17.4 days sooner than with in-office visits alone.

Research has shown that physician-patient communication is important to improving health outcomes overall (Barrier, Li, & Jensen, 2003; DiMatteo, 1998; Griffin et al., 2004; Ong et al., 1995; Street, 2013; Zolnierek & DiMatteo, 2009). Both the patient and the physician have roles to play in this exchange, and both can be trained to do better (Cegala, Post, & McClure, 2001; Cegala, Street, & Clinch, 2007; DiMatteo, 1998; Griffin et al., 2004; Harrington et al., 2004; Zolnierek & DiMatteo, 2009). Technology is playing a larger role in physician-patient communication, and there have been positive outcomes related to mediated communication between patients and physicians (Niksch et al., 2014; Spielberg, 1998).

Health Behavior Change

Health behaviors are affected by factors at varying levels. One major factor found to be a statistically significant predictor of both positive and negative health behaviors, such as seeking healthcare, exercising, dieting, smoking or drinking, is socio-economic status (SES) (Barkley, 2008). Other factors, such as age, gender, and social networks were also found to be predictors of health behaviors (Barkley, 2008). While some of these factors lie at environmental levels, individual-level motivation and capabilities are key as well and have been explored through several theoretical models of individual-level health behavior change.

Some of the major theories and approaches on health behavior change include: social cognitive theory (Bandura, 2004), self-efficacy (Bandura, 1977), self-determination theory (Deci & Ryan, 1985), the theory of planned behavior (Ajzen 1991), diffusion of innovation (Rogers, 2003), and the transtheoretical model and stages of change (TTM) (Prochaska, Redding, & Evers, 2008). Each of these theoretical approaches includes the construct of self-efficacy, or the belief in one's ability to successfully accomplish a particular behavior (Bandura, 1977) as a major component of the theory.

Social-cognitive theory specifies core determinants of effective health practices: knowledge of health information, perceived self-efficacy that one can control his/her health habits, outcome expectations about the expected costs and benefits to health habits, health goals individuals set along with plans and strategies for achieving those goals, and perceived facilitators along with the social and structural impediments to the changes they seek (Bandura, 2004). Self-efficacy is a major component of social-cognitive theory because of its effect on health behavior directly as well as its influence on the other determinants (Bandura, 2004). Taken together, these determinants can affect the extent to which an individual engages in physical activity, nutritious eating, and avoidance of unhealthy substances, as well as how much an individual complies with other health-related activities, such as taking prescribed medications regularly or monitoring glucose for diabetics.

Other theoretical approaches involve self-efficacy constructs as well. In Deci and Ryan's (1985) self-determination theory, perceived competence, or an individual's belief that he/she is capable of achieving a behavior, is a determinant of intrinsic motivation, which is a key component to adopting and sustaining a behavior. Ajzen's (1991) theory of planned behavior also includes an element that parallels self-efficacy, perceived behavioral control, as a major factor in predicting one's likelihood of adopting a behavior. In Rogers's (2003) discussion of the diffusion of innovations, complexity is a major consideration for individuals who are considering adoption. Complexity, according to Rogers, is the extent to which an individual views adoption as difficult or achievable. Prochaska et al. (2008) include self-efficacy as a major component of an individual's propensity to maintain a healthy behavior (or termination of an unhealthy one).

With his discussion of self-efficacy, Bandura (1977) posits that one's beliefs about his/her capabilities of carrying out a particular behavior successfully serve as major determinants not only of one's choice of activities, but also in one's expenditure of effort and perseverance in stressful situations. "People fear and tend to avoid threatening situations they believe exceed their coping skills, whereas they get involved in activities and behave assuredly when they judge themselves capable of handling situations that would otherwise be intimidating" (Bandura, 1977, p. 194). Self-efficacy matters because, as Bandura (1977) demonstrates, an individual with high efficacy beliefs is more likely to not only persevere in the behavior at hand until one reaches success, but is also more likely to generalize those efficacy expectations to other behaviors. Therefore, when considering the adoption of a behavior, especially one that might pose challenges, it may be important to address one's efficacy expectations (Bandura, 1977).

Strecher, DeVellis, Becker, and Rosenstock (1986) discuss the strong relationships between self-efficacy and health behavior change and maintenance in their review of health behavior change studies that investigated the self-efficacy concept in general health practice areas. They found that self-efficacy was a consistent predictor of both short- and long-term success. Further, they posit that self-efficacy can be manipulated, such as in experimental studies, and this enhancement may be related to subsequent health behavior change (Strecher et al., 1986). Recent research also supports the notion that self-efficacy is related to, and can even cause, health behavior change. In their meta-analysis of 204 experimental studies on determinants of intentions and behavior, Sheeran et al. (2016) found that interventions that modify attitudes, norms, and self-efficacy have causal effects of meaningful magnitude on health decisions and actions, with self-efficacy having the strongest effects on behavior of the three. Manipulating an enhancement of self-efficacy may involve action in several ways. Bandura (1977) notes that one's efficacy expectations are informed by four major sources of information: *performance accomplishments, vicarious experience, verbal persuasion,* and *physiological states (emotional arousal)*. Table 2 explains these sources in further detail. Of these four sources of information, Bandura (1977) found that the most influential are performance accomplishments because they are based on personal mastery experiences in which individuals develop strong efficacy expectations through repeated success. The enhancement of self-efficacy in one behavior may extend to an enhancement of self-efficacy in other behaviors, especially if those behaviors are similar to those affected by the treatment (Bandura, 1977).

Table 2

Sources of Efficacy Expectations (Bandura, 1977, p. 195)

Source	**Based On**	**Influencing Factors**
Performance Accomplishments	Personal mastery experiences, successes raise mastery expectations, repeated failures lower them	Participant modeling, performance desensitization, performance exposure, and self-instructed performance
Vicarious Experience	Seeing others perform without adverse consequences	Live modeling, symbolic modeling
Verbal Persuasion	Suggestions from others that they can cope successfully with what has overwhelmed them in the past	Suggestion, exhortation, self-instruction, interpretive treatments
Emotional Arousal	Lowering levels of anxiety, fear, and stress in threatening situations	Attribution, relaxation, biofeedback, symbolic desensitization, symbolic exposure

Enhancing self-efficacy in interventions aimed at health behavior change is expected to bring out positive results, especially if efficacy enhancements are drawn from performance accomplishments (Bandura, 1977). Several scholars have demonstrated this effect in their studies of behavior change and self-efficacy. For instance, Kreausukon, Gellert, Lippke, and Schwarzer (2011) found that self-efficacy and planning can increase fruit and vegetable consumption; Achterkamp, Hermens, and Vollenbroek-Hutten (2011) found that performance accomplishments may contribute to changing behavior, especially in technology-supported interventions.

Finally, and specific to health behavior change, the transtheoretical model of stages and processes of change (TTM) posits that individuals are in certain stages in terms of readiness to adopt or change a behavior, and interventions that are aligned with the stages are more likely to be successful (Prochaska, Redding, & Evers, 2008). They differentiate between stages and processes of change. In stages of change, Prochaska et al. (2008) note that there are several stages: precontemplation, contemplation, preparation, action, maintenance, and termination. Individuals move through these stages in a cyclical manner, with movement occurring over time. The processes of change are what people use to progress through these stages (Prochaska et al., 2008). These processes provide guides for intervention programs. They include: consciousness raising, dramatic relief, self-reevaluation, environmental reevaluation, self-liberation, social liberation, counterconditioning, stimulus control, contingency management, and helping relationships (Prochaska et al., 2008). In addition to these processes, individuals will also weigh pros and cons in decisional balance, and assess self-efficacy and temptation (Prochaska et al., 2008). The importance of TTM, as noted by the authors, is that the model can be applied to both research and to clinical settings to effect healthy behavior change in individuals (Prochaska et al., 2008). The success of the model lies in the correct application of processes and interventions matched to an individual's stage of change, which was shown to be successful in smoking cessation programs (Prochaska et al., 2008).

Wearables

Individuals are becoming more involved with seeking health-related information and tracking their own health, as Nielsen (2014) reports more than 70 percent of Americans say they are actively working to either improve or maintain their current health. About 15 percent of consumers who were aware of wearables reported using them, and the majority of those devices were related to fitness and health (Nielsen, 2014). Once purchased, 62 percent of consumers report daily use, and 29 percent report use several times per day (Nielsen, 2014). Even though there is rapid growth in the adoption of wearables in the U.S. and other western economies (Zweig et al., 2017), with estimates that nearly two out of five Internet users will use wearables by 2019 (eMarketer, 2015), the average user abandons a wearable after just six months (Ledger, 2014).

Wearables can be viewed as a socio-technical system, which Bostrom and Heinen (1977) describe as comprising both a technical system and a social system that are jointly independent, but interacting. The technical system includes the processes, tasks, and technology to transform inputs to outputs (Bostrom & Heinen, 1977). For a wearable, this includes the technology that transforms the movement and measurements into outputs that allow users to monitor their health and health behaviors such as steps taken, calories burned, sleep quality, and heart rate. The devices give users the ability to visualize their personal data through logs, charts and graphs. The social system includes things such as attitudes, skills, values, relationships among people, reward systems, and authority structures (Bostrom & Heinen, 1977). The social systems of wearables allow users to set goals and to be prompted via the wearable and associated software when those goals are met (e.g., via sound cues, emails, or notifications on mobile devices), but they also allow for users to share their data with others and connect to vast social networks stemming from their own. Most wearables can be worn continually and thus allow users to do other things while using them because they do not require undivided attention. They can attract a user's attention if needed, are responsive to user inputs, and environmentally aware. They can also be used as a communication medium, and can entwine individual human action with computer features (Mann, 1997).

Through both technical and social systems, health-related wearables are designed to enhance and promote healthy behaviors. Wearables allow individuals to incorporate tailored, realistic goals in conjunction with alerts for the achievement of those goals. Tailoring goals and extrinsic rewards have been associated with enhancing an individual's perceived competence (Deci & Ryan, 1985; Kreuter & Wray, 2003; Lustria et al., 2013). The wearables also allow for enhanced informational and social capabilities, which can result in heightened motivation, both intrinsic and extrinsic, social comparison, and perceived competence, all of which have been found to be highly correlated with the adoption of healthy behaviors (Deci & Ryan, 1985). Deci and Ryan's (1985) perceived competence parallels Bandura's (1977) self-efficacy. Both terms refer to the extent to which an individual perceives he/she is capable of successfully achieving a particular behavior. Wearables show promise for promoting and reinforcing changes in an individual's lifestyle and health-related behaviors. An individual's penchant for adoption of a wearable may indicate that the individual is in a stage of change such as preparation or action, as indicated in the TTM model (Prochaska, Redding, & Evers, 2008), which in turn places that individual into a category of higher likelihood for successful adoption of other healthy behaviors, such as increasing participation in physician-patient communication. Thus, individuals who adopt wearables may be positioned to successfully adopt other healthy behaviors, and research has supported this. Studies have shown that use of wearables can lead to increased physical activity and other improved health outcomes (Bravata et al., 2007; DiFrancisco-Donaghue et al., 2018; Talbot et al., 2003). However, it should also be noted that not all studies on wearables have found positive relationships with health outcomes. Finkelstein et al. (2016), for instance, found no evidence of improvements in health outcomes from the use of wearables, and questioned the value of the devices for health promotion. These mixed results in finding effectiveness in using wearables for improving health outcomes suggest a need for further research. Further, as Wright, Collier, Brown, and Sandberg (2017) note, studies are wearables tend to focus on either accuracy of the devices or on physical activity as a primary outcome. This highlights a gap in the research on wearables and their influences on psychological factors, such as self-efficacy, and other health promoting activities, like physician-patient communication.

Wearables also afford users value through extrinsic features. For instance, they allow individuals to connect to vast social networks in geographically dispersed locations, thus creating social "supernets" with more ties, both strong and weak, than would ordinarily be feasible in offline settings (Donath, 2007). Weak ties serve as sources of information individuals may not usually have access to, and thus give individuals more opportunities to learn new things (Granovetter, 1983). Through these features, users may be exposed to information regarding the penetration of the devices within their social networks that they may have otherwise been unaware of had they been limited to face-to-face encounters. Looking at this from Rogers' (2003) diffusion of innovations perspective, one might also make the argument that by opening oneself up to an expanded interpersonal network, one is also expanding the range of subjective evaluations of innovations, which Rogers has said lies at the heart of the diffusion process. These social supernets also increase observability of not only the results of adoption of innovation, as Rogers has noted is important to potential adopters in making adoption decisions, but also to information regarding the ways in which successful adoption can occur. This modeling may help to increase individuals' self-efficacy beliefs (Bandura, 1977). These networks allow for social comparison, and, through the affordances of the technologies, encourage positive feedback. Both social comparison and positive feedback have been found to enhance self-efficacy (Mouton & Roskam, 2015).

Wearables offer another value through the connection of social networks, such as the ability to compete against others. The Fitbit, which the International Data Corporation recognized as the top wearable vendor (IDC, 2015), allows users to connect with others in competitions that reward physical activity through the use of the devices. This serves as extrinsic motivation to achieve physical activity goals, which can enhance intrinsic motivation to continue using the device if the competitions allow the person to experience the activity's intrinsically interesting properties (Ryan & Deci, 2000). Further, van Mierlo, Hyatt, Ching, Fournier, & Dembo (2016) found that challenges and incentives associated with wearables may be effective at increasing physical activity.

While wearables show much promise at improving an individual's health through physical activity and connection to others, comprehensive and long-lasting improvement in individual health also requires effective utilization of health care services for preventative medicine (such as screening tests), diagnosis (such as acute or chronic conditions), and treatment (such as medication and monitoring of chronic health conditions). Further, as Jakicic et al. (2016) found, wearables alone may not offer advantages over standard behavioral approaches for health improvements such as weight loss. Thus, for wearables to have a substantive impact on individual and population health, their use should be synergistic and integrated with the larger context of healthcare, which includes physicians/healthcare providers, rather than being viewed as a substitute for these services. There have been steady calls for those involved in healthcare to incorporate patient-centered care that is based on reciprocity and shared decision-making (ONC, 2015; Street, Gordon, & Haidet, 2007). This highlights the potential for engaged individuals to connect with their physicians and healthcare providers.

For wearables to contribute to the improvement of health outcomes, studies should move beyond individual factors and incorporate factors related to the larger context of healthcare management, and both individual factors and social context (social/environmental determinants) need to be considered (McLeroy et al., 2008). This is echoed in Duggan's (2016) call to explore the ways in which patients perceive and engage the physician-patient relationship as well as the ways in which physicians validate and engage with patients in decision-making. Some studies focus on individual factors related to wearables. For instance, Sun and Rau (2015) explored factors related to patient acceptance of wearables, concluding that attitude toward the technology, perceived usefulness, ease of learning and availability, social support, and perceived pressure were among the top five factors influencing adoption. Perceived usefulness referred to the extent to which patients/users believed wearables would influence overall health. Approaching this from a social-ecological perspective, for wearables to have a positive influence on health, we must consider their use and acceptance as they relate to both individual *and* environmental determinants. Evaluating the individual experiences of adopting wearables for health as a starting point, paired with the examination of how or whether wearables will affect physician-patient communication, while considering perspectives of physicians/healthcare providers, is therefore important.

The Physician's Perspective. With the increases in consumer adoption of wearables, there is much potential in sharing information between wearable users (patients) and physicians, and by extension, potentially improving patients' healthcare outcomes. However, there are also questions of whether the information provided would truly be beneficial or whether it could pose increased burdens and thus serve as obstacles to improved physician-patient communication. For physicians to incorporate the type of patient generated health data from wearables into their treatments, they must first be willing to accept the legitimacy and value of that data for their interactions with patients. One point when this could happen is during physician-patient encounters in office visits. Physicians of differing specialties all incorporate a medical interview into office visits. This is the time when patients give their medical history, their symptoms, their concerns, and their reports of what they have done, what they are doing, and what they hope to get out of the visit or treatment. Good physician-patient communication during these encounters is a hallmark of effective healthcare services, as scholars have noted poor communication can negatively impact patient compliance and outcomes (Barrier, Li, & Jensen, 2003), and good communication can result in more patient-centered care, patient satisfaction and improved health outcomes overall (DiMatteo, 1998).

Loos and Davidson (2016) conducted a survey on physician perspectives of incorporating data from wearables into practice in which respondents reported overall favorability toward the practice. The respondents indicated that they saw potential in wearables for improving physician-patient communication in the areas identified by Ong et al. (1995) as the main purposes of physician-patient communication: exchanging information, making treatment-related decisions, and creating an interpersonal relationship. On the other hand, there may be a reverse effect with patients who provide what physicians perceive as too much information, in particular if they viewed a patient as exhibiting hypochondria to begin with. Physicians also expressed concerns about whether dealing with data from wearables would take more time or fail to integrate with other health IT such as an electronic medical records system. This survey was limited in sample size and to physicians' perceptions of how they might react should patients present them with data from wearables, rather than actual experiences with patients bringing wearable data into an encounter. However, findings suggest that physicians' attitudes about sharing wearable health data during patient encounters could vary from positive and encouraging to skeptical and burdensome.

Wearables offer users the abilities to track behavior, such as exercise, to visualize that data, and to share it with others, creating potential for that information to not only be shared with physicians and healthcare professionals, but also to influence the relationship between physicians and patients and, subsequently, health outcomes overall. How wearables factor into physician-patient communication is not known. However, researchers point to promise in opportunities for wearables to increase patient empowerment, to redefine population medicine, and unravel the true potential of personalized medicine (Majmudar, Colucci, & Landman, 2014). While researchers have explored the ways in which patient participation can influence physician-patient communication (Brown et al., 2007; Cegala et al., 2013; Cegala et al., 2012; Cegala et al., 2000; Cegala et al., 2001; Cegala et al., 2007; Harrington et al., 2004; Street et al., 2007; Street & Millay, 2001), there is still a need for research that evaluates the incorporation of health-related, general consumer wearables into the exchange.

Research Summary and Motivation

Patients' health outcomes may be improved overall by improving physician-patient communication. If successful, this communication can lead to desirable health outcomes (Barrier, Li, & Jensen, 2003; DiMatteo, 1998; Ong et al., 1995; Zolnierek & DiMatteo, 2009). Patient participation in this communication is essential, and it can affect the ways in which physicians treat the patients, leading to increased information provision, more patient-centered care, increased patient satisfaction, and better patient adherence (Cegala, Street, & Clinch, 2007; Harrington, Noble & Newman, 2004; Street & Millay, 2001). Based on studies of patient participation in physician visits (Barrier et al., 2003; Cegala et al., 2012; Cegala et al., 2013; Cegala et al., 2001; Cegala et al., 2000; Cegala et al., 2007; Gruman et al., 2010; Harrington et al., 2004; Heisler et al., 2003; Ong et al., 1995; Street et al., 2007; Street, 2013; Street & Millay, 2001), patients with high self-efficacy are more likely to participate in communication with their physicians, via asking more questions or giving more information.

Self-efficacy, or the perceptions of individuals that they are capable of carrying out behaviors successfully, is one of the most powerful factors in behavior change (Ajzen 1991; Bandura, 1977; Deci and Ryan, 1985; Rogers, 2003;). Enhancing self-efficacy is best done through participatory modeling in which individuals perform behaviors themselves (Bandura, 1977). Once an individual has gained high self-efficacy in one area, it is possible for that self-efficacy to extend into related areas (Bandura, 1977). For the present study, wearables were considered as a potential vehicle for enhancing health-related self-efficacy through participatory modeling. This study sought to explore how that self-efficacy might extend into physician-patient communication.

Research has shown that healthy behaviors contribute to improved health outcomes, and social psychological studies have shown that health self-efficacy–the belief that you can change health-related behaviors–is critical to individuals attempting and ultimately succeeding in adopting these behaviors. At the same time, studies have indicated that effective communication between patients and physicians is an essential component to improving health outcomes, and again, the patient's self-efficacy plays a role in their engagement with their physicians. Wearable health technologies present a promising opportunity to enhance health self-efficacy, and, ideally, to also improve physician-patient communication that together would help patients to improve health outcomes. Yet, whether wearables are an effective socio-technical intervention, especially for a community with low socio-economic status, is uncertain, and their potential influence on physician-patient communication is even less understood. This research study was designed to improve understanding of these issues so that these technologies might be utilized productively to improve health outcomes. Research questions and key concepts that guided the study are presented in the following chapter.

CHAPTER 3: RESEARCH QUESTIONS AND KEY CONCEPTS

Based on the literature review, I generated research questions regarding patient experience with wearables, including associated constructs, and physician-patient communication. This chapter will present these research questions along with a research model and the key concepts included in the study.

General consumer wearables for health include components that may enhance users' self-efficacy. Increased use of a wearable has been shown to increase physical activity (Bravata, 2007; DiFrancisco-Dongahue et al., 2018; Talbot, 2003). Demonstrating that an individual can do something through personal experience is the strongest method for enhancing self-efficacy (Bandura, 1977). Therefore, if individuals increase their physical activity, then it should follow that their physical activity self-efficacy would also increase. At the same time, Bandura (1977) asserts that self-efficacy in one arena can extend into related behaviors. Therefore, physical activity self-efficacy could theoretically extend into other health arenas, such as general health self-efficacy. Related to general health self-efficacy are preferences for information and personal innovativeness.

To learn more about how a wearable might influence an individual's physical activity, I addressed the following research question and sub-questions:

Research Questions

RQ1: How does use of a wearable influence self-efficacy?

RQ1a: To what extent do patients use a wearable when one is given to them?

RQ1b: To what extent does using a wearable influence a patient's physical activity?

RQ1c: How does a patient's use of a wearable affect physical activity self-efficacy?

RQ1d: How does a wearable affect an individual's general health self-efficacy?

RQ1e: To what extent does use of a wearable affect preferences for health information?

RQ1f: To what extent does use of a wearable affect personal innovativeness?

Self-efficacy may also affect patient participation in a medical visit. While it has been said that individuals with high self-efficacy tend to participate more in medical visits (Cegala et al., 2001; Cegala et al., 2007), the extent to which self-efficacy derived from the use of a wearable can affect this communication is yet to be seen. Theoretically, if a patient has strong self-efficacy, he/she may be more likely to have higher participation in a medical visit (Cegala et al., 2001; Cegala et al., 2007). Higher participation from the patient has been shown to be reciprocated with higher information provision from the physician (Cegala et al., 2001; Cegala et al., 2007; Cegala et al., 2012; Cegala et al., 2013; Griffin et al., 2004; Harrington et al., 2004; Kaplan et al., 1996; Street et al., 2007; Street, 2013). To learn more about how the use of a wearable might influence communication in a medical visit, I addressed the following research question and sub-questions:

RQ2: To what extent does patient use of a wearable affect physician-patient communication?

RQ2a: How does patient use of a wearable affect patient participation in a medical visit?

RQ2b: To what extent does patient use of a wearable affect physician information provision in a medical visit?

Based on these research questions, I developed the following research model (Figure 1), which guided the study.

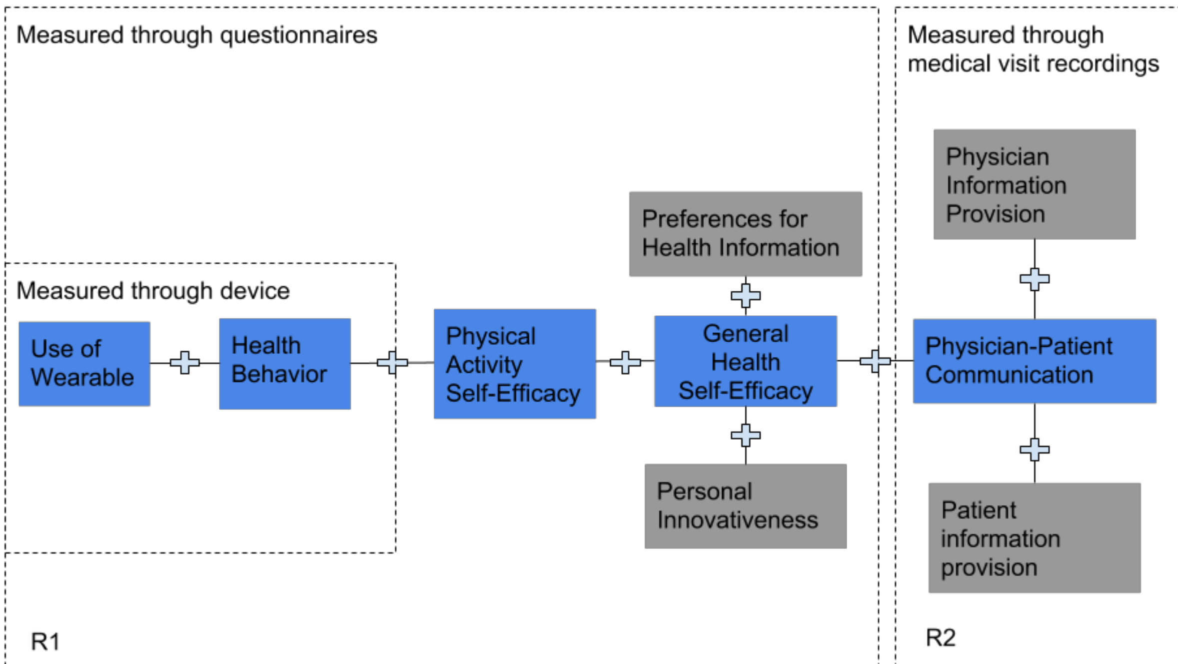

Figure 1. Research model.

Key Concepts

This section presents the conceptual and operational definitions of the key concepts constituting the research questions. Each concept was evaluated in terms of its relationships with the use of a wearable and physician-patient communication. These concepts are: use of a wearable, physical activity, physical activity self-efficacy, general health self-efficacy, preferences for information, personal innovativeness, patient participation, and physician information provision. Table 3 provides a summary of the concepts, their conceptual definitions, operational definitions, sources, method for collection, and point of collection.

Table 3

Summary of Key Concepts, Operational Definitions, and Data Sources

Concept	Conceptual Definition	Operational Definition	Source(s)	Method	Data Collection
Use of a Wearable	The depth and breadth that individuals used the Fitbit devices	- On a typical day, I checked the Fitbit tracker to see how close to my goal I have gotten - In a typical week, I logged onto my Fitbit.com account - Did you use the Fitbit mobile app? - If yes, how often did you use the Fitbit mobile app? How often did you do the following: •Synced tracker to phone or Web •Checked step progress •Checked active hours •Checked calories burned •Checked active minutes •Added other forms of exercise •Input weight •Logged calorie intake •Checked calories left •Logged water consumption •Checked sleep •Participated in competitions •Checked progress of friends	Items 1-4: Wang et al. (2016);	Online questionnaires; Fitbit data export, phone interview, encounter notes	Questionnaire items at baseline, week 1, week 2, and follow-up; Data export and encounter notes throughout
PA	The extent to which individuals participate in physical activities of various levels	During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling? How much time did you usually spend doing vigorous physical activities on one of those days? During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking. How much time did you usually spend doing moderate physical activities on one of those days? During the last 7 days, on how many days did you walk for at least 10 minutes at a time? How much time did you usually spend walking on one of those days? During the last 7 days, how much time did you spend sitting on a week day?	Van Dyck, Cardon, Deforche, & De Bourdeaud huij (2015)	Online questionnaire; Fitbit data export	Questionnaire items at baseline, week 1, week 2, and follow-up; Data export and encounter notes throughout

PA Self-Efficacy	The degree to which participants believe they are capable of being physically active under a variety of conditions	Participants will rate, between 0 to 10, how certain they are that they could be physically active in the following conditions in the next 6 months: - When I am tired? - During or following a crisis? - When I am feeling depressed? - When I am feeling anxious? - When I am slightly sore from the last time I was physically active? - When I am on vacation? - When there are competing interests (like my favorite TV show)? - When I have a lot of work to do? - When I haven't reached my physical activity goals? - When I don't receive support from family or friends? - When I have no one to be physically active with? - When my schedule is very busy? - During bad weather? - When it's too hot and sunny? - Following complete recovery from an illness? - When there is housework to do? - When you don't have money? - When you feel like you don't have the time? - When you have family or friends visiting you for the holidays or their vacation? - When you have a job working at home?	Albright et al. (2012); Albright et al. (2014)	Online questionnaire	Baseline, posttest
General Health Self-Efficacy	The extent to which patients perceive they are able to improve their health	7-point scales rating level of agreement with the items: - I am confident I can have a positive effect on my health. - I feel that I am in control of how and what I learn about my health. - I have been able to meet the goals I set for myself to improve my health. - I have set some definite goals to improve my health. - I am actively working to improve my health.	Lee, Hwang, Hawkins, & Pingree (2008)	Online questionnaire	Baseline, posttest
Prefer-ences for Informa-tion	A patient's perceptions about what or how he or she prefers to give and get information in a medical visit	7-point scales rating level of agreement with the items: - I usually ask the doctor or nurse lots of questions during a medical exam. - It is better to trust the doctor or nurse in charge of a medical exam than to question what they are doing. - I'd rather have doctors and nurses make the decisions about what's best for me than for them to give me a whole lot of choices. - I usually wait for the doctor or nurse to tell me the results of a medical exam rather than asking them immediately	Krantz, Baum, & Wideman (1980)	Online questionnaire	Baseline, posttest

Personal Innova-tiveness	"The willingness of an individual to try out a new information technology" (p. 206).	7-point scale rating level of agreement with the items: - If I heard about a new information technology, I would look for ways to experiment with it. - Among my peers, I am usually the first to try out new information technologies. - In general, I am hesitant to try out new information technologies. - I like to experiment with new information technologies.	Agarwal & Prasad (1998)	Online questionnaire	Baseline, posttest
Patient Info-Seeking	Utterances made by patients looking for information from their physicians	Consists of frequencies of patient questions, which can be direct, indirect, solicited or unsolicited. These also include information-verifying statements.	Cegala et al. (2007)	Audio transcript analysis	Medical visit
Pt. Assert. Utter-ances	Declarative statements from patients	These statements include expressing opinions, stating preferences, offering suggestions or recommendations, expressing disagreements or challenging the physician in some other way, or issuing a request.	Cegala et al. (2007)	Audio transcript analysis	Medical visit
Patient Info. Prov.	Patient-provided information to the physician	Consists of statements made as a response to solicitation from the physician or volunteered information. These include statements about symptoms, family history, and psychosocial factors that give insight into illness or life experiences.	Cegala et al. (2007)	Audio transcript analysis	Medical visit
Patient Expressio ns of Concern	Individual discourse units of affect	Statements include expressions of anxiety or worry	Cegala et al. (2007)	Audio transcript analysis	Medical visit
Phys. Info. Prov.	Information a physician provides to patients	Consists of two subcategories: - Question-elicited information: Information physicians provide in response to questions from patients - Volunteered information: Information provided by physicians without prompts from patients	Cegala et al. (2000); Cegala et al. (2001); Cegala et al. (2007); Street & Millay (2001)	Audio transcript analysis	Medical visit

Use of a Wearable

Conceptual definition: This concept refers to the depth and breadth that individuals used the wearable and its features.

Operational definition: To measure wearable use, I first distributed Fitbit Flex devices to participants. I then measured use through exported data from the device, responses to questionnaire items, discussions through phone interviews, and information from encounter notes.

When participants sync activity from their wearables, data gets collected and stored on the Fitbit.com website. From the site, I was able to export this data using Fitbit's Data Export tool. To measure use from the Fitbit, I looked at various points in the data that Fitbit automatically categorizes. These included: dates of use, number of steps, weight input, food and water intake, and sleep.

In addition to this, I measured Fitbit use through several questionnaire items. I asked participants to rate the frequency that they participated in the following behaviors (items 1 through 4), adapted from Wang et al. (2016), as well as additional items asking them to rate how often they engaged in other behaviors related to the Fitbit (items 5 through 17). I also asked participants open-ended questions regarding their experiences (items 18 through 20):

1. On a typical day, I checked the Fitbit tracker to see how close to my goal I have gotten:
    - Very often
    - Often
    - Sometimes
    - Rarely
    - Never

2. I logged onto my Fitbit.com account:

    - Every day (7 days/week)
    - Most days (5-6 days/week)
    - Some days (3-4 days/week)
    - Rarely (1-2 days/week)
    - Never (0 days/week)

3. Did you use the Fitbit mobile app?
4. If yes, how often did you use the Fitbit mobile app?

    - More than once a day
    - About once a day
    - Few times per week
    - Couple times per week
    - About once per week
    - Less than once per week

5. Synced tracker to phone or Web
6. Checked step progress
7. Checked active hours
8. Checked calories burned
9. Checked active minutes
10. Added other forms of exercise
11. Input weight
12. Logged calorie intake
13. Checked calories left

14. Logged water consumption
15. Checked sleep
16. Participated in competitions
17. Checked progress of friends
18. What were some of the positive experiences you had with your Fitbit this week?
19. What were some of the negative experiences you had with your Fitbit this week?
20. Please describe your overall experience with the Fitbit this week.

To get even more insight into participant use of a wearable, I conducted semi-structured phone interviews and asked questions related to the Fitbit and other major constructs of the study:

1. One goal I had was to see how and whether the Fitbit might help you to increase your physical activity. What do you think about this idea? Did the Fitbit affect your physical activity?
2. How did you feel about the use of the Fitbit? Was it easy, hard?
3. How did others react to your use of the Fitbit?
4. What were some other feelings you had regarding the Fitbit?

Because participants often discussed their experiences with the Fitbit in times between questionnaire distribution and phone interviews, I also took encounter notes from recruitment through follow-up. I evaluated these in conjunction with other data collections in order to learn more about the extent of participant wearable use.

Physical Activity (PA)

Conceptual definition: This concept refers to the actions an individual takes to be physically active. Health behaviors can directly affect health outcomes, and they account for roughly 25 percent of socioeconomic status disparities in health on average (Pampel, Krueger, & Denney, 2010). More specifically, this concept refers to the extent to which individuals participate in PA, such as walking, moderate exercise, and vigorous exercise.

Operational definition: I measured PA according to two methods of data gathering: self-report and Fitbit activity monitoring. To measure self-reported PA, I used the International Physical Activity Questionnaire (IPAQ), which is available from https://sites.google.com/site/theipaq/home and has been validated by van Dyck, Cardon, Deforche, & De Bourdeaudhuij (2015). I asked participants the following items, which I then scored according to the IPAQ scoring protocol.

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?
2. How much time did you usually spend doing vigorous physical activities on one of those days?
3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.
4. How much time did you usually spend doing moderate physical activities on one of those days?
5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?
6. How much time did you usually spend walking on one of those days?
7. During the last 7 days, how much time did you spend sitting on a week day?

To measure PA through Fitbit activity, I evaluated Fitbit data to answer the IPAQ discussed above. However, rather than rely on self-report, I looked at Fitbit's categorization scheme for minutes of activity at various levels: sedentary, lightly active, fairly active, and very active. I corroborated these categorizations to stand in for the IPAQ's categorization of PA: sedentary, walking, moderate exercise, and vigorous exercise.

Physical Activity Self-Efficacy

Conceptual definition: Related to self-efficacy, which refers to the extent to which an individual perceives he/she is capable of successfully completing a particular behavior (Bandura, 1977), this concept refers more specifically to the self-efficacy related to PA. For this study, PA self-efficacy refers to the degree to which participants believe they are capable of being physically active under a variety of conditions.

Operational definition: To measure this construct, I used the Self-Efficacy to Overcome Barriers to Physical Activity instrument from Albright et al. (2012) and Albright et al. (2014). I asked participants to rate, between 0 and 10, how certain they were that they could be physically active under each of the following conditions over the next 6 months:

- When I am tired?
- During or following a crisis?
- When I am feeling depressed?
- When I am feeling anxious?
- When I am slightly sore from the last time I was physically active?
- When I am on vacation?
- When there are competing interests (like my favorite TV show)?
- When I have a lot of work to do?
- When I haven't reached my physical activity goals?

- When I don’t receive support from family or friends?
- When I have no one to be physically active with?
- When my schedule is very busy?
- During bad weather?
- When it’s too hot and sunny?
- Following complete recovery from an illness?
- When there is housework to do?
- When you don’t have money?
- When you feel like you don’t have the time?
- When you have family or friends visiting you for the holidays or their vacation?
- When you have a job working at home?

General Health Self-Efficacy

Conceptual definition: Self-efficacy refers to an individual’s perception of his or her ability to successfully engage in a behavior (Bandura, 1977). Several scholars have posited that perceptions of self-efficacy are positively correlated with the successful adoption of a behavior (Bandura, 1977; Ajzen, 1991; Rogers, 2003; Prochaska et al., 2008). For this study, I am interested in patient’s general health-related self-efficacy, which refers to the extent to which patients perceive they are able to improve their health.

Operational definition: To measure this construct, I asked individuals to rate the extent to which they agreed with the following statements, using five-point-scale-type responses, ranging from strongly disagree to strongly agree. The statements come from various, previously validated scales on health-related self-efficacy, cited accordingly below. Because I am interested in potential effects of wearable use on self-efficacy, I administered these items at baseline and immediately before a visit with the physician. The questionnaire items were:

From Lee, Hwang, Hawkins, and Pingree (2008):

- I am confident I can have a positive effect on my health.
- I feel that I am in control of how and what I learn about my health.
- I have been able to meet the goals I set for myself to improve my health.
- I have set some definite goals to improve my health.
- I am actively working to improve my health.

Preferences for Information

Conceptual definition: This concept refers to a patient's perceptions regarding the types of information he/she gets in a medical visit and when.

Operational definition: Krantz, Baum, and Wideman (1980) measure information preferences using a subscale on the Krantz Health Opinion Survey. The following items from that subscale will be used for this study, and the asterisk (*) indicates items that will be reverse-scored:

- I usually ask the doctor or nurse lots of questions during a medical exam.
- It is better to trust the doctor or nurse in charge of a medical exam than to question what they are doing.
- I'd rather have doctors and nurses make the decisions about what's best for me than for them to give me a whole lot of choices.*
- I usually wait for the doctor or nurse to tell me the results of a medical exam rather than asking them immediately.*

Personal Innovativeness:

Conceptual definition: This concept refers to the extent to which an individual perceives that he/she is willing to try out a new information technology (Argawal & Prasad, 1998).

Operational definition: This concept was measured using the items from Argawal and Prasad's (1998) seven-point scale on personal innovativenss in the domain of information technology, the asterisk (*) indicates items that were reverse-scored:

- If I heard about a new information technology, I would look for ways to experiment with it.
- Among my peers, I am usually the first to try out new information technologies.
- In general, I am hesitant to try out new information technologies.*
- I like to experiment with new information technologies.

Patient Participation

Conceptual definition: This concept refers to the extent to which a patient produces meaningful verbal responses that can significantly influence an interaction in a medical visit (Street & Millay, 2001).

Operational definition: To measure this concept, transcriptions of medical appointments between patients and physicians were coded and scored according to the framework by Cegala et al. (2007). This coding scheme conceptualizes patient participation as consisting of four components: information-seeking, assertive utterances, information providing, and expressions of concern. Each concept is explained in more detail below in terms of conceptual and operational definitions.

Information-Seeking (IS)

Conceptual definition: This concept refers to utterances made by patients in which they are looking for information from their physicians (Cegala et al., 2000; Cegala et al., 2001; Cegala et al., 2007).

Operational definition: Information-seeking consists of the frequency of patient questions, which includes direct questions, assertive questions, and information-verifying statements (Cegala et al., 2007). For example, these are discourse units that would be coded as IS from Cegala et al. (2007):

> D: Do the 40 mg twice a day so it's just one pill twice a day.
> P: In the morning and one in the afternoon.
> D: Exactly.
> P: Now what about, we were talking one time here about late in the afternoon maybe taking it.
> D: I would move it into the afternoon so you aren't peeing.

Assertive Utterances (AU)

Conceptual definition: This concept refers to the declarative utterances made by patients.

Operational definition: AU consists of the frequency of declarations made by the patients. These include statements in which patients are expressing opinions, stating preferences, offering suggestions or recommendations, expressing disagreements or challenging the physician in some other way, or issuing a request (Cegala et al., 2007)Cegala et al. (2007) give the following as an example of a discourse unit that would be coded as AU:

> D: then I would say every other year because they still haven't come out with clear guidelines.
> P: I really would like it to be yearly, considering my history.

Information Provision (IP)

Conceptual definition: This concept refers to the information that patients provide to the physician either as a response to solicitation from the physician or as volunteered information (Cegala et al., 2007).

Operational definition: Information provision consists of the frequency of patient-provided information units. These include information about symptoms, family history, and psychosocial factors that give insight into illness or life experiences (Cegala et al., 2007). Cegala et al. (2007) give the following as an example of a discourse unit that would be coded as IP:

> D: So, you have been going to rehab. Your blood sugar numbers look real good and .
> P: About this rehab. I have to tell you, you know, I tried this concentrate on breathing and all that. And then write down whatever's bothering you.
> The thing that was bothering me was going in there. And I'll be honest with you, since I've quit going in there I sleep straight through at night. I don't worry or anything about it. And Sara will tell you that, really, I was walking better before I went down there. And now since I haven't been going over there about two weeks now, well I can start to feel that I'm walking better again.

Expressions of Concern (EC)

Conceptual definition: This concept refers to affective patient utterances such as those that express anxiety or worry (Cegala et al., 2007).

Operational definition: EC consists of frequencies of utterances that reflect patient affect. Cegala et al. (2007) give the following as an example:

> D: So what would be done is a blood test would be taken from her, the gene would be isolated, and you would be checked to see if you have it.
> P: So her having colon cancer, you're assured then that she has this gene? I mean, it looks like, I'm going to get it too.

Physician Information Provision

Conceptual definition: This concept refers to the dialogue from a physician that provides information to patients regarding their health. While physicians may give patients written instructions and/or give instructions via a physician assistant or nurse, this study is interested only in the verbal information provision from the physician during the in-office visit.

Operational definition: Physician information provision can be categorized as either question-elicited information, which includes information physicians provide in response to questions from patients; and/or volunteered information, which includes information provided by physicians without prompts from patients (Cegala et al., 2007; Cegala et al., 2001; Cegala et al., 2011).

An example of a discourse unit coded as volunteered information is:

> D: Remember our A1-C. What's our goal for A1-C?
> P: Uh, I don't remember.
> D: You don't remember? It should be less than 7.
> P: Less than 7.

An example of a discourse unit coded as question-elicited information is:

> P: There are no side effects from melatonin?
> D: Just vivid dreams. Vivid dreams, like you will remember your dreams after.

CHAPTER 4: METHODS

This chapter will present the methods used for data collection and analysis for this study. In order to achieve greater insight into the research questions, the study gathered information from several data sources and used both quantitative and qualitative methods for analysis. This section will cover: an overview of the study, the sample, the questionnaires, the medical appointments, and the phone interviews. It will also include details on the data gathering and data handling procedures.

Overview

This was a quasi-experimental field study with multiple observations and measurements. This study employed the use of patient participants and two physicians. The patients were recruited by phone via the appointment records with the physician(s) as well as via on-site recruitment when they scheduled follow-up visits. All were given a wearable, a Fitbit Flex device, to use during the course of the study. Data were collected in five ways: (1) online questionnaires, (2) the Fitbit website data export tool, (3) audio recording of the participants' medical visits (one visit per participant), (4) telephone interviews, and (5) encounter notes taken throughout the duration of the study. The online questionnaires consisted of: one baseline, two weekly progress questionnaires, one posttest, and one follow-up. Both the participants and the physicians were assessed during the medical visit, and both were interviewed at the conclusion of the study. Figure 1 provides a diagram of the major events of the study. Figure 2 provides a simplified diagram of the patient portion of the study design.

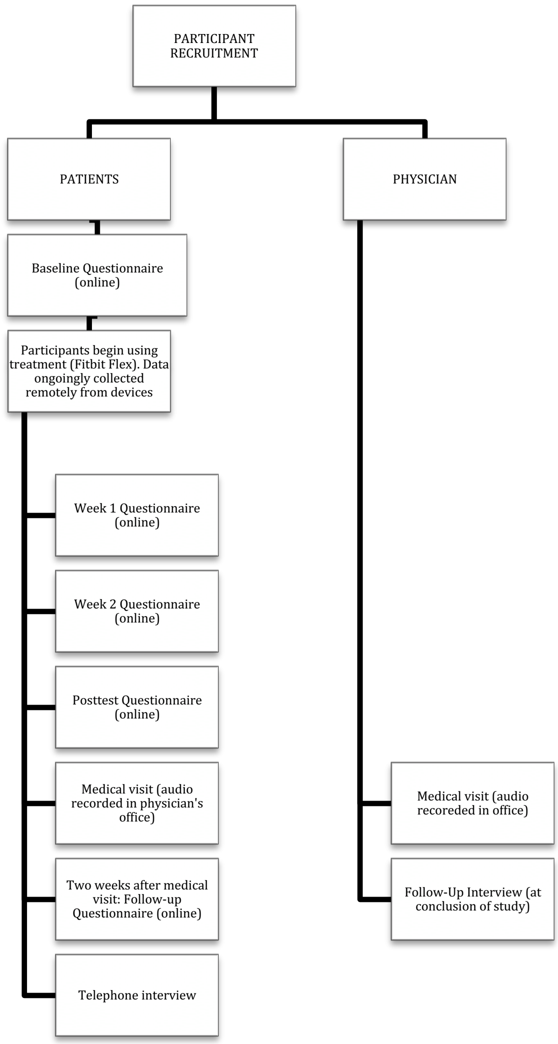

Figure 2. Flow of events for patients and physicians.

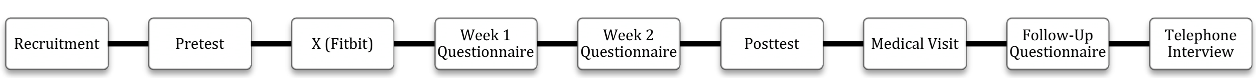

Figure 3. Simplified study diagram for patient participants.

This design was meant to help assess how a wearable might influence patients in terms of general health-related self-efficacy, physical activity self-efficacy, physical activity, and also in communication styles in medical visits. This design was meant to guard against threats to validity such as maturation (with multiple observations) and instrumentation through the use consistent instruments.

The Sample

This sample consisted of physician(s) and patients in a rural community on the island of Oahu, Hawaii. This community has one of the highest percentages of Asians (63.6%), Filipinos in particular (43.1%), and ranks in the lowest 20% in the state for per capita income, according to the University of Hawaii's Center on the Family (COF) (2003). This community also ranks second-highest in the state for seniors with disabilities and fourth-highest for individuals over the age of 65 living in poverty (COF, 2003). A predominantly Filipino population may particularly benefit from findings (Bhimla et al., 2017). Physicians and patients will be described in further detail below, including information about the rationale for selection in terms of characteristics and the method for recruitment.

Physician(s). Two private practice physicians from the same community on Oahu, Hawaii, participated in the study. One is a family doctor and the other specializes in internal medicine. Both regularly see adult patients (18 and over) for both well and sick visits. Based on a previous study, the value of data from wearables may be more applicable to some specialties such as general practice and less so in specialties such as obstetrics (Loos & Davidson, 2016). Participating physicians acted as partial confederates. They were informed that the general purpose of the study was to assess physical activity and physician-patient communication. They consented to the audio recording of the patient encounter, and they authorized office staff to assist in recruiting patients. The physicians were also study subjects, insofar as they were not aware of the intervention (a wearable) so as to reduce behavior bias during the in-office visit. Physician participation in the medical visit was also analyzed. The physicians were debriefed and interviewed after data collection from patients concluded.

Patients. Study subjects were patients of the participating physician(s), between 18 and 64 years of age, said they had regular access to the Internet and smart phone devices, and were capable of safely increasing their physical activity. These participants were recruited with the help of the physician staff. If patients had upcoming appointments or a need for a return visit within the time frame of the study, they were considered as potential participants. Office staff made initial contact due to HIPAA guidelines. They identified patients with a need to return within a specified time frame, let them know about the study, and asked their permission to allow me to talk to them. A script for the staff's initial contact can be found in Appendix A. Once the patients agreed, I talked to them directly to solicit their participation. I informed them that the physician had agreed to participate in a study on physician-patient communication and asked if they were interested in participating. I assessed whether they fit inclusion criteria, which were: (i) Must be between 18 years and 65 years of age; (ii) Must have a smart phone with Internet access capabilities; (iii) Must not be a current user of a modern-day wearable (a wrist-based activity monitor with Internet connectivity), and (iv) Must be capable of safely increasing their physical activity. I used the Physical Activity Readiness Questionnaire (PAR-Q) to assess the safety of increasing physical activity (ACSM, 1997). Following PAR-Q guidelines, if a participant answered yes to one or more of the questions, I consulted the physician to determine whether he/she could safely increase physical activity (ACSM, 1997). A script for my recruitment of the patients can be found in Appendix B.

These individuals were of interest for several reasons. For one, Loos and Davidson (2016) found that physicians viewed wearables as potentially more applicable for certain physicians, such as general practitioners, over others, such as obstetricians. Further, these participants consisted of patients that could potentially adopt wearable devices on their own with relatively low barriers to access, provided that they had regular access to the Internet and smart devices. Assessing physician-patient communication in the manner outlined by this study also required that measurement of physician-patient communication take place. Because these participants already had a reason to return for a visit, they were going to be discussing information that would be particularly useful to them and therefore also relevant to the study.

Ethics. This study aimed at keeping respect for persons, beneficence, and justice as core principles. Respect for their autonomy was kept throughout the study. Participants were recruited from a pool of patients that is capable of making informed decisions autonomously. They were informed of the voluntary nature of the study and were also informed that they could drop out at any time. At no time were participants deceived. The study aimed to do no harm while maximizing benefits and minimizing risks to participants. Some potential benefits to participants that included encouraging behaviors that are linked to improving health, such as tracking health activities and setting goals for health. Taking steps to protect participant data, outlined in further detail in the following sections, helped to minimize risks.

All patient participants were asked to fill out questionnaires at baseline, weekly, before the physician visit, and two weeks after the visit. These questionnaires were administered online via the Qualtrics website. I recorded participant medical visits as well, which is explained in more detail in the next sections. I also conducted phone interviews with these participants after the follow-up questionnaire.

The patient participants were given a Fitbit Flex device, which included instructions a handout with brief setup instructions and a specified login (Appendix J). I also made myself available to participants if they had any technical issues during the study.

Data Gathering

Data were gathered in several ways: online questionnaires, data exports from Fitbit devices, audio recordings of medical visits, phone interviews, and encounter notes.

Patient self-reports via online questionnaires. Participants were sent questionnaires regarding health behaviors and perceptions of self-efficacy as well as questions regarding their experiences with the wearable devices. I focused on self-efficacy in pretest and posttest questionnaires in order to determine indirect effects of the devices. Klasnja, Consolvo and Pratt (2011) posit that studies that focus on the specific, intended outcome of a device, for instance, increased physical activity from a wearable, are too limited. Instead, they argue that research on health-related IT should focus on efficacy evaluations that contribute to a deeper understanding of individuals' experiences with the IT. In addition to pretest and posttest questionnaires, I sent participants questionnaires about physical activity and wearable device experiences in the weeks leading up to medical visits. I also sent participants follow-up questionnaires two weeks after the medical visit to assess their physical activity and wearable device use. After this questionnaire, I conducted telephone interviews with the patients to get some qualitative feedback about their experiences. Full questionnaires are available in Appendix D (pretest questionnaire), Appendix E (Week 1 and Week 2 questionnaires), Appendix F (posttest questionnaire), Appendix H (follow-up questionnaire), and Appendix G (guidelines for patient telephone interview).

Patient activity monitoring via Fitbit data export tool. When participants synced their Fitbit devices to either their mobile phones or their computers, data from their devices were automatically be collected and available for export. Fitbit provides a data export tool to all users within the user settings section of the website. Because I had user login and password information (usernames were participant email addresses and passwords were provided by me), I was able to export this data at any point during the study. This gave me insight into how the participants were using their devices and how that use related to the answers they provided in their questionnaires. Participants were informed via an informed consent form (Appendix C) that their data was going to be collected.

Patient-physician interaction. Data were also gathered during the office visits. Here, I audio recorded the interactions, following the procedures outlined by Cegala et al. (2000), Cegala et al. (2001), and Street and Millay (2001). A wireless microphone was placed in the patient room. In a nearby room with access to the audio of the patient room and an audio recorder, I relied on office staff to alert me when a patient participant was in the room. Upon that cue, I turned on the recording equipment. However, this procedure resulted in some technical and logistical issues that prevented some medical appointments from being recorded. Therefore, I altered recording procedures. Instead of relying on a wireless microphone, I placed a recording device directly in the room with the physician and patient when a patient entered the room. After the physician visited with the patient, (i.e. when the appointment finished), I turned off the equipment. Following Street and Millay's (2001) guidelines for measuring patient participation, I then had the recordings transcribed before dividing responses into discourse units for coding.

Physician response. I interviewed the physicians after the medical visits concluded. Physicians received IRB consent forms before the interview (Appendix H and Appendix I). Although the physicians were informed that they their patient participants received an intervention, they were not told the exact nature of the intervention. Patient participant visits occurred during normal business days. (Physicians saw both study participants and patients regularly scheduled that day.) Physicians were not told which patients were study participants and which were not. However, I did not take explicit steps to hide the Fitbit devices or the recording equipment. I did not ask participants to remove their devices if they were wearing them, and I did not prompt them to discuss the study or the wearables in their appointments.

Data Handling

Data was stored in a manner that proactively protected participants. Online responses were gathered through Qualtrics, which incorporates the use of high-end firewall systems and scans for vulnerabilities regularly, according to the site. The site uses Transport Layer Security, also known as HTTPS for all transmitted data, and surveys are password-protected. Further, Qualtrics employs safeguards to protect customer data and uses secure data centers to offer high data protection per Health Information Technology for Economic and Clinical Health Act requirements (Qualtrics). Offline, data were stored on a password-protected hard drive and kept in a locked cabinet in a secure location. Participant information, such as names and addresses, were only kept as long as necessary for the study. After data were gathered, participant names were encoded to translate them into numbers, further protecting participant identity. Mailing addresses were deleted after sending the necessary items to the participants. Email addresses were also deleted after completion of the study. Appointment transcriptions were altered to change names to initials, where applicable. For example, if a physician was mentioned by name, the name was changed to Dr. H. If a patient was referred to by name, brackets and [patient's name] were used instead.

Expectations

Overall, I expected that participants would have improved self-efficacy over the course of the study. I expected to see participants with higher use of the wearables to have higher self-efficacy, which would in turn lead to higher participation in their medical visits and more physician information provision in those visits as well. Figure 3 below shows the conceptual model of these expectations.

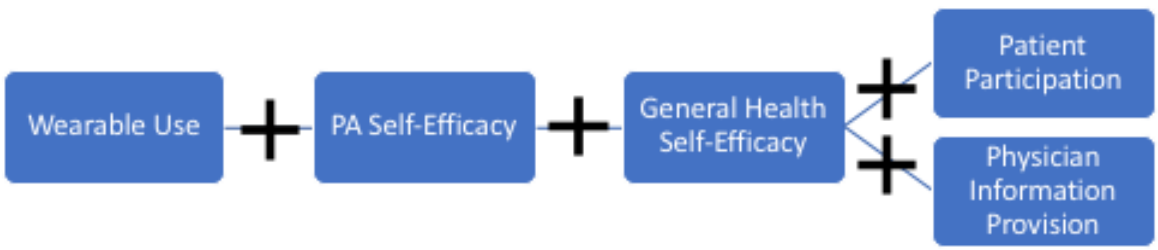

Figure 4. Construct relationship expectations.

Because the Fitbit device and software design include tools that encourage users to tailor their goals, reward users for reaching those goals, and allow for users to compare themselves to others, all in a relatively unobtrusive manner, I expected that participants with high wearable use would exhibit higher health self-efficacy. The Fitbit Flex shows individuals their capabilities of reaching their goals by allowing them to participate in the activities themselves, by doing so, they appeal to self-efficacy through participatory modeling, which is the most powerful form of self-efficacy enhancement (Bandura, 1977). Because self-efficacy can extend into related arenas (Bandura, 1977), I also expected participants with high wearable use to have more participation in their medical visits. Individuals who believe they are capable of successfully engaging in a behavior, i.e. those with high self-efficacy, are more likely to engage in that behavior (Bandura, 1977).

Research has shown that patient training that enhances patient self-efficacy is effective in physician-patient communication at enhancing not only patient participation, but in enhancing physician participation as well (Cegala, 2006; Cegala, Chisolm, & Nwomeh, 2012; Cegala, Post, & McClure, 2001; Cegala, Street, & Clinch, 2007). Therefore, I expected to find that participants with higher self-efficacy would have higher participation in their medical visits than those with lower self-efficacy. Further, I expected the physicians to offer more information to those patients as well, as research has shown that physicians tend to offer more information to high-participation patients (Cegala, Street, & Clinch, 2007). In summary, I expected that individuals with high use of the wearable would have higher self-efficacy, more patient participation, and more physician information provision in the medical visits, as compared to those with low use.

CHAPTER 5: RESULTS

A total of 29 participants took part in the study. This sample consisted of mostly female participants (69 percent). Roughly 30 percent graduated from college. This sample predominantly identified as at least part Filipino (69 percent). Two Filipino physicians also took part in the study, one male and one female. Table 4 provides participant demographics.

Table 4

Participant Demographics

		n	% Sample
Gender			
	Male	9	31
	Female	20	69
Race/Ethnicity			
	American Indian	2	7
	Black/African-American	2	7
	Chinese	3	10
	Filipino	20	69
	Japanese	4	14
	Korean	1	3
	Native Hawaiian	5	17
	Pacific Islander	4	14
	Portuguese	2	7
	White	2	7
	Prefer not to answer	1	3
Age			
	18 to 24	6	21
	25 to 34	6	21
	35 to 44	6	21
	45 to 64	11	38
Education			
	Some high school	2	7
	High school graduate	8	28
	Some college	8	28
	Trade/technical/vocational training	2	7
	College graduate	8	28
	Post graduate degree	1	3
Marital Status			
	Single, never married	13	45
	Married or domestic partnership	14	48
	Widowed	1	3
	Divorced	0	0
	Separated	2	7

I analyzed results both quantitatively and qualitatively. Quantitative results were based on responses to closed-ended questionnaire items, Fitbit data, and coded transcriptions of medical appointments. Qualitative findings were based on open-ended questionnaire items, phone interviews with patients and physicians, and encounter notes taken throughout the study.

For quantitative analysis, I used IBM's Statistical Package for the Social Sciences (SPSS) to run various statistical analyses, specified by construct in more detail below. It should be noted that because of the low n (29 participants or fewer), power is extremely limited. Therefore, reporting of these statistical analyses here is done for reference only. Suggestions for future research are discussed later in the document, and these include incorporating more participants in order to generate the power needed to statistically analyze results meaningfully.

Responses to questionnaire items varied, and the n for each analysis is specified with those constructs. Where appropriate, statistical analyses were run with estimations. In the event of missing data, for example, if a participant answered the baseline questionnaire but not the posttest questionnaire, I used maximum likelihood estimation, which provides unbiased estimates where there is at least one measure, provided the data can be considered as missing at random (Hox, 2010). After examining the individuals with missing data in greater detail, there was considerable evidence the data were likely missing at random. There were no adverse events or other occurrences to suggest otherwise. According to Hox (2010), keeping individuals with partial data in the analysis greatly increases the likelihood that individuals with missing occasions are missing at random. In contrast, however, using listwise deletion of cases with partial data will introduce considerable bias into the analysis and reduce the power to detect effects (Hox, 2010). In addition to reported analyses below, I analyzed results controlling for demographic variables and found no significant results. The research questions that guided this study are summarized in Table 5.

Table 5

Research Questions

RQ1: How does use of a wearable influence self-efficacy?	
	RQ1a: To what extent do patients use a wearable when one is given to them?
	RQ1b: To what extent does using a wearable influence a patient's physical activity?
	RQ1c: How does a patient's use of a wearable affect physical activity self-efficacy?
	RQ1d: How does a wearable affect an individual's general health self-efficacy?
	RQ1e: To what extent does use of a wearable affect preferences for health information?
	RQ1f: To what extent does use of a wearable affect personal innovativeness?
RQ2: To what extent does patient use of a wearable affect physician-patient communication?	
	RQ2a: How does patient use of a wearable affect patient participation in a medical visit?
	RQ2b: To what extent does patient use of a wearable affect physician information provision in a medical visit?

Wearable Use and Influence on Self-Efficacy

This study's **Research Question 1 asks: How does a wearable influence self-efficacy?** To look further into this question, this study evaluated data related to associated constructs, such as use of a wearable, physical activity, physical activity self-efficacy, general health self-efficacy, preferences for information, and personal innovativeness. This section presents results related to these constructs.

Use of a Wearable

To address **Research Question 1a (To what extent to do patients use a wearable when one is given to them?)**, I examined both exported Fitbit.com data and participant responses to questionnaires at three points during the study: one week after Fitbit use started, two weeks after Fitbit use started, and two weeks after the medical appointment (follow-up questionnaire). Self-reports gave insight into factors such as how often participants used various features of the device and how participants interacted with the device (i.e. through the mobile application website, and how often they synced devices). Fitbit-reported data gave insight into participants' levels of use and wearable-reported physical activity.

According to self-reports [n = 15 (Time 1); 17 (Time 2); 16 (Time 3)], participants varied in how often they checked their trackers (Chart 1), how often they logged onto their accounts from the Fitbit.com website (Chart 2), and whether they used the Fitbit mobile application (Chart 3). While respondents reported using both the Fitbit app and website, use tended to center around basic functionalities that the Fitbit device automatically tracks, such as step counts (Chart 4) and sleep (Chart 5). Some participants also input their weight (Chart 6). However, more advanced features of the mobile application, such as social functions like participating in competitions (Chart 7) or comparing oneself to others in a social network (Chart 8), were extremely limited (just 1 participant indicated participation in competitions or checking friends' progress).

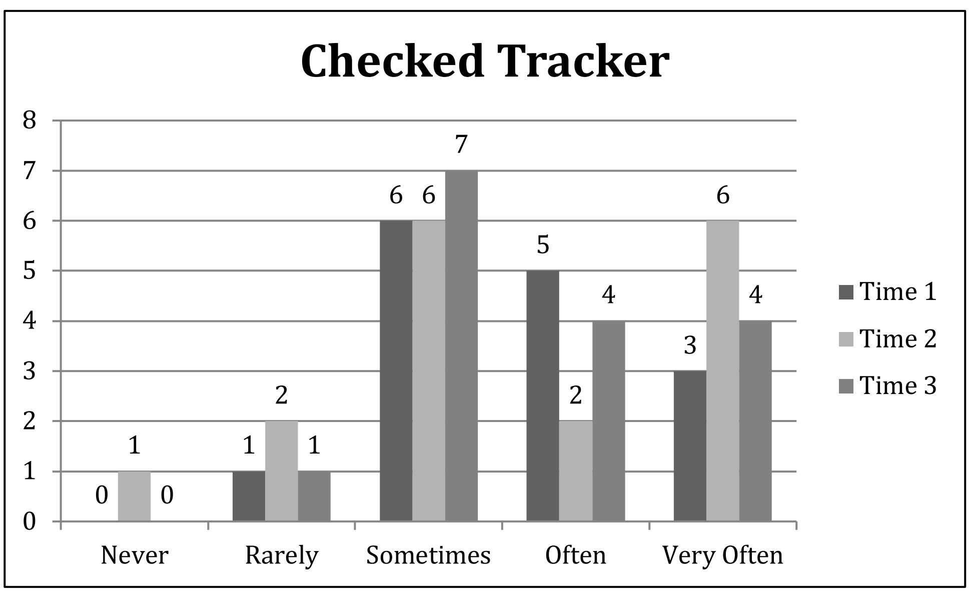

Chart 1. How often participants reported they checked the device on their wrists.

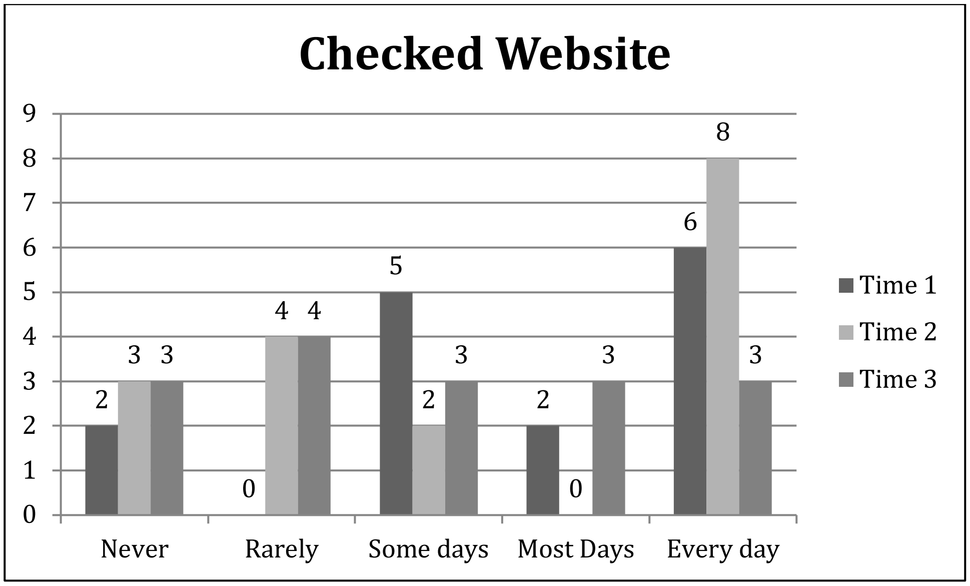

Chart 2. How often participants reported they looked at their data on the Fitbit website.

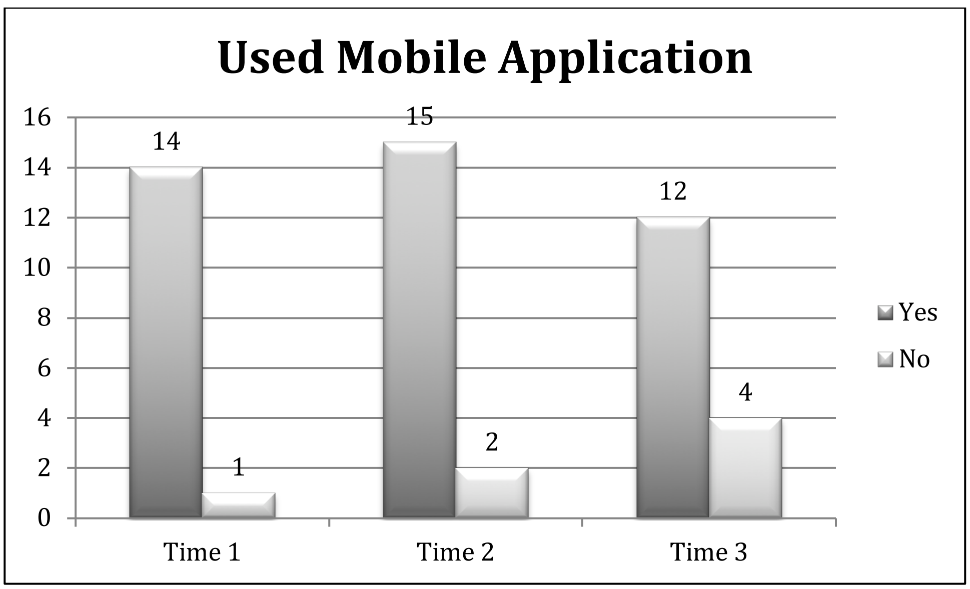

Chart 3. How often participants said they used the Fitbit mobile application.

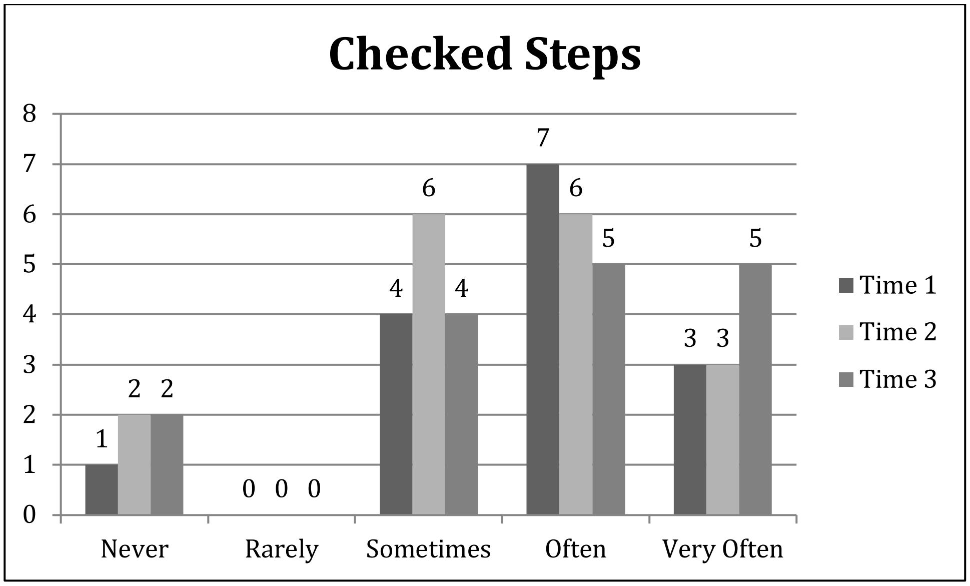

Chart 4. How often participants reported they checked their steps.

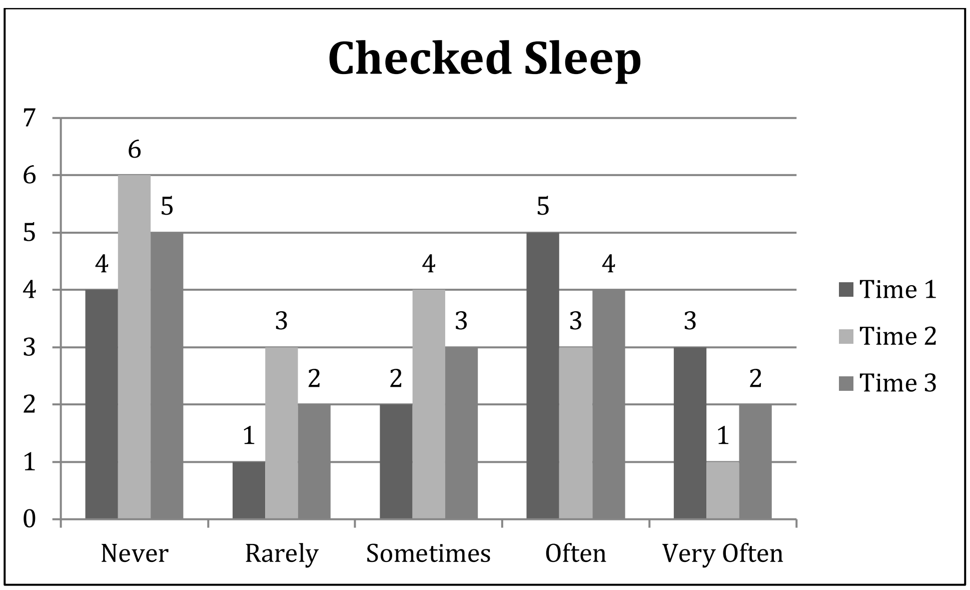

Chart 5. How often participants reported they checked their sleep.

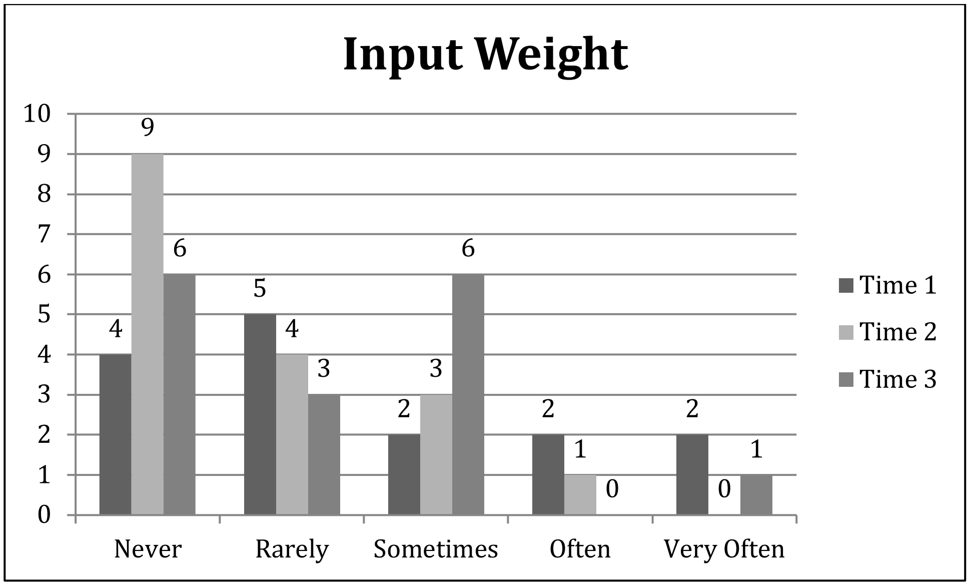

Chart 6. How often participants input their weight, according to self-reports.

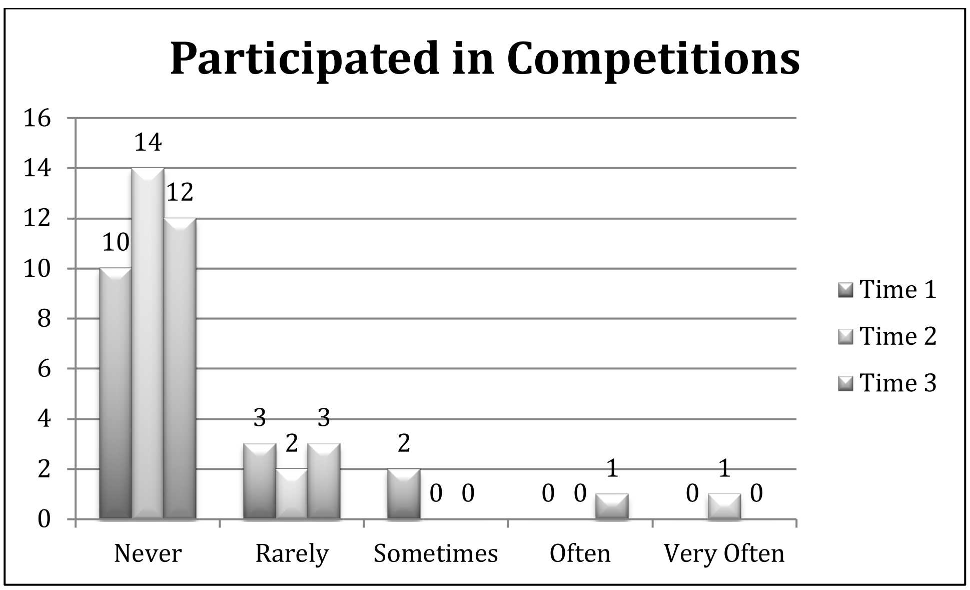

Chart 7. How often participants participated in competitions, according to self-reports.

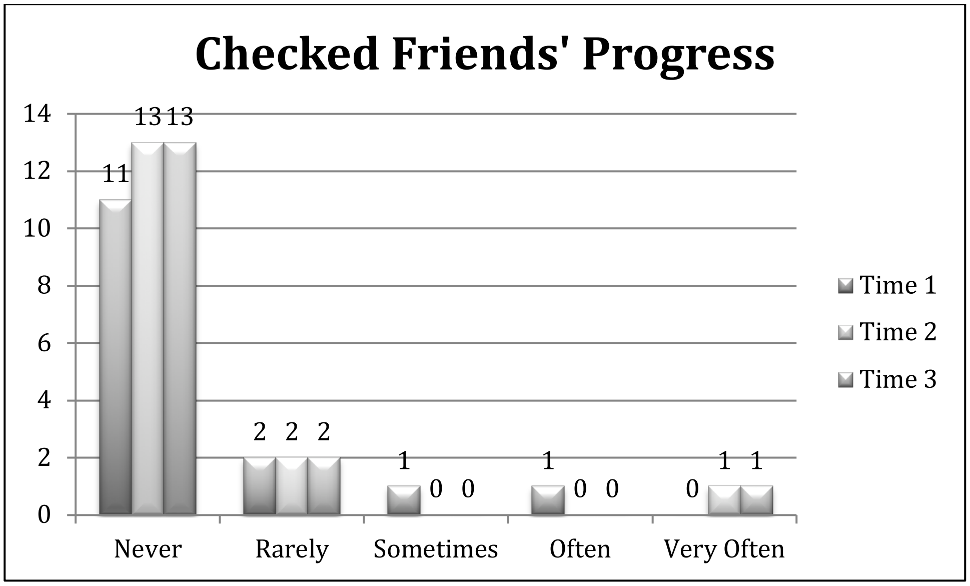

Chart 8. How often participants checked the progress of friends, according to self-reports.

Level of Fitbit Use. In order to see how participants used their Fitbits over time, I first measured their use at three time periods (Time 1 = 1 week after they set up their wearables; Time 2 = 1 week after Time 1; Time 3 = 1 week after Time 2). To obtain use scores, I first exported participant device data from Fitbit.com. Each day a participant logged at least one step was considered to be one day of use. The number of days used divided by the number of days within the timeframe resulted in a percentage use score. I classified those scores into four categories:

1. No use (0)
2. Low use (≤ .32)
3. Moderate use (between .33 and .67)
4. High use (between .68 and 1)

I analyzed these scores using ordinal logistic regression. Results indicated that participants tended to increase in their Fitbit use after two weeks (odds ratio = 1.758, $p < .01$) and after three weeks (odds ratio = 2.335, $p < .01$), compared to one week after setup, holding all other variables constant. These odds ratios suggest, on average, individuals were about 1.8 times more likely to be in higher versus combined lower levels of Fitbit use two weeks after setup, compared to the beginning of the study, holding all other variables constant. Similarly, they were 2.3 times more likely to be at higher categories of use versus combined lower categories at three weeks after setup, compared to one week after setup, holding all other variables constant. This indicates that Fitbit use increases over time, and these increases are significant ($p < .01$). At both two and three weeks after setup, use is higher than at one week after setup. See the Table 6.

Table 6

Results: Level of Fitbit Use, n = 22

Parameter		B	Std. Error	95% Wald Confidence Interval Lower	95% Wald Confidence Interval Upper	Hypothesis Test Wald Chi-Square	Hypothesis Test df	Hypothesis Test Sig.	Exp (B)	95% Wald Confidence Interval for Exp(B) Lower	95% Wald Confidence Interval for Exp(B) Upper
Threshold	High Fitbit Use	.210	.3512	-.478	.898	.357	1	.550	1.234	.620	2.455
	Moderate Fitbit Use	.638	.3906	-.127	1.404	2.670	1	.102	1.893	.880	4.071
[Time=3]		.848	.2693	.320	1.376	9.920	1	.002	2.335	1.378	3.959
[Time=2]		.564	.1960	.180	.948	8.288	1	.004	1.758	1.197	2.581
[Time=1]		0[b]	.	.	.	.	.	.	1	.	.
(Scale)		1									

Dependent Variable: Level of Fitbit use
Model: (Threshold), Time

I also looked at Fitbit use overall, and I scored participants according to their levels of use throughout the duration of the study. Using the same scheme as above, dividing use by number of days, I then categorized users as (1) No use; (2) Low use; (3) Moderate use; and (4) High use. The median score for participants was 2. The mean was 2.55, and scores ranged from 1 to 4.

Physical Activity

To address **Research Question 1b (To what extent does using a wearable influence a patient's physical activity?)**, I looked at both self-reported physical activity (PA) and Fitbit-collected data on PA.

Self-Reported Physical Activity. Participants reported their physical activity (PA) at baseline, Week 1, Week 2, and at follow-up, by answering items on the International Physical Activity Questionnaire (IPAQ) (International Physical Activity Questionnaire, 2005). Using the IPAQ scoring protocol, I categorized participants at each time interval into one of three levels of activity: (1) low, (2) moderate, and (3) high. At baseline, week 1, and week 2, the median category for participant PA was 2. At follow-up, the median score increased to 2.5.

Next, I analyzed these scoring categories using longitudinal ordinal logistic regression. I used a maximum likelihood estimation of ordinal outcome and the four scores for each participant. The maximum likelihood estimation allowed for me to include participants with partial data, which provides a more rigorous test. This resulted in analyses for 28 participants. One participant had no self-reported PA for any of the four measurements, so this participant was left out of analysis.

Results were not significant. They neared significance at posttest, which was two weeks after the study began, but at $p = .058$ they were still not significant. Therefore, time does not seem to be related to the outcome. Self-reported PA decreased over time, but not significantly.

Table 7

Results: Self-Reported PA, n = 28

Parameter		B	Std. Error	95% Wald Confidence Interval Lower	95% Wald Confidence Interval Upper	Hypothesis Test Wald Chi-Square	Hypothesis Test df	Hypothesis Test Sig.	Exp (B)	95% Wald Confidence Interval for Exp(B) Lower	95% Wald Confidence Interval for Exp(B) Upper
Threshold	High PA	-.835	.4002	-1.619	-.051	4.355	1	.037	.434	.198	.950
	Moderate PA	1.026	.4148	.213	1.839	6.119	1	.013	2.790	1.238	6.291
Follow-Up		-.852	.5185	-1.868	.164	2.703	1	.100	.426	.154	1.178
Week 2/Posttest		-.877	.4632	-1.785	.031	3.585	1	.058	.416	.168	1.031
Week 1		-.073	.5774	-1.204	1.059	.016	1	.900	.930	.300	2.883
Baseline		0[a]	.	.	.	.	.	.	1	.	.
(Scale)		1									
Dependent Variable: Level of PA (Low, Moderate, High) Model: (Threshold), Time											

Fitbit-Reported Physical Activity. Fifteen participants established a user account on the Fitbit platform and linked their individual devices during the study. Fitbits collect participant PA data through the devices when participants sync to either their phones or computers, which I gathered using Fitbit.com's data export tool. This data includes information such as number of steps per day and active minutes. Fitbit further breaks down active minutes into several categories: minutes sedentary, minutes lightly active, fairly active, and very active. I used the Fitbit data to answer the IPAQ questions and categorize users in the same fashion as the self-reported PA measures[1]. Following the IPAQ

[1] The data exported through the Fitbit website categorizes active minutes into sedentary, lightly active, fairly active, and very active. To match the IPAQ items, these minutes were used to stand in for minutes sedentary, walking, moderately exercising, and vigorously exercising, respectively.

guidelines, I counted any number of minutes that exceeded 180 as 180 and did not record activity for minutes less than 10.

One deviation from IPAQ scoring guidelines was in terms of calculating scores. In the self-reported PA IPAQ scoring, users multiply the number of minutes they reported spending per day doing an activity by the number days they reported doing that activity in that week. Then, this number was multiplied by 3.3 (walking), 4 (moderate) or 8 (vigorous) to obtain a number of MET minutes per week. "MET minutes represent the amount of energy expended carrying out physical activity" (IPAQ, 2005). Once these scores were obtained, users were classified as high, moderate or low, based on the IPAQ scoring categorizations. For the Fitbit data, rather than multiplying activity per day by days they were active, I used actual minutes in that week and multiplied by the associated IPAQ (2005) multiplier specified above.

To obtain scores, I gathered data from all 15 users for seven days at three different time periods during the study. Time 1 scores came from the first seven days a participant had the Fitbit, starting with the first day a participant recorded activity. Time 2 measurements came from the seven days after Time 1 (two weeks after Fitbit setup), and Time 3 came from the seven days after Time 2 (three weeks after Fitbit setup).

Once I categorized users according to the IPAQ activity levels (low, moderate, high), I analyzed these scores using ordinal logistic regression. Results were not significant at two weeks after Fitbit setup (odds ratio = 1.687, $p > .05$), holding all other variables constant. At three weeks after setup, participants increased, this time significantly (odds ratio = 4.248, $p < .05$), holding all other variables constant. This suggests that, at three weeks after setup, participants were 4.2 times more likely to have higher PA versus combined lower levels of PA than they were one week after setup, holding all other variables constant. See Table 8.

Table 8

Results: Fitbit-Reported PA, n = 15

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp (B)	95% Wald Confidence Interval for Exp(B)	
				Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
Threshold	High Fitbit PA	.406	.5110	-.596	1.407	.630	1	.427	1.500	.551	4.084
	Moderate Fitbit PA	1.871	.6554	.587	3.156	8.155	1	.004	6.498	1.799	23.474
Week 3		1.447	.6212	.229	2.664	5.421	1	.020	4.248	1.257	14.355
Week 2		.523	.6226	-.698	1.743	.705	1	.401	1.687	.498	5.715
Week 1		0[a]	.	.	.	.	.	.	1	.	.
(Scale)		1									
Dependent Variable: Fitbit PA (low, moderate, high) Model: (Threshold), Time											

To assess whether self-reported PA correlated with Fitbit-reported PA, I analyzed scores from Week 1, Week 2, and follow-up questionnaires using bivariate correlation. I found no statistically significant relationships.

Physical Activity Self-Efficacy

To address **Research Question 1c: How does a patient's use of a wearable affect physical activity self-efficacy?** I looked at participant responses for the 20 items measuring PA self-efficacy on the baseline and posttest questionnaires. Per scoring guidelines from Albright et al. (2014), items were first scored from 1 to 10 based on responses ranging from "Certain I cannot do" to "Very certain I can do." Scores came from summing these values and then taking the mean. The mean score for PA self-efficacy at baseline was 6.11, with a median of 5.95. Posttest scores for PA self-efficacy were 6.60 for mean and 6.55 for median.

Next, I analyzed the longitudinal (repeated measures with a continuous outcome) data using a maximum likelihood estimation on a continuous outcome and two points in time, using linear regression. I was able to analyze data from all 29 participants. Results were not statistically significant (p = .158).

Table 9

Results: PA Self-Efficacy, n = 29

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	6.112	.3553	5.416	6.808	295.969	1	.000
[Posttest]	.491	.3476	-.191	1.172	1.992	1	.158
[Baseline]	0[a]	.	.	.	.	.	.
(Scale)	3.327						
Dependent Variable: PA-SE Model: (Intercept), Time							

General Health Self-Efficacy, Preferences for Information, and Personal Innovativeness

I analyzed self-efficacy, preferences for information, and personal innovativeness by first creating indices for each of those constructs. I next analyzed the longitudinal (repeated measures with a continuous outcome) data using a maximum likelihood estimation on a continuous outcome and two points in time. I was able to analyze data from 27 participants. Two participants had not answered items for either baseline and posttest questionnaires, so they were not included in the analysis.

General Health Self-Efficacy. To address **Research Question 1d (How does a wearable affect an individual's general health self-efficacy?)**, I created a self-efficacy index by combining the results for the five items measuring self-efficacy. I calculated Cronbach's alpha, and reliability was 0.836. Mean scores for baseline self-efficacy were 5.59, with a median of 6.0.

Posttest scores for were 5.61 (mean) and 5.60 (median). Changes in self-efficacy were not statistically significant ($p > .10$). See Table 10.

Table 10

Results: General Health Self-Efficacy, n = 27

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	5.592	.2303	5.140	6.043	589.642	1	.000
[Posttest]	.025	.2643	-.493	.543	.006	1	.925
[Baseline]	0[a]	.	.	.	.	.	.
(Scale)	1.030						
Dependent Variable: Self-Efficacy Model: (Intercept), Time							

Preferences for Information

To address **Research Question 1e (To what extent does use of a wearable affect preferences for health information?)**, I used the four questionnaire items for preferences for information to create a preferences index. Cronbach's alpha for the four questionnaire items measuring this construct was 0.640. If I removed one item (I usually ask the doctor or nurse lots of questions during a medical exam), then Cronbach's alpha increased slightly to 0.661. Because this was a seemingly small difference, I decided to keep all four items in the index. Mean scores for preferences for information were 4.61, with a median of 4.50. Posttest scores were 4.87 (mean) and 5.0 (median). Changes in preferences for information were not statistically significant ($p > .10$). See Table 11.

Table 11

Results: Preferences for Information, n = 27

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald Chi-Square	df	Sig.
(Intercept)	4.615	.2389	4.146	5.083	373.127	1	.000
[Posttest]	.273	.2480	-.213	.759	1.211	1	.271
[Baseline]	0[a]	.	.	.	.	.	.
(Scale)	1.207						
Dependent Variable: Preferences Model: (Intercept), Time							

Personal Innovativeness

To address **Research Question 1f (To what extent does use of a wearable affect personal innovativeness?)**, I combined three items to create the personal innovativeness index. Originally measured with four items, Cronbach's alpha for the four items together was 0.421. If I eliminated one item (In general, I am hesitant to try out new information technologies.), then Cronbach's alpha increased to 0.715. Because of this, I kept only the other three items in the index. Mean scores for personal innovativeness at baseline were 4.83, with a median of 5.0. Posttest scores were 4.81 (mean) and 4.67 (median). Changes in personal innovativeness were not statistically significant ($p > .10$). See Table 12.

Table 12
Results: Personal Innovativeness, n = 27

Parameter	B	Std. Error	95% Wald Confidence Interval Lower	Upper	Hypothesis Test Wald Chi-Square	df	Sig.
(Intercept)	4.833	.2341	4.375	5.292	426.423	1	.000
[Posttest]	.000	.3220	-.631	.631	.000	1	1.000
[Baseline]	0[a]	.	.	.	.	.	.
(Scale)	1.754						
Dependent Variable: Innovativeness Model: (Intercept), Time							

Physician-Patient Communication

Research Question 2 asked: **To what extent does patient use of a wearable affect physician-patient communication?** To examine this question, I recorded participant medical appointments approximately two weeks after each enrolled in the study. Of the 29 recruited participants, 17 attended their medical appointments. Technical issues prevented two from being recorded, and 15 were recorded successfully. These recordings were transcribed by professional medical transcriptionist. I then checked transcriptions against recordings a second time and reconciled any missing information. For one participant, this involved translating portions of the appointment from Taglog to English. The transcriptionist was not a Tagalog speaker, so I translated these portions of the dialogue. Transcriptions were then coded according to the PACE (**P**resenting detailed information about your illness, **A**sking questions, **C**hecking your understanding of information, and **E**xpressing concerns) coding system (Cegala et al., 2007; Cegala, 2011). Following this coding scheme, medical appointment transcriptions were divided into discourse units and then coded according to four function categories: information-seeking and verifying (IS), assertive utterance (AU), information-providing (IP), and expression of concern (EC). Discourse units coded as IP were further coded as: information giving solicited

(GS), information giving elaboration (GE), and information giving unsolicited (GU). Physician dialogue was also coded according to the Cegala (2011) and Cegala et al. (2007) coding scheme. This categorized physician discourse units into question-elicited information (QE) and volunteered information (V). An independent coder and I coded 30 percent of all transcriptions. We then discussed any discrepancies until we reached agreement. Then, the coder coded the remaining transcriptions.

Patient Participation. To address **Research Question 2a: How does patient use of a wearable affect patient participation in a medical visit?** I first looked at raw participation scores. These scores were calculated based on the frequencies of discourse units in the four function categories (Mean = 17.16, Median = 16.67, SD = 8.88). Additionally, patient participant scores were categorized as high or low by splitting the scores at the mean (Cegala et al., 2007). Results showed that participants were roughly split in terms of high and low participation (46.7 percent and 53.3 percent, respectively). In analyzing patient participation with Fitbit use, I used ordinal logistic regression with categorized patient participation scores and level of Fitbit use at the time of the medical appointment (two weeks after Fitbit setup). Because one participant had not used the Fitbit at the time of his appointment, he was left off of the analysis. Results were not significant. I used the same analysis to look at patient participation and physical activity, both self-reported and according to Fitbit use, and did not find significant results in either case. Patient participation did not significantly correlate with posttest scores of self-efficacy, preferences for information, personal innovativeness, or PA self-efficacy.

Physician Information Provision. To address **Research Question 2b: To what extent does patient use of a wearable affect physician information provision?** I first calculated physician information provision scores. These scores were based on frequencies of QE and V

(Mean = 20.4, Median = 19, SD = 11.45). To categorize physician information provision as high or low, scores were split at the mean. Physicians had relatively low information provision (60%). I used one-way ANOVA to examine the relationship between physician information provision and level of Fitbit use at the time of the medical appointment. Because one participant had not used the Fitbit at the time of his appointment, he was left off of the analysis. Results were positive, but not significant ($p = .35$)

Table 13

Results: Interaction Between Physician Information Provision and Level of Fitbit Use (n = 14)

ANOVA					
Level of Physician Information Provision					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.578	2	.289	1.147	.350
Within Groups	3.022	12	.252		
Total	3.600	14			

In addition to analyzing medical visit scores with wearable use, I looked at patient participation and physician information provision scores. Correlation analysis of raw scores (n = 15) revealed a significant correlation (.693, $p < .01$). This supported similar findings in previous studies (Cegala et al., 2000; Cegala et al., 2007; Cegala, 2011; Street & Millay, 2001). I also looked at physician-patient communication qualitatively, and those results are discussed further later in this chapter.

Additional Analyses

After analyzing constructs related to the research questions, I looked at additional relationships that might inform the study further. These included: Fitbit use and self-reported PA, Fitbit-reported PA and self-reported PA, level of Fitbit use and Fitbit-reported PA, and more analyses of the study overall using qualitative data. The qualitative data gave deeper insight to constructs already of interest and are discussed later in this section.

Fitbit Use and Self-Reported Physical Activity

In order to see whether Fitbit use and self-reported PA went together (i.e. Did high-level users of Fitbits tend to have high levels of self-reported PA?), I used ordinal logistic regression and found: Relative to low Fitbit users, medium and high Fitbit users tended to report lower levels of physical activity at the beginning of the study (significant for high-level users at $p = .003$). Over time, however, medium and high users tended to report higher levels of PA (significant for high users at $p = .006$). In other words, the significant interaction ((2.288, $p < .01$) indicates that over time, high levels of Fitbit use were related to increased reported PA. See Table 14.

Table 14

Results: Interaction Between Fitbit Use and Self-Reported PA, n = 28

Parameter		B	Std. Error	95% Wald Confidence Interval Lower	95% Wald Confidence Interval Upper	Hypothesis Test Wald Chi-Square	Hypothesis Test df	Hypothesis Test Sig.	Exp(B)	95% Wald Confidence Interval for Exp(B) Lower	95% Wald Confidence Interval for Exp(B) Upper
Threshold	High PA	-5.131	1.4509	-7.975	-2.288	12.507	1	.000	.006	.000	.102
	Moderate PA	-3.028	1.3578	-5.689	-.366	4.972	1	.026	.048	.003	.693
Time		-2.221	.7563	-3.703	-.739	8.626	1	.003	.108	.025	.478
High Fitbit Use		-4.806	1.5910	-7.924	-1.687	9.124	1	.003	.008	.000	.185
Moderate Fitbit Use		-4.506	2.4206	-9.250	.238	3.465	1	.063	.011	9.609E-5	1.269
No Fitbit Use		0[b]	.	.	.	.	.	.	1	.	.
High Fitbit Use * Time		2.288	.8364	.648	3.927	7.481	1	.006	9.853	1.913	50.765
Moderate Fitbit Use * Time		2.221	1.1823	-.096	4.538	3.529	1	.060	9.218	.908	93.544
No Fitbit Use * Time		0[b]	.	.	.	.	.	.	1	.	.
(Scale)		1[b]									

Dependent Variable: Self-Reported PA

Model: (Threshold), Time, Level of Fitbit use, Level of Fitbit use * Time

For those with low self-reported PA (the reference group) and low reported Fitbit use, which is the reference group for Fitbit use, the tendency was for the individual to drop in reported level of PA over each time interval (odds ratio = 0.108, $p < .01$). In other words, participants with low self-reported PA and low Fitbit use tended to decrease in self-reported PA over time. Those with high Fitbit use at the beginning of the study (one week after device setup) reported low levels of PA (odds ratio = 0.008, $p < .01$), holding all other variables constant. For moderate Fitbit users, the results were not significant ($p > .05$).

Over time, however, high Fitbit users reported increased PA. For high Fitbit user, the odds ratio is 9.853, $p < .01$, holding all other variables constant. This suggests high Fitbit users were 9.9 times more likely to be in higher versus combined lower categories of PA at two weeks after setup compared to their peers who were not Fitbit users, holding all other variables constant. Moderate Fitbit users were 9.2 times more likely to be at higher versus combined lower categories of reported physical activity than their peers who were not Fitbit users, holding all other variables constant. However, this was not significant for moderate Fitbit users.

To get even more insight into these results, I checked against a crosstabulation table (Table 22). Here, several points can be made:

1) One week after device setup, participants were less likely to be in the high PA category than the combined lower categories. For the totals at this time, 9 were in the high category against 18 in the combined lower categories. This is why the time coefficient is negative (-2.221, $p < .01$).
2) One week after device setup, high Fitbit users were significantly less likely to be in high versus combined lower categories. Among high Fitbit users, only 6 were in the high PA category, while 11 were in the combined lower categories (i.e., 9 in moderate and 1 in low).
3) Also at one week after device setup, the low-Fitbit-use participants were much more likely to report low PA (i.e., 6 out of 8 people).

4) Two weeks after device setup, high Fitbit users were more likely to be in moderate and high categories of PA compared to the reference group.

5) Three weeks after device setup, moderate and high Fitbit users were more likely to report higher PA than lower activity.

Table 15

Results: Crosstabulation of Self-Reported PA and Level of Fitbit Use

Time			Level of Fitbit use			Total
			1.00	3.00	4.00	
1 week after device setup	Self-Reported PA	Low	6	1	1	8
		Mod	1	0	9	10
		High	1	2	6	9
	Total		8	3	16	27
2 weeks after device setup	Self-Reported PA	Low	0	1	3	4
		Mod	1	1	4	6
		High	1	0	4	5
	Total		2	2	11	15
3 weeks after device setup	Self-Reported PA	Low	0	1	0	1
		Mod	1	0	7	8
		High	3	2	3	8
	Total		4	3	10	17
Total	Self-Reported PA	Low	6	3	4	13
		Mod	3	1	20	24
		High	5	4	13	22
	Total		14	8	37	59

Qualitative Analyses

To get more insight into the participants' experiences, I looked at encounter notes taken on each participant throughout the study (n = 29), open-ended responses to questionnaires (n = 15 to 17), and phone interviews with the participants (n = 10) and the physicians (n = 2) involved in the study. A professional medical transcriptionist transcribed these interviews, which I corroborated. Using this data, I wrote short narratives for each participant. Through this analysis, several themes from emerged: issues with technology, extended behavior, reactions from others, goal setting, and physician communication.

Issues With Technology

Participants encountered difficulties with technology, such as email, that affected participation in the study as well as using the Fitbit devices. Encounter notes, open-ended responses, and phone interviews revealed that 59 percent of participants mentioned issues with technology. These issues included: accessing email, completing questionnaires online, setting up the wearable health monitors, charging the health monitors, and having support.

Accessing Email. Of those participants who experienced technological issues, 29.4% noted issues with accessing email. These issues included not remembering passwords to open email and not remembering email addresses. For example, one participant asked that I send her text messages or snail mail for correspondence because she did not know how to open the email application on her phone. She also does not use email regularly on her computer because she does not know her password and does not know how to reset it.

Completing Online Questionnaires. Of participants who experienced technological issues, 17.6 percent noted issues with completing online questionnaires. For example, one participant wanted me to mail her paper copies of the questionnaires. However, she was able to enlist her son's help so that she could take them online. Another participant asked if I could read each question to her over the phone because she was not sure that she would be able to answer them online.

Setting up Device. Of participants who experienced technological issues, 64.7 percent noted issues regarding setting up the device (nearly 38 percent of total participants). Some of these participants were able to set up accounts on Fitbit.com, but they were not able to sync the device to their accounts. In walking through device setup with one participant, she was unable to sync her device because she did not know or understand how to turn her Bluetooth on and pair devices.

Charging. Nearly one-fourth (23.5 percent) of participants who experienced technological issues noted problems with charging the device. For some participants, this was a frustration with the frequency of charging. For example, one participant mentioned the frequency of charging and the difficulty of physically putting the device back on her wrist. She said, "*The only part I don't like is having to charge it. Cuz then you gotta take it off and then you know, charge it. And then when you putting in the battery, and taking out the battery is hard, and putting in the battery is a pain in the butt, and then to clamp it on. I can't do it myself, you know. I have to have someone do it, you know. My son, my son, my 20-year-old usually do it really fast, but my husband can't do it. He can't put it on for me. It's too hard. That's the only problem: When you charge it you're losing all the input, too, you know what I mean*."

Extended Behavior

In phone interviews, 40 percent of participants discussed how the wearable health monitors influenced them to extend their behavior into related activities. Related activities included other forms of exercise and social activities. For example, one participant said, "*It* *motivated me to like really get out there and walk more and I haven't logged it, but I just started doing the small weights that I have. I have ankle weights and these little dumbbells that I am starting off small cuz I want to work with my body shape and, you know, my leg shape and stuff like that and stamina… I'm trying to take kickboxing, too. It's something that I've always wanted to do*."

Another participant mentioned an influence on both physical and social activities. She said, "*It got me to be more physically active. .. Like, oh, go to the park and just walk with my boyfriend, so I got him into like being physically active, too. Or just getting out of the house, so that was fun. … I'll make him get one."*

Reactions From Others

In phone interviews, more than half (70 percent) of participants mentioned being motivated by reactions they received from others. These motivations included experiencing reactions from people who saw their devices in-person, getting "cheers" from individuals in extended social networks through the mobile application, and being aware that someone else could see their activity. One participant said, "*Actually, so my Auntie had a group going and she actually scolded me yesterday about not reaching my goal one day. Then she was like 'Oh, you need to reach your goal.' Then I explained to her that I did have a funny like sensation when I wear watches and rings and necklaces. So, I have a habit of taking it off. But, I mean, it's not that the device itself was uncomfortable, like, I'm not used to wearing things, like watches and… but, yeah, you know, that was a good thing, you know, someone actually was paying attention to my progress. Not you, but like my Auntie, and my other Auntie in Texas, like a totally different state. Just motivating each other."*

Goal Setting

Participants mentioned that being able to see and monitor progress toward goals served as a motivating factor in using the wearable health monitors. In phone interviews and encounter notes, 70 percent of participants mentioned goal setting. One participant sent an unsolicited text message during the study, "*Cheehoo! Girl 10493! Steps; Plus I was active for 30plus and I did 4miles! This Fitbit is my best friend! Thank you!" Another participant said, "Goals and realistic. I mean, writing them down on a piece paper is something, but then putting it on your phone and actually having something that reminds you. That's a little more tangible, I guess you would say."*

Physician Communication

Fifty percent of phone interviews mentioned how the wearable health monitor influenced or changed communication with physicians. Participants discussed using the device information to provide a sense of proof to physicians that they are following orders. Other participants discussed opening up the conversation to other topics. One participant said, "*It kinda overlapped and even the, 'cause I'm seeing a gastroenterologist, also. … I was trying to explain to her about the Fitbit and how, you know. She might not believe me if I tell her I'm exercising. But if can show her, you know… it helped. … She was happy. I'm not sure whether she thinks I'm not exercising or gotten lazy, but you know, it's a sign that I'm headed in the direction that she wants me to go in. … it seemed like more back and forth than just her thing, like a routine kind of thing, but it seemed more back and forth conversation about what's going on and what we're gonna do from here."*

Another participant talked about how the use of the device and conversation regarding it may have helped her relationship with her physician. She said, *"I was starting to feel like I* *wasn't getting enough care from the doctor and, you know, like or motivation or anything to do anything different about my weight, you know, about helping my weight loss and stuff. … But then I really got down and talked to her about everything that's been going on, you know ever since I started using the Fitbit and the changes I've noticed and stuff and then she was like, you know, oh she was very happy, you know and she encouraged me more and I was able to open up more to her."*

Physicians were also interviewed and both discussed thoughts about patients who use wearable health monitors and communication in office visits. They mentioned seeing promise in including this type of information in office visits through extending the conversation and also through perhaps helping to detect some health issues. They also mentioned, however, that communication may have been unaffected by use of the device because of already established relationships with patients. One physician said, "*[Fitbit use] can open up more of the conversation, not just stay focused. Because it's usually whatever they just came in for and they are seen for. Therefore, I treat you with this and that. Even if I add anything else I definitely won't talk about lifestyle, unless they we talking about, you know, diabetes, which should be part of the counseling. But for regular, especially for new patients, we usually don't have enough time to talk about every single… definitely, you know, a complete discussion."* She continued, "*it somehow opened my perspective in terms of, ok, I can improve my practice because you know I shouldn't just think that you know, [lifestyle topics are] not important or not important for that specific visit. I should take advantage of every visit*."

CHAPTER 6: DISCUSSION

This chapter presents a summary of the study and major conclusions drawn from the results. It discusses implications for both theory and practice, and it concludes with recommendations for future research.

Study Summary

Overview of the problem. The use of wearables for health reasons is growing at a rapid pace (Zweig et al., 2017), especially due to the increasing support from employers, insurers, and health providers (Dans, 2018). Much of the promise of these wearables lies in the intersection of seemingly low barriers to entry and their potential to improve health outcomes (DiFrancisco-Donaghue et al., 2018). At the same time, the Filipino community as a whole is in need of more health research (dela Cruz et al., 2002). Due various factors, studies have shown that individuals in this community are more susceptible to chronic conditions like hypertension (Ye et al., 2009) and diabetes (Karter et al., 2012). Improving chronic conditions often involves action on the part of the patient through health behavior change (Department of Health and Human Services, 2008). Related to this is effective physician-patient communication. Successful physician-patient communication has been shown to improve health outcomes through factors such as better treatment adherence, enhanced understanding of medical advice, and improved information recall of physician instructions (Cegala et al., 2001; Harrington et al., 2004; Ong, et al., 1995). Physician-patient communication may be improved with increased patient participation through enhancing patient self-efficacy (Cegala et al., 2007). Wearables incorporate features that enhance individual factors related to health behavior change, such as self-efficacy. Because self-efficacy can often extend from one behavior to a related behavior (Bandura, 1977), wearables show promise at helping to improve individual health through enhancing patient participation in medical visits and thus physician-patient communication and health outcomes overall. While scholars in the past have studied patient participation in medical visits, few if any have done so in a way that has incorporated the use of wearables.

This purpose of this study was to examine the influence a wearable might have on patients and physicians in a predominantly Filipino community. It builds on previous studies, which have explored factors related to patient participation in medical visits (Barrier et al., 2003; Cegala et al., 2012; Cegala et al., 2013; Cegala et al., 2001; Cegala et al., 2000; Cegala et al., 2007; Gruman et al., 2010; Harrington et al., 2004; Ong et al., 1995; Street et al., 2007; Street, 2013; Street & Millay, 2001). Based on the literature review, this study focused on the exploring two major research questions: **(RQ1) How does a wearable influence self-efficacy?** and **(RQ2) To what extent does patient use of a wearable affect physician-patient communication?**

Review of the methodology. To explore these questions, this study employed the use of a quasi-experimental field study with multiple observations and measurements. It administered online questionnaires, evaluated data gathered through a wearable device, recorded and coded medical appointments, and analyzed phone interviews and encounter notes. Results were analyzed both quantitatively and qualitatively. Quantitatively, research questions were tested using ordinal logistic regression and correlations, where appropriate. Qualitatively, themes emerged from an analysis that involved writing narratives for each participant and evaluating open-ended responses, interviews, and encounter notes. See Figure 1 (page 26) for an overview of the measurements, the major constructs related to the measurements, and the research questions they were meant to address.

Research Findings

Through the methods described above, I was able to get more insight into the study's major research questions, which are discussed in more detail in this section. For a summary of major research findings, please see Appendix L.

RQ1: How does use of a wearable influence self-efficacy? To explore this question, I had to look first at how participants used the wearable. This study suggested that use varied across participants. While data showed that participants tended to increase in Fitbit use over the course of the study, how they used the wearable was limited to basic functionalities. Further, more than half of participants experienced issues with the technology including problems with email, trouble setting up the device, and difficulties with charging the devices.

In relation to PA, self-reports did not significantly correlated with Fitbit-reported PA across several measurements. This suggests that there may be a disconnect between the perceptions of engagement in various levels of PA and output of measurement using a wearable device.

The wearable used in this study, The Fitbit Flex, came with features that are associated with enhancing self-efficacy. These include allowing users to set and track tailored goals (Kreuter & Wray, 2003; Lustria et al., 2013, Croteau et al., 2007; Talbot et al., 2003; Wang et al., 2016), connecting users to a social network of peers who can encourage them along the way (Donath, 2007; Granovetter, 1983; Rogers, 2003), and giving users the opportunity to participate in competitions (Bandura, 1977; Mouton & Roska, 2015). It should have followed, then, that high users of the wearable would also have increased self-efficacy. However, the study found that there were no significant effects on general health self-efficacy or on PA self-efficacy. There are several potential explanations for this. The duration of this study may have been relatively short for a change in self-efficacy to take place. Further, statistical power was limited due to a small sample size. Another potential explanation for non-significant changes could be a result of the participants tapping only the basic functions of the devices, such as tracking steps. Only one participant took advantage of more advanced functions, such as connecting to a social network and participating in competitions. These more advanced functions of the devices are where much of the efficacy-enhancing mechanisms lie. These mechanisms enhance constructs related to self-efficacy and intrinsic motivation, such as social comparison (Deci, 1985), increased observability (Rogers, 2003), social supernets (Donath, 2007) and the strength of weak ties (Granovetter, 1973).

RQ2: To what extent does patient use of a wearable affect physician-patient communication? To explore this question, I looked more closely at physician-patient communication in a medical visit. While patient participation and physician information provision were positively and significantly correlated, there were no other statistically significant relationships with patient participation. Participant use of a wearable was not related to participation. This may have been due to a number of factors. First, based on analyses from Research Question 1, the study found no significant changes in self-efficacy based on use of the wearable. Self-efficacy has been shown to have positive effects on improving patient participation in medical visits (Cegala et al., 2007). However, because the wearables in this study did not produce significant changes in participant self-efficacy, they cannot be expected to show significant results in the medical visit.

Further, it can be assumed that these participants already had existing relationships with the physicians. These participants were recruited with help from the physicians' staff. These personnel recruited participants based on the study criteria, but also based on their personal knowledge of the patients. Patients were selected based on judgments of their reliability to not only participate through the duration of the study, but also on their likelihood to return for their follow-up visits. Transcriptions of both medical visits and phone interviews also showed that the physicians and participants had longstanding, preexisting relationships with already established patterns of communication. It is unclear whether a wearable device, whether successful or not at enhancing self-efficacy, would significantly change communication patterns in these cases, especially without further interventions, such as training on the part of patients and/or physicians and increased time in encounters in which to have these discussions.

Additional analyses also gave insight to other themes present in the study. One notable theme was that of digital literacy. Having access to the Internet and smart phones does not equate to understanding how to use these devices. As Van Deursen and Van Djik (2014) suggest, the digital divide is shifting from a question of access to a question of usage. This was evident in this study. All participants had access to regular Internet and smart mobile devices, and yet they varied in their understanding of technological features related to the initial setup of the device and in their use of basic versus advanced features. The digital literacy issues were not limited to participants in an older demographic. This may be due to the presence of a support person in these instances. Having a support person present can help to reduce the uncertainty associated with the device and increase the potential that it will be adopted (Rogers, 2003). Social support may also help to enhance an individual's perceptions regarding subjective norms ("the perceived social pressure to perform or not perform a certain behavior") surrounding the technology and further persuade the individual to adopt (Ajzen, 1991, p. 188). Participants who mentioned having a support person that they typically turn to, such as another family member, were in the age range of 45 to 64 years old. Participants in this same age demographic also accepted my assistance when offered. On the contrary, participants in younger demographics did not mention having a support person to help them with technological issues, and only one expressed a willingness to accept my assistance (although she did not end up setting up her device after we talked). This suggested that participants in older age demographics may be more willing to accept help with technology than participants in younger demographics. Having social support when adopting technology may aid in adoption decisions and overall success in adoption. Courtois and Verdegem (2016) echo this sentiment in their emphasis on social support in social learning of digital sources. Sun and Rau (2015) also point to social support as a major factor in their discussion of the acceptance of personal health devices.

Limitations

Due to the longitudinal design (extending two to three weeks for individual participants), participant dropout was a risk. This was evident through decreases in questionnaire responses, limited phone interviews, and just slightly more than half of participants attending medical appointments. (See Appendix K for a summary of data collection throughout the study.) This may have been symptomatic of the duration of the study and/or of the setting in which the study took place. In a low-SES community, the community practices studied typically relied on walk-in visits versus scheduled appointments. According to the physicians, the majority of their patient panels use Medicare or Medicaid for their healthcare insurance, and physicians are unable to penalize patients who do not show up for appointments. They noted that "no-shows" are typical, so rather than scheduling patients, they see patients on a first-come, first-served basis. According to office staff and observations while on site, this often results in patients lining up outside of the offices, waiting for several hours to be seen. If the wait is too long, patients will either come back another day or not at all. Whether this contributed to participant dropout in the study is unknown.

While the duration of the study may have influenced factors like participant dropout, an even longer duration with the Fitbit devices may have been necessary to assess the effect of the device on patient health self-efficacy. This is echoed in Coughlin and Stewart's (2016) call for longer study durations of consumer wearables in their review of wearable studies in which they noted study durations that ranged from 6 weeks to 24 months. In this study, participants may have needed more time to fully utilize the devices in ways that might influence constructs such as self-efficacy.

Another limitation was sample size. Limited resources and other factors (discussed here) resulted in a small sample of both patients and physicians. A low number of patient participants limited statistical power and also limits generalizability to other populations. In terms of physicians, this study included only two physician practices. This was due to difficulties in recruiting community physicians (the study added workload on their practices by requiring the help of office staff) and limited funding to conduct the study. Community physicians provide much service to populations such as these, but they are often difficult to recruit for research purposes (Asch, Connor, Hamilton, & Fox, 2000). Asch et al. (2000) attribute some of this difficulty in recruitment to time and resource constraints put on the physicians and their staff, and these difficulties were reflected in physician recruitment in this study as well. Future studies should employ the use of additional resources to recruit more physician practices and patient participants. While these limitations put constraints on the statistical power of the study's quantitative results and generalizability of the study findings to the community population, the rich detail of the study provides significant insights to inform larger-scale studies in future.

Conclusions

This study evaluated patient use of a wearable device and looked at how that use related to self-efficacy and physician-patient communication in a rural, predominantly Filipino community on Oahu, Hawaii. This section will discuss the implications for theory and the implications for practice deduced from this study's major findings, as well as suggestions for future research and concluding remarks.

Implications for Theory

The literature review led to research questions regarding the use of a wearable and factors that related to physician-patient communication in a medical visit. This research has found that although these devices employ features that may theoretically enhance self-efficacy, actual use of the devices may differ from expected use, even when users have regular access to Internet and smart mobile devices. These participants were positioned to successfully adopt the devices: They were already engaged in taking steps to improve their health, as evidenced by their actions to not only attend their medical appointments but also in their plans to attend follow-up visits. According to Prochaska et al. (2003), individuals who are most likely to successfully adopt a health behavior change are those who are already prepared to take action. Adopting the device, theoretically, should have led to enhancements of participants' self-efficacy, based on the features included in the device. However, this outcome was not evident in this study.

Even though users of the device increased their use throughout the study, they did not take advantage of more advanced efficacy-enhancing features offered by the device. Rather, most participants limited their use to tracking steps on an individual basis. This suggests that social support, social comparison, competition, and other extrinsic motivators may play a larger role in these devices at enhancing self-efficacy than do individual factors. Features of these devices that do not require participants to tap into extended networks may have less power at enhancing self-efficacy than a combination of the two.

Previous studies of physician-patient communication have shown that patients with higher self-efficacy tend to participate more in the conversation, which leads to increased information provision by the physician. In this study, while higher levels of patient engagement in a medical visit was reciprocated by physician information provision, it did not follow that these were participants with high self-efficacy. Preexisting, already established relationships with physicians may play a larger role in communication patterns than self-efficacy.

This is not to say, however, that the use of a wearable had no effect on physician-patient communication. Similar to a previous study's findings that physicians viewed wearables as potentially enhancing communication with patients by providing a burden of proof of patient adherence as well as patient engagement with health (Loos & Davidson, 2016), the current research results suggested that physician-patient communication could be improved with patient use of a wearable by way of extending the conversation into otherwise rarely addressed topics such as lifestyle choices. Considering the propensity for individuals in the Filipino community for chronic conditions such as hypertension (Ye et al., 2009) and diabetes (Karter et al., 2012), including lifestyle choices into regular office visit discussions could potentially improve health outcomes.

Based on these findings, the research model of this study should be extended to allow for some of these more intricate factors to be included and to perhaps focus less on other constructs. See Figure 1 for the original research model for reference (page 26). In the extended model, use of the wearable should be specified to account for differences in use of specific features of the device. Use of advanced features, such as participation in competitions and connection to social networks, may show more promise in enhancing self-efficacy and allowing participants to open up themselves to social comparison. This in turn, could suggest an increased willingness to discuss health behavior with others. Self-efficacy should be more focused to specify behaviors. For instance, rather than including general-health self-efficacy, self-efficacy in an office visit should be used instead. This more specific self-efficacy construct might inform patient participation in the discussion in the medical visit. Measuring topics discussed will allow for an exploration of whether discussions defer from the intended purpose of the visit to include additional topics, such as lifestyle choices. An increase in topics discussed should theoretically lead to an improved physician-patient communication experience based on higher levels of both patient participation and physician information provision. As a result, health outcomes in the form of health behaviors should be measured as well. Constructs that contribute to health behaviors include patient engagement and PA. Methods should include more qualitative data gathering procedures to allow for participants to share their experiences in-depth. The revised research model is shown in Figure 5.

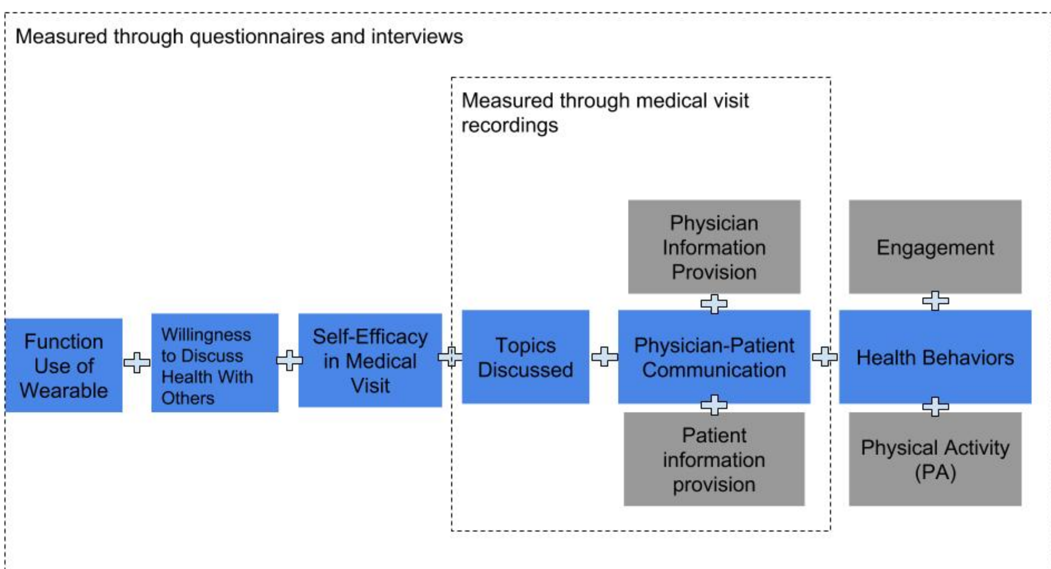

Figure 5. Extended research model based on research findings.

Implications for Practice

This study evaluated how an underserved, predominantly Filipino population might adopt a wearable and how that adoption might influence physician-patient communication in a medical visit. This evaluation showed that there are many factors at play in the adoption of these devices in the first place. Digital literacy may be at the heart of whether these devices are adopted and whether advanced features of them are used. In this type of community, where issues with health are a big concern, wearables such as these may not be practical, even among a demographic assumed to have high digital literacy (younger aged individuals). As suggested by previous research, social support may be of growing importance when it comes to the adoption of technology (Courtois & Verdegerm, 2016). A broader view of technology adoption should be taken to move from individual use to considerations of use among the population. Assumptions about ease of use and actual use should not be taken for granted.

Much of the promise of these devices is for them to extend into health arenas by providing individuals with information about their own health and allowing them to extend that information sharing into medical visits. This study showed that in practice, physicians and patients can use the devices as monitoring tools. They can serve as seemingly objective measures of PA that give patients a source of proof for the physician that they are following orders and taking steps to improve their health. They may also provide a more realistic self-assessment for PA as well. Additionally, wearables such as these can extend into the medical visit in other, unforeseen ways. Participants noted a heightened awareness to their health, which played into some conversations with physicians. This could play into practice by way of opening up the medical visit conversation to topics otherwise not discussed, like lifestyle choices.

Another insight gleaned from this study is that patient expectations of physician-patient communication in this community may inform patterns of interaction. In both practices, physicians accepted patients based on walk-in visits rather than scheduled appointments, which were minimal. This was due to acceptance of Medicare and Medicaid patients, which comes with the caveat that patients utilizing these forms of insurance cannot be penalized for failing to show up for medical appointments, according to the physicians studied. This suggests that in community practices such as these, patient engagement is more informal, unplanned, and often disruptive. This is not a smooth set of interactions, especially for this community. Engagement of office staff and the community is of importance when studying this population. As Asch et al. (2000) note, for many researchers, relationships with community physicians may be a precursor to inclusion of their practices in studies.

If providers are willing to accept patient sharing of information, then they, too, should be educated on the devices. As Ong et. al (1995) discuss, communication in office visits is of utmost importance in influencing the health of individuals, and the time spent on these discussions is limited. In these visits, providers must attend to the primary reason for the visit while also attending to creating or maintaining a relationship with the patient. Incorporating additional topics as a result of wearable use will require training on the part of the provider in order to ensure that these discussions do not compromise the duration of the visit. Providers should be encouraged to implement lifestyle questions into their discussions and to inquire about health behaviors if/when they notice a wearable on a patient.

Suggestions for Future Research

This study provides an understanding of critical issues that may help to inform future studies with longer-term investigations and increased resources. This was an exploratory, in-depth study that helped to inform an understanding of the challenges faced in a low-income, low-literacy Filipino population. Wearable devices may be helpful at improving health in some contexts, such as DiFrancisco-Donaghue et al.'s (2018) study among future physicians, but a low-SES community with individuals who have a propensity for chronic conditions might reap greater benefits. This study can be seen as a standard approach to this topic. Future research should build upon the framework presented here in the extended research model. It should incorporate mechanisms to explore in more detail why and how individuals adopt wearable devices and, further, how they are using them. This should include an examination of digital literacy as it pertains to the usage aspect of the digital divide.

The population of interest, Filipinos in a rural community, could benefit from future research on not just technology use, but also on communication with physicians. Future research should go beyond the function of discourse units in medical visits to include characteristics about the nature of the subject matter discussed. This will give insight into whether and how wearables may be extending the conversation into related topic areas, such as lifestyle choices. Future research should consider cultural dimensions, such as power-distance, when evaluating patterns of communication in office visits in this population.

Methodologically, future studies should incorporate the use of control groups in order to compare patients who use wearables to patients who do not. A higher number of physician practices and patient participants should also be used in order to increase statistical power and generalizability to the population studied. Comparative studies in higher-SES communities may also lend insight into how those patient panels may differ in both wearable use and physician-patient communication from patient panels in low-SES, predominantly Filipino communities.

Final Remarks

This study explored the ways in which a wearable might influence self-efficacy and physician-patient communication. It found that, for a sample in a rural, predominantly Filipino community, adoption of these devices is not uniform or without difficulty, even when participants have access to the necessary components to successfully adopt them. There is much to be explored in terms of whether and how individuals in this community adopt these devices and whether this adoption would be useful. Devices such as these may show promise, but how these devices are actually used may lend insight into whether they could be useful, especially for this group.

APPENDIX A: PHYSICIAN STAFF SCRIPT

Good afternoon, this is [staff's name] from Dr. [insert name's] office. I am calling you because you are scheduled for an appointment on [insert date]. We are working with a researcher, Joanne Loos, from the University of Hawaii at Manoa, who is doing a study on walking, physical activity, and health communication. You're being invited to participate because [insert physician's name] has agreed to participate, and you are a patient. The project will run over two to three weeks. During this time, Joanne will ask you to take online surveys, track your health behavior, and allow her to audio record your appointment. All of your data will be held confidentially and will not be reported in ways that identify you as an individual.
Your participation in this study is completely voluntary, and in no way affects your relationship or your appointment with Dr. [insert name]. As compensation for your participation in the study, Joanne will give you a device worth $100 and a gift card worth $25. Would you be open to Joanne contacting you to give you more details about the project?

[If yes] Thank you. I will pass along your contact information to Joanne, and she will be in touch with you shortly. What is the best day/time for her to call?

[If no] Thank you. I appreciate your talking to me today and will see you at your scheduled appointment.

APPENDIX B: RECRUITER SCRIPT

Hi, my name is Joanne Loos, and I am from the University of Hawaii at Manoa. [Insert name of staff member] said that it would be OK to call you. The reason I am calling you is because I would like to invite you to take part in a research study on walking and health communication. You're being invited to participate because your physician, Dr. [insert name] has agreed to participate, and you are a patient of his/hers. We will ask you to track your health and fitness activities through the use of a Fitbit in the two weeks leading up to your scheduled well visit with Dr. [insert name]. Your participation will include taking several surveys, which I will send to you through email and text message. Each survey should take approximately 5-10 minutes to complete. You will get one at the beginning of the study, two in the two weeks leading up to your appointment, one shortly before your appointment with Dr. [insert name] and one after. Another part of the study will consist of an audio recording of your appointment to analyze how patients and physicians talk to each other about health and wellness. The final part of the study will consist of a telephone interview with me after the other portions of the study have been completed. I will not share any personally identifiable information with others, and the data I collect will be analyzed and reported in such a way that it will not be identifiable to you.

Is this study something you might be interested in?

If yes, I have some qualifying questions for you.

(1) Are you between the ages of 18 and 65?

(2) Do you have regular access to both the Internet and a smart phone?

(3) Do you have an appointment scheduled within [specified dates] that you expect to keep?

(4) Are you a current user of a wearable fitness device, like a Fitbit, Jawbone, or Garmin?

[If answers to questions 1-3 are yes, then proceed to next paragraph. If any answers are no, or if question 4 is yes, then continue in this paragraph.] Thank you. Unfortunately, you do not fit the requirements for this study. I appreciate your time, and hope you have a good rest of the day.

Because this is a study on walking and physical activity, I have some additional questions to ensure that it is safe for you to increase your physical activity:

- Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
- Do you feel pain in your chest when you do physical activity?
- In the past month, have you had chest pain when you were not doing physical activity?
- Do you lose your balance because of dizziness or do you ever lose consciousness?
- Do you have a bone or joint problem that could be made worse by a change in your physical activity?
- Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
- Do you know of any other reason why you should not do physical activity?

[If patient answers yes to any of these questions] As a precaution, I would like to ask Dr. [insert name] if it is safe for you to continue as part of this study. Is that OK? [If yes, then proceed to ask Dr. if it is OK and contact patient with decision. If no, then read previous paragraph thanking them for their time but letting them know they do not fit the requirements.]

[If patient answers no to all of the questions, proceed to next paragraph.]

Great! As a thank you for your participation, I will give you a Fitbit that is worth approximately $100. This Fitbit will be used as part of the study, so I will ask that you wear it. You may keep it once the study is done, and do with it as you please. As an additional thank you for your participation, I will give you a $25 Amazon gift card upon completion of the study.

May I please have some of your contact information so that I can send you the next steps for the study? I will be sending you links to the online questionnaires. What is your email address? What is your mobile phone number? When I send the surveys, do you prefer email, text message, or both?

Thank you. I will be in touch soon with the first questionnaire. When you receive the link, please take the survey within two days. The first pages of the survey will include a form that describes your potential risks and benefits to participating in the study. Should you have any questions or concerns at any time, please feel free to contact me. My phone number is 440-864-1901, and my email address is JOANNEDR@HAWAII.EDU. Thank you!

APPENDIX C: INFORMED CONSENT – PATIENTS

COLLEGE of SOCIAL SCIENCES
UNIVERSITY of HAWAI'I at MĀNOA

Greetings! Thank you for agreeing to take part in this study. In the next few pages, you will see three things: First, you will read a short statement regarding the study as well as the benefits and risks of participating. If you consent to participate in the study after reading this description, please proceed to the next section of the survey. Second, I will ask you to respond to a few questions about your health and wellness goals and activities.Third, I will ask you to provide some demographic information to help me to analyze the results of this study across all the participants.The survey should take you about 10 minutes to complete. If you are taking the survey on your mobile phone, it is best viewed in landscape mode (with the phone turned horizontally). Mahalo!

Consent to Participate in Research

Physical Activity and Health Communication

My name is Joanne R. Loos. I am a graduate student at the University of Hawaii at Manoa in the Communication and Information Sciences program. As part of the requirements for earning my graduate degree, I am doing a research project.

This is a study on walking, physical activity, and health communication, and potential ways of improving it. I am asking you to participate because you are between 18 and 65 years of age, have reliable access to the Internet, own a smart phone, can safely increase your physical activity, and are a patient of Dr. [insert name here] scheduled for an appointment.

Activities and Time Commitment: The first part of this study consists of the following survey. It should take you approximately 10 minutes to complete. The remainder of the study will consist of four more surveys (which take about 5 to 10 minutes to complete and will all be distributed online), an audio recording of a visit with your physician, and a telephone interview after that (which should take about 10 to 15 minutes).

Another part of this study entails the use of a wearable fitness device, the Fitbit Flex. I will mail the Fitbit to the address you have provide to me at the end of this survey. Included in the package will be instructions for setting up your Fitbit. I will gather data from your Fitbit through a software platform called Fitabase. I will use the email address you provide and give you a password for you to use when setting up your account. This will give me access to the data that you create while using your Fitbit. This may include the step goals you set, the number of steps you take each day, the hours of sleep you get at night, and any additional information you set up your Fitbit to collect. It will not give me information about your location, your heart rate, or any information that you cannot see from your own Fitbit dashboard. Upon the conclusion of this study, the software will stop collecting your data, and I will no longer be able to see any data you create. However, as an extra layer of protection, please change your password once the study is over. For more information on Fitabase's use of your data, including the steps the company takes to protect it, please visit https://www.fitabase.com/Privacy. The Fitbit organization will also have access to the data you create through the use of the device. In addition to the behavioral information that Fitabase will allow me to see, the Fitbit organization will also be able to see when you activate your device, when you create an account, when you sync your device, and when you contact the organization for support, among other things. I will not have access to this data. For more information about the types of data Fitbit collects and how they use it, please visit https://www.Fitbit.com/uk/legal/privacy.

Benefits, Risks, and Compensation: There will be no direct benefit to you for taking part in this project. However, it may result in increasing your physical activity. The findings from this project may help to create a better understanding of health communication. The findings will also help to inform future research projects I plan to undertake as a researcher. The risks involved with your participation include a potential loss of privacy, particularly because the Fitbit will track your activity, as well as the possibility of a rash development from the use of the device. If a rash occurs, please remove the device. Then, visit the Fitbit product support page for information on wearing the band comfortably: https://www.Fitbit.com/productcare. You may also contact me or the Fitbit support team for further assistance. You may also stop wearing the device at any time. If, at any time, you suffer any adverse effects as a result of wearing the Fitbit or increasing your physical activity, please stop and notify your physician. In exchange for your participation, you may keep the Fitbit Flex device and you will also receive a $25 Amazon gift card.

Privacy: I will ask you for personally identifiable information, such as your name and email address. This information will not be shared with anyone, will be kept private throughout the study, and will be deleted after completing data analysis for the study. Information you provide and information from the recorded physician visit will be coded into categories for analysis and reported anonymously or in aggregate in research reports.

Voluntary Participation: You can freely choose to take part or to not take part in this study. There will be no penalty or loss of benefits for either decision. If you do agree to participate, you can stop at any time.

Questions: If you have any questions about this study, please call or email me at 440-864-1901 or joannedr@hawaii.edu. You may also contact my adviser and coauthor, Professor Elizabeth Davidson, at 808-956-6657 or edaviso@hawaii.edu. If you have questions about your rights as a research participant, you may contact the UH Human Studies Program at 808-956-5007 or uhirb@hawaii.edu.

To Access the Survey: Please click on the arrow button below to begin the survey. Completing this and future surveys will be considered as your acknowledgement that you are at least 18 years old and that you consent to participate in this study.

Thank you for your time,

Joanne R. Loos

Doctoral student, Communication and Information Sciences program

University of Hawaii at Manoa

Please print a copy of this page for your reference.

APPENDIX D: PRETEST QUESTIONNAIRE

To begin, please rate your level of agreement with the following statements:

	Level of Agreement						
	Strongly Disagree	Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Agree	Strongly Agree
In general, I am hesitant to try out new information technologies.	❍	❍	❍	❍	❍	❍	❍
I am confident I can have a positive effect on my health.	❍	❍	❍	❍	❍	❍	❍
I usually ask the doctor or nurse lots of questions during a medical exam.	❍	❍	❍	❍	❍	❍	❍

Among my peers, I am usually the first to try out new information technologies.	❍	❍	❍	❍	❍	❍	❍
I feel that I am in control of how and what I learn about my health.	❍	❍	❍	❍	❍	❍	❍
If I heard about a new information technology, I would look for ways to experiment with it.	❍	❍	❍	❍	❍	❍	❍

I have been able to meet the goals I set for myself to improve my health.	❍	❍	❍	❍	❍	❍	❍
I like to experiment with new information technologies.	❍	❍	❍	❍	❍	❍	❍
It is better to trust the doctor or nurse in charge of a medical exam than to question what they are doing.	❍	❍	❍	❍	❍	❍	❍

I have set some definite goals to improve my health.	❍	❍	❍	❍	❍	❍	❍
I am actively working to improve my health.	❍	❍	❍	❍	❍	❍	❍
I'd rather have doctors and nurses make the decisions about what's best for me than for them to give me a whole lot of choices.	❍	❍	❍	❍	❍	❍	❍

I usually wait for the doctor or nurse to tell me the results of a medical exam rather than asking them immediately.	❍	❍	❍	❍	❍	❍	❍

Many people report that it is more difficult to be physically active under some conditions than others. Please choose a circle with a number between 0 and 10 to show how certain or sure you are that you could be physically active under EACH of the following conditions over the next 6 months. Please choose a circle with a number for each of the items below using the following scale, with 0 meaning "certain I CANNOT do," 5 meaning "moderately certain I CAN do," and 10 meaning "very certain I CAN do."

	How sure am I that I could be physically active...										
	0 certain I cannot do	1	2	3	4	5 moderately certain I can do	6	7	8	9	10 very certain I can do
When I am tired?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
During or following a crisis?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When I am feeling depressed?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When I am feeling anxious?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When I am slightly sore from the last time I was physically active?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

When I am on vacation?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When there are competing interests (like my favorite TV show)?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When I have a lot of work to do?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When I haven't reached my physical activity goals?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When I don't receive support from family or friends?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

When I have no one to be physically active with?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When my schedule is very busy?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
During bad weather?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When it's too hot and sunny?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
Following complete recovery from an illness?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When there is housework to do?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When you don't have money?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

When you feel like you don't have the time?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When you have family or friends visiting you for the holidays or their vacation?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
When you have a job working at home?	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

❍ Days per week ____________________

❍ No vigorous physical activities

How much time did you usually spend doing vigorous physical activities on one of those days?

❍ Hours per day ____________________

❍ Minutes per day ____________________

❍ Don't know/Not sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

❍ Days per week ____________________

❍ No moderate physical activities

How much time did you usually spend doing moderate physical activities on one of those days?

❍ Hours per day

❍ Minutes per day

❍ Don't know/Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.   During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

❑ Days per week ____________________

❑ No walking

How much time did you usually spend walking on one of those days?

❑ Hours per day ____________________

❑ Minutes per day ____________________

❑ Don't know/Not sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.During the last 7 days, how much time did you spend sitting on a week day?

- ❍ Hours per day ____________________
- ❍ Minutes per day ____________________
- ❍ Don't know/Not sure

Next, I'd like to ask you some demographic questions. What is your gender?

- ❍ Male
- ❍ Female
- ❍ Prefer not to answer

Next, we'd like to ask about your ethnicity. Are you Spanish, Hispanic, or Latino (for example: Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin)?

- ❍ Yes
- ❍ No
- ❍ Prefer not to answer

What is your race/ethnicity? (Fill in all the circles / races that apply to you)

❑ American Indian

❑ Alaska Native

❑ Black or African American

❑ Chinese

❑ Filipino

❑ Japanese (includes Okinawan)

❑ Korean

❑ Native Hawaiian

❑ Other Asian (includes: Vietnamese, Thai, Cambodia, India, etc.)

❑ Pacific Islander (Includes Samoan, Tongan, Micronesian, Chamorro/Guamanian, etc.)

❑ Portuguese

❑ White

❑ Other (fill in) ____________________

❑ Don't know

❑ Prefer not to answer

What is your age?

❍ 18 to 24

❍ 25 to 34

❍ 35 to 44

❍ 45 to 64

Education: What is the highest degree or level of school you have completed? If currently enrolled, highest degree received.

- Some high school
- High school graduate
- Some college
- Trade/technical/vocational training
- College graduate
- Some post graduate work
- Post graduate degree

What is your main occupation?

Marital Status: What is your marital status?

- Single, never married
- Married or domestic partnership
- Widowed
- Divorced
- Separated

To conclude, I would like to ask for your name, phone number, and email address so that I may contact you for the remaining portions of the study. I will send you no more than one questionnaire per week for the remainder of the study. I will not share your information with others. What is your first and last name?

What is your mobile phone number (for text message notifications for the remaining portions of the study)?

What is your email address (for email notifications for the remaining portions of the study)?

What is your mailing address (so I can mail you the Fitbit and instruction)?

Street

City

Zip

APPENDIX E: PROCESS QUESTIONNAIRE

**Note: Although the text says that this is the second out of five online questionnaires, the text will change with the next process questionnaire, which will say "third." All other content will remain the same.*

Thank you for your continued participation. This is the second out of five online questionnaires for this study. I appreciate your feedback and your time. Please proceed to the next page to begin this survey, which should take you approximately 5 to 10 minutes to complete.

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

❍ Days per week ____________________

❍ No vigorous physical activities

How much time did you usually spend doing vigorous physical activities on one of those days?

❍ Hours per day ____________________

❍ Minutes per day ____________________

❍ Don't know/Not sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal.

Think only about those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

❍ Days per week ____________________

❍ No moderate physical activities

How much time did you usually spend doing moderate physical activities on one of those days?

❍ Hours per day

❍ Minutes per day

❍ Don't know/Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

❑ Days per week ____________________

❑ No walking

How much time did you usually spend walking on one of those days?

❑ Hours per day ____________________

❑ Minutes per day ____________________

❑ Don't know/Not sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.During the last 7 days, how much time did you spend sitting on a week day?

- Hours per day ____________________
- Minutes per day ____________________
- Don't know/Not sure

Next, please answer the following questions about your Fitbit use over the last seven days.

On a typical day, I checked the Fitbit tracker to see how close to my goal I have gotten:

- Very often
- Often
- Sometimes
- Rarely
- Never

I logged onto my Fitbit.com account:

- Every day (7 days/week)
- Most days (5-6 days/week)
- Some days (3-4 days/week)
- Rarely (1-2 days/week)
- Never (0 days/week)

Did you use the Fitbit mobile app?

- ❍ Yes
- ❍ No

If yes, how often did you use the Fitbit mobile app?

- ❍ More than once a day
- ❍ About once a day
- ❍ Few times per week
- ❍ Couple times per week
- ❍ About once per week
- ❍ Less than once per week

Next, please select how often you did each of the following activities:

	How Often Did You Do Each Activity?				
	Never	Rarely	Sometimes	Often	Very Often
Synced tracker to phone or Web	❍	❍	❍	❍	❍
Checked step progress	❍	❍	❍	❍	❍
Checked active hours	❍	❍	❍	❍	❍
Checked calories burned	❍	❍	❍	❍	❍
Checked active minutes	❍	❍	❍	❍	❍
Added other forms of exercise	❍	❍	❍	❍	❍
Input weight	❍	❍	❍	❍	❍
Logged calorie intake	❍	❍	❍	❍	❍
Checked calories left	❍	❍	❍	❍	❍
Logged water consumption	❍	❍	❍	❍	❍

Checked sleep	❍	❍	❍	❍	❍
Participated in competitions	❍	❍	❍	❍	❍
Checked progress of friends	❍	❍	❍	❍	❍

What were some of the positive experiences you had with your Fitbit this week?

What were some of the negative experiences you had with your Fitbit this week?

Please describe your overall experience with the Fitbit this week.

What is your first and last name? (To be used for data analysis only.)

APPENDIX F: FOLLOW-UP QUESTIONNAIRE

Thank you for your continued participation. This is the last online questionnaires for this study. I appreciate your feedback and your time. Please proceed to the next page to begin this survey, which should take you approximately 5 to 10 minutes to complete. At the end of the survey, I will ask you for information so that I can send you a gift card for your participation.

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport. Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

❍ Days per week ____________________

❍ No vigorous physical activities

How much time did you usually spend doing vigorous physical activities on one of those days?

- ❍ Hours per day ____________________
- ❍ Minutes per day ____________________
- ❍ Don't know/Not sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

- ❍ Days per week ____________________
- ❍ No moderate physical activities

How much time did you usually spend doing moderate physical activities on one of those days?

- ❍ Hours per day
- ❍ Minutes per day
- ❍ Don't know/Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

- ❑ Days per week ____________________
- ❑ No walking

How much time did you usually spend walking on one of those days?

- ❑ Hours per day ____________________
- ❑ Minutes per day ____________________
- ❑ Don't know/Not sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.During the last 7 days, how much time did you spend sitting on a week day?

- ❍ Hours per day ____________________
- ❍ Minutes per day ____________________
- ❍ Don't know/Not sure

Next, please answer the following questions about your Fitbit use over the last seven days.

On a typical day, I checked the Fitbit tracker to see how close to my goal I have gotten:

- ❍ Very often
- ❍ Often
- ❍ Sometimes
- ❍ Rarely
- ❍ Never

I logged onto my Fitbit.com account:

- ❍ Every day (7 days/week)
- ❍ Most days (5-6 days/week)
- ❍ Some days (3-4 days/week)
- ❍ Rarely (1-2 days/week)
- ❍ Never (0 days/week)

Did you use the Fitbit mobile app?

- ❍ Yes
- ❍ No

If yes, how often did you use the Fitbit mobile app?

- ❍ More than once a day
- ❍ About once a day
- ❍ Few times per week
- ❍ Couple times per week

❍ About once per week

❍ Less than once per week

Next, please select how often you did each of the following activities:

	How Often Did You Do Each Activity?				
	Never	Rarely	Sometimes	Often	Very Often
Synced tracker to phone or Web	❍	❍	❍	❍	❍
Checked step progress	❍	❍	❍	❍	❍
Checked active hours	❍	❍	❍	❍	❍
Checked calories burned	❍	❍	❍	❍	❍
Checked active minutes	❍	❍	❍	❍	❍
Added other forms of exercise	❍	❍	❍	❍	❍
Input weight	❍	❍	❍	❍	❍
Logged calorie intake	❍	❍	❍	❍	❍
Checked calories left	❍	❍	❍	❍	❍
Logged water consumption	❍	❍	❍	❍	❍

Checked sleep	❍	❍	❍	❍	❍
Participated in competitions	❍	❍	❍	❍	❍
Checked progress of friends	❍	❍	❍	❍	❍

What were some of the positive experiences you had with your Fitbit this week?

What were some of the negative experiences you had with your Fitbit this week?

Please describe your overall experience with the Fitbit this week.

What is your first and last name? (To be used for data analysis only.)

When is a good time/date for me to call you for the telephone interview portion of the study? The phone call will take approximately 10 to 15 minutes.

Thank you again for your participation in this study. You may keep the Fitbit and do with it what you please. I will no longer be collecting data from the device. I encourage you to change your password at this time. I will also send you a $25 Amazon gift card for your participation. This gift card will come in the form of an email from Amazon with a gift card code. What is the best email address to send this card?

APPENDIX G: PATIENT TELEPHONE INTERVIEW GUIDELINES

Note: These questions will be asked in an telephone interview. Therefore, the following questionnaire will serve only as a guideline for that interview.

Thank you for participating in the Physical Activity and Health Communication study. As you know, in this study I asked you to wear a Fitbit for a few weeks, answer a series of online questionnaires, and allow me to record your medical visit with Dr. [insert name]. I would like to ask you some questions about how you feel the study went and about your experiences.

One goal I had was to see how and whether the Fitbit might help you to increase your physical activity. What do you think about this idea? Did the Fitbit affect your physical activity?

How did you feel about the use of the Fitbit? Was it easy, hard?

How did others react to your use of the Fitbit?

What were some other feelings you had regarding the Fitbit?

Another goal was to see whether the use of the Fitbit would affect the ways in which you spoke to Dr. [insert name]. Did you feel like this visit you spoke any more or less than you normally would have? Why or why not?

What additional comments do you have regarding the Fitbit, your communication with Dr. [insert name] or the study overall?

APPENDIX H: INFORMED CONSENT – PHYSICIAN

Consent to Participate in Research

Health Communication

My name is Joanne R. Loos. I am a graduate student at the University of Hawaii at Manoa in the Communication and Information Sciences program. As part of the requirements for earning my graduate degree, I am doing a research project.

I am studying health communication, and potential ways of improving it. I am asking you to participate because you are a general practitioner/family practice physician with patients who are 18 years of age or older with smart phones and reliable access to the Internet.

Activities and Time Commitment: The first part of this study consists of recruiting your patients with the help of your staff. This would involve your staff making initial phone calls to patients who are scheduled for appointments within a date range agreed upon between you and me. I will provide scripts for your staff to read in these initial phone calls. They will be asking patients if they are willing to hear more about the study and if they give permission for me to follow up. Your staff will then give me the contact information of patients who have given their permission, and I will follow up with them from there. I will be asking your patients to take a series of online questionnaires, which will take them approximately 5 to 10 minutes each to complete. I will also be tracking their physical activity through information provided by them. The second part of the study consists of audio recording the medical appointment of participating patients (one per participant). This may involve assistance from your staff. I will anonymize the identities of you and your patients in the transcription of the audio recordings. When the study is done, I will destroy the recording. I will not be analyzing medical information. Instead, what I will be looking for are communication patterns. The third part of the study consists of an in-person interview with you, in which I will inform you of the preliminary study results and ask you about your reactions to the study overall.

Benefits, Risks, and Compensation: There will be no direct benefit to you for taking part in this project. This study may help give you insights into information technology, health communication, and the experiences of your patients to enhance patient engagement in their health and wellness. You may request a report of research findings and the recordings, if you would like. The findings from this project may help to create a better understanding of physician-patient communication. The findings will also help to inform future research projects I plan to undertake as a researcher. There is little risk to you for participating in this project.

Privacy: Information you and your patients provide will be kept confidential and anonymized when possible. I will ask your patients for personally identifiable information, such as their names, email and mailing addresses. This information will not be shared, will be kept private throughout the study, and will be deleted after completing data analysis. Information you and your patients provide and information from the recorded physician visit will be coded into categories for analysis and reported anonymously or in aggregate in research reports.

Voluntary Participation: You can freely choose to take part or to not take part in this study. There will be no penalty for either decision. If you do agree to participate, you can stop at any time.

Questions: If you have any questions about this study, please call or email me at 440-864-1901 or joannedr@hawaii.edu. You may also contact my adviser and coauthor, Professor Elizabeth Davidson, at 808-956-6657 or edaviso@hawaii.edu. If you have questions about your rights as a research participant, you may contact the UH Human Studies Program at 808-956-5007 or uhirb@hawaii.edu.

Thank you for your time,

Joanne R. Loos

Doctoral student, Communication and Information Sciences program

University of Hawaii at Manoa

You may keep portions of this consent form above the horizontal line for your records.

Signature:

I have read and understand the information provided to me about participating in the Joanne Loos's Health Communication research project.

My signature below indicates that I agree to participate in this research project.

Printed name: ______________________________

Signature: _________________________________

Date: ______________________________

APPENDIX I: PHYSICIAN INTERVIEW GUIDELINES

Note: These questions will be asked in an in-person interview. Therefore, the following questionnaire will serve only as a guideline for that interview.

Thank you for participating in the Health Communication study. This study employed the use of a quasi-experimental design to assess effects of wearables on the self-efficacy of patients and, therefore, an indirect effect on patient participation in a medical visit. Participants responded to four online questionnaires over a duration of two and a half weeks. They were given Fitbit Flex devices to use during this time, and I gathered data from their devices using a research software platform. I also spoke to/plan to speak to them for telephone interviews.

I then audio recorded participants' medical visits. I will transcribe these recordings and analyze them for communication patterns. In particular, I will be looking at four categories: (1) information seeking, (2) assertive utterances, and (3) information provision. I will also analyze information provision from the physician.

I will ask you a series of questions regarding your experience in this study and your reaction to its main objective: the effect of wearables on physician-patient communication.

What do you think about the notion that wearables, like the Fitbit Flex, might have an effect on physician-patient communication?

From your perspective, how did you feel this study went, overall?

Did you, at any point, attempt to decipher which patients participated in the study?

Did you, at any point, attempt to decipher what the intervention in the study may have been?

Can you guess what the intervention may have been?

How did your knowledge of the study affect your interaction with your patients on days you knew we would be recording the visits?

What concerns do you have regarding this study?

What hopes do you have regarding this study?

Would you be willing to participate in a study of this nature again in the future? Why, or why not?

Any additional comments or questions?

APPENDIX J: WEARABLE INSTRUCTIONS

Thank you for agreeing to participate in this study. Your participation will help to serve as a guide for future studies on wearable technologies and health. To get started, please refer to the following instructions. If you encounter any issues or have any questions along the way, please send me an email at JOANNEDR@HAWAII.EDU, or give me a phone call/text at (440) 864-1901.

1. Open your Fitbit Flex device and follow the manufacturer instructions for getting started. When you set up your device please use this email address and password. It is very important that you use this email address and password:

   Email:

   Password:

2. Please keep an eye on your email inbox for notifications regarding the remaining portions of the study. Once you receive a notification that a new questionnaire is available, please visit the link and answer the questionnaire within two days.

MAHALO once again for your participation. Should you have any questions or encounter any issues along the way, please let me know.

Joanne R. Loos
Ph.D. Candidate, Communication and Information Sciences
University of Hawaii at Manoa
joannedr@hawaii.edu | (440) 864-1901

APPENDIX K: SUMMARY OF DATA COLLECTION

Baseline Questionnaire	29
Week 1 Questionnaire (1 Week After Fitbit Setup)	15
Week 2 Questionnaire (2 Weeks After Fitbit Setup)	17
Posttest Questionnaire	20
Medical Appointment Recording	15
Week 3/Follow-Up Questionnaire (3 Weeks After Setup)	16
Fitbit Data Export	22
Phone Interview	10 patients, 2 physicians
Participant Narrative	29
Encounter Notes	29

APPENDIX L: SUMMARY OF RESEARCH QUESTION FINDINGS

RQ1: How does use of a wearable influence self-efficacy?	**Finding**	**Comment**
a: To what extent do patients use a wearable when one is given to them?	- Basic functions over advanced - Increased use two and three weeks after setup (p < .01>	Digital literacy issues may have factored into use.
b: To what extent does using a wearable influence a patient's physical activity?	- No significant changes in self-reported PA - 4.2 times more likely to have higher Fitbit PA three weeks after setup compared to one week after (p < .05> - Increased use of the Fitbit may have contributed to increased levels of PA over time. Over time, high levels of Fitbit use were related to increased self-reported PA (p. < .01) - Qualitative analyses revealed that patients may have extended behaviors into related activities and/or felt motivation through reactions from others or the goal-setting mechanisms of the device.	High-level users of Fitbit may benefit more than lower-level users of the device. These participants may also be the ones who are more likely to take advantage of the devices' advanced features.
c: How does a patient's use of a wearable affect physical activity self-efficacy?	No statistically significant changes	Contributing factors may include a low sample size, short duration for technology adoption, and limited use of advanced functions of the device.
d: How does a wearable affect an individual's general health self-efficacy?		
e: To what extent does use of a wearable affect preferences for health information?		
f: To what extent does use of a wearable affect personal innovativeness?		

RQ2: To what extent does patient use wearable affect physician-patient communication?	**Finding**	**Comment**
a: How does patient use of a wearable affect patient participation in a medical visit?	No statistically significant relationship	- Patient participation and physician information were positively and significantly correlated. - Qualitative analyses also revealed that wearable use did influenc patient communication with physicians and vice versa. Both patients and physicians mentioned Fitbit allowing them to ope the conversation into topics that might otherwise not be discussed.
b: How does patient use of a wearable affect physician information provision in a medical visit?	No statistically significant relationshi	

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