

MOBILE HEALTH ENTREPRENEURSHIP: AN OPPORTUNITY EXPLOITATION PERSPECTIVE

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Abstract

Mobile health presents an entrepreneurial opportunity for healthcare providers, especially physicians who run their clinics individually or jointly. Based on entrepreneurship literature, this study examines the adoption of mobile health technologies in terms of the factors that influence the decisions of physicians to exploit the opportunity. Compared with other health information technologies, the direct users of mobile health technologies are patients rather than physicians. Demand-side factors related to patient-centered care may play important roles in physicians' adoption of mobile health technologies. A research model of mobile health entrepreneurship were developed and tested with empirical observations. The results provide supporting evidence for most of the hypothesized relationships. Finally, the theoretical and practical implications of the findings are discussed.

Keywords: mobile health, patient-centered care, physician entrepreneurship, opportunity exploitation, demand-side factors, patient needs

INTRODUCTION

The use of mobile technology in healthcare, or mobile health, is gaining more and more momentum due to the high population penetration of cell phones and the power of ubiquitous computing (Istepanian, Laxminarayan, and Pattichis, 2006; Kahn, Yang, and Kahn, 2010). The recent results of Pew Internet and American Life Project suggested that most U.S. adults (85%) were cell phone owners, and more than half of them (53%) owned smartphones (Fox and Duggan, 2012). Also, the findings revealed that 31% cell phone owners had used their devices to look for health information, in comparison to 17% two years before (Fox and Duggan, 2012).

Based on new-generation wireless and handheld technologies, mobile health has recently emerged as a new opportunity in the healthcare industry (Istepanian et al., 2006). Mobile health applications have huge potentials to provide informational support for medical interventions and improve disease-related health outcomes (Krishna, Boren, and Balas, 2009). Through wireless networks, seamless connections can be established between provider-side systems and patient-side devices anytime and anywhere.

Various mobile health applications support and deliver medical interventions via wireless devices (Ritterband, Andersson, Christensen, Carlbring, and Cuijpers, 2006). For instance, mobile appointment reminder applications are designed to reduce the missing rate of medical appointments by showing automatic reminder messages on patients' cellphones. For another example, mobile body monitoring systems allow healthcare providers to keep track of the vital signs of patients in homes and workplaces beyond the traditional reach of physicians.

According to the Innovation Diffusion Theory, the impact of a new technology on human society largely depends on the extent of usage (Rogers, 1983). As an emerging innovation in the medical industry, mobile health will not reach its full potential unless it is utilized extensively. Unlike traditional medical technologies, mobile health applications mainly target patient-end users (Demiris, Afrin, Speedie, Courtney, Sondhi, and et al., 2008). Healthcare providers make the decisions to adopt such applications, but it is mainly the patients who directly use them. The diffusion of mobile health at this early stage largely depends on how willing health care providers are to try out the "patient-side" innovation when the majority are still watching.

Willing to explore the potentials of new technologies, the innovators or early adopters are generally less risk averse and more socially forward than later adopters (Rogers, 1983). They share a lot in common with entrepreneurs who are more capable of exploiting a new business opportunity than others (Venkatraman, 1997). The majority of ambulatory medical care providers in the U.S. are owned by physicians (Cherry, Hing, Woodwell, and Rechtsteiner, 2008). They are the entrepreneurs in the position of exploiting the new opportunity contained in mobile health applications. In this study, such an endeavor is denoted as mobile health entrepreneurship.

STATEMENT OF OBJECTIVE

Despite the potentials of mobile health applications to improve health conditions for patients and enhance healthcare services for physicians, the percentage of mobile health usage in the U.S. still remains low (Cutler, Feldman, and Horwitz, 2005). A mobile health survey by PEW in 2012 showed that less than 10% of cell phone owners received any text updates or alerts about health or medical issues, in contrast to the fact that 80% of them regularly sent and received text messages (Fox and Duggan, 2012).

There are both patient-side and physician-side reasons that contribute to the low adoption of mobile health by healthcare providers. Nevertheless, patients and physicians have never been readier for mobile health. As aforementioned, cell phone ownership is widespread in the U.S. and the majority of people use smart phone nowadays. Meanwhile, the cost and access issues associated with wireless data plans are no longer the major barriers to the adoption of mobile health applications.

However, not all applications present an opportunity for healthcare providers as they may be too expensive to implement or incompatible with existing IT infrastructure.

With the mandatory electronic health records (EHR) initiative, clinics must install and operate EHR systems to meet the meaningful use requirement by 2016 (Blumenthal and Tavenner, 2010). Most of the EHR vendors provide mobile applications such as mobile appointment reminder as optional functionalities for their customers. The additional cost of implementing such an optional application is marginal compared to the overall investment in an EHR system, yet the tangible and intangible benefits can be significant. Based on the required EHR infrastructure, it is not only feasible but also profitable for healthcare providers to open up new mobile health channels to their patients.

Many physicians and other health professionals nowadays combine their traditional roles as care providers and new roles as business entrepreneurs (McCleary, Rivers, and Schneller, 2006). Most studies explore the adoption of mobile health from technology diffusion perspective, and few have investigated it from the entrepreneurship perspective. The overlook of entrepreneurial aspect in the technology adoption process may hinder our complete understanding of the low adoption rate of mobile health.

As an effort, this study aims to explore the adoption of mobile health from the entrepreneurial point of view. The healthcare industry is in the midst of change, and mobile health shows the great potential of improving healthcare quality in this wave of change. Some physicians embrace the opportunity but more are on the look. Therefore, the research question of this study is: what are the factors that make differences in the entrepreneurial propensity of physicians to adopt mobile health applications during the transformation of healthcare industry?

The main premise is that there must be something quite unique about entrepreneurs, which gives them the propensity to make entrepreneurial endeavors in the midst of the change, chaos and confusion (Schumpeter, 1976; Stevenson and Gumpert, 1985). Traditional entrepreneurship studies focus on the supply-side factors related to the characteristics of entrepreneurs themselves. In addition, this study considers demand-side factors in the examination of healthcare providers' entrepreneurial orientation and motivation that drive the adoption mobile health applications.

THEORETICAL BACKGROUND

In the current entrepreneurship literature, there are a few studies related to the healthcare industry, and most of them address the characteristics of healthcare professionals who start up their own practices. For instance, Marques, Ferreira, Ferreira, and Lages (2013) investigated the entrepreneurial orientation and motivation to start up new practices among a group of 367 healthcare professionals.

They found that entrepreneurial healthcare professionals display a profile similar to the entrepreneurs in other industries.

Much fewer articles focus on the entrepreneurial activities in established healthcare institutions. One such study was conducted by McCline, Bhat, and Baj (2000). They expanded Robinson, Stimpson, Huefner, and Hunt's (1991) Entrepreneurial-Attitude Orientation instrument that measures perceived control, self-esteem, achievement, and innovativeness by including two new scales to measure attitude toward risk, and opportunity recognition. They found that the updated instrument can produce a correct classification rate of 82% among healthcare professionals between those who have explored an entrepreneurial opportunity and those who have not.

On the other hand, McCleary et al. (2006) took environmental influences into account. Based on Green, Kreuter, Deeds, Partridge, and Bartlett's (1980) and Moore and Coddington's (1999) work, they proposed a comprehensive diagnostic model to examine the internal and external drivers of healthcare entrepreneurship. This conceptual model provides a list of factors worth of further empirical investigations in the healthcare context. In the framework, there are three categories of factors that contribute to healthcare entrepreneurship: predisposing factors, enabling factors, and reinforcing factors:

- Predisposing factors: individual motivation (related to both intrinsic personality and the enthusiasm for a product or service) to pursue an entrepreneurial endeavor;
- Enabling factors: skills and resources necessary to perform a given behavior;
- Reinforcing factors: appropriate safeguards, responsibilities and consequences that confirm or support the entrepreneurial actions taken.

Few studies have examined mobile health entrepreneurship, and the current literature on general healthcare entrepreneurship does not provide appropriate frameworks for the investigation. In particular, there is a lack of demand/patient-side studies in healthcare entrepreneurship research. For better understanding of the relationship between potential value creation and entrepreneurial decisions, Priem, Li, and Carr (2012) advocated that researchers take a systematic view that consider not only focal firms but also downstream product markets and consumers. Due to the unique potentials for advancing knowledge in entrepreneurship research, they called for more demand-side empirical studies.

The healthcare industry in the U.S. is in the transition to patient-centered care in which patients are no longer passive recipients of medical services (Stewart, Brown, Weston, McWhinney, McWilliam, and et al., 2003). Rather, healthcare consumerism continues to grow as better-informed and savvy patients become more active in dealing with service providers (Fottler, Ford, and Heaton, 2002). In particular, patient consumers want to have a say in how they are treated and cared for, and believe that their time and perspective should be valued as well (Hacker, 1997).

Mobile health applications have intrinsic potentials for wide diffusion in the era of patient-centered care (Demiris et al., 2008). Though healthcare providers make the adoption decisions on such applications, it is the patients who are primary end-users. The diffusion of mobile health at this early stage largely depends on how willing health care providers are to try out this “patient-side” innovation. Nevertheless, many mobile health applications are not totally standalone systems, but based on EHR. For instance, most of EHR vendors provide the mobile appointment reminder application as an optional functionality (Car, Gurol-Urganci, de Jongh, Vodopivec-Jamsek, and Atun, 2012). The national policies regarding healthcare service delivery are undergoing major changes, especially the adoption of EHR (Shi and Singh, 2009).

An entrepreneurial opportunity may emerge when there is a dramatic change in market and industry structure and customer perceptions and mood (Moore and Coddington, 1999). In the healthcare industry, information technology advances, patient-centered care movement, and governmental policy changes all contribute to the environment conducive to the entrepreneurial opportunity in mobile health. However, there are few studies that investigate how environmental factors influence healthcare practitioners’ decisions to exploit such an opportunity.

In primary care, patients usually establish a long-term relationship with their physicians. Unlike a shopper of regular products and services, a patient is generally unlikely to frequently switch from one family doctor to another. Therefore, it is particularly necessary to take patient perspective into account in the investigation of mobile health adoption.

To fill in the literature gap, this study focuses on the demand-side factors associated with mobile health entrepreneurship. In particular, it examines the patient-related factors pertinent to the decisions of healthcare providers regarding the adoption of mobile health applications. There are two levels of factors related to the macro environment in terms of general healthcare industry movement (i.e. patient-centered care) and micro environment in terms of specific service population (i.e. patient status) respectively. The multilevel conceptualization may lead to a framework to understand mobile health entrepreneurship beyond the characteristics of healthcare providers themselves.

RESEARCH MODEL AND HYPOTHESES

According to Priem et al. (2012), there are two schools of thoughts in entrepreneurship literature on demand-side view: Kirzner’s theory and Penrose’s theory. Kirzner (1973; 1979; 1982) developed the concept of “entrepreneurial alertness” based on the assumption that entrepreneurship involves the discovery of both the opportunity and resource to exploit. In particular, the “unthought-of knowledge” about the market that an entrepreneur discovers gives him/her the advantages over others. On the other hand, Edith Penrose (1959) argued that demand discovery is a product of “imagination” rather than something obvious for everyone

to see as it depends on both past knowledge/experiences and the resources available. In this sense, a market demand cannot be directly discovered but it offers the opportunity for entrepreneurial imagination (Kor, Mahoney, and Michael, 2007).

Synthesizing these two views, Priem et al. (2012) proposed the concept of opportunity signal, defined as “the general process whereby overt or latent consumer or market demands indicate to entrepreneurs’ prospects for opportunity creation or discovery” (p. 354). The literature suggests two sources of opportunity signals. First, changing customer preferences may signal new demands that indicate potential opportunities for entrepreneurial actions (Yli-Renko, Autio, and Sapienza, 2001; Yli-Renko and Janakiraman, 2008). In addition, a new customer-supplier relationship may be a sign for entrepreneurs to adjust their services (Coviello, Brodie, and Munro, 2000; Kor et al., 2007).

The main opportunity signal of mobile health entrepreneurship is related to the ongoing patient-centered care movement. Patient-centered care means “providing care that is respectful of and responsive to individual patient preferences, needs, and values, and ensuring that patient values guide all clinical decisions” (Richardson, Berwick, Bisgard, Bristow, Buck, and et al., 2001). It is a new service approach that empowers patients and their families to become active participants in the decision-making about their options for treatment (Reynolds, 2009). Researchers agree that patient-centered care can improve disease outcomes and patients’ quality-of-life (Delbanco, Stokes, Cleary, Edgman-Levitan, Walker, and et al., 1995; Stewart, Brown, Donner, McWhinney, Oates, and et al., 2000).

Enabled by the advance in personal information and communication technologies (ICT), mobile health applications may greatly facilitate patient-centered care through enhancing the communication and interaction between healthcare professionals and patients (Demiris et al., 2008). In this way, practitioners, patients, and their families can work in a partnership for the consideration of patients’ needs and preferences in medical decision-making.

If healthcare providers are open to patient-centered care and encourage patients to get actively involved in medical decision-making, they are more likely to explore new mobile health applications that support patient-centered care. Hence the first research hypothesis:

H1: Openness to patient-centered care has a positive effect on the decision to exploit the mobile health entrepreneurial opportunity.

The paradigmatic shift in the general approach of service delivery may also cause the changes in patients’ specific needs. That is, the patient-centered care trend in the macro environment of healthcare industry inevitably has an impact on the individual preferences of patients in the micro environment of particular clinics. In particular,

patients prefer to know more about their health conditions and medical treatments so as to have a say in intervention process.

Entrepreneurs differ from others because they are sensitive to market demands (Kirzner, 1997). An empirical study by Choi and Shepherd (2004) shows that there is a positive relationship between entrepreneurs perceived knowledge of market demands and their decisions to take the advantage. The knowledge of market demands builds upon the alertness of changing customer preferences as well as the close relationship with customers (Priem et al., 2012). Therefore, entrepreneurial physicians are in a better position to understand patient needs than others.

Mobile health applications cater to the needs of patients and make them better informed and better cared. In the transition of patient-physician relationship, some physicians are more aware of patient needs than others. To those physicians who are ready to embrace the changes, they are more likely to spot and exploit the mobile health opportunity than those who are not. Therefore, the second research hypothesis is as follows:

H2: Alertness to patient needs has a positive effect on the decision to exploit the mobile health entrepreneurial opportunity.

Healthcare professionals who have a closer relationship with patients are also likely to have a better understanding of their patients' limitations. Unlike traditional health IT applications, mobile health applications target patients as end users rather than physicians. It is one thing for physicians to appreciate the advantages of mobile health applications over the traditional methods, and it is another to predict how well their patients will accept and use such applications. An application will not do anything good if it is not utilized.

Meanwhile, entrepreneurs inevitably face a lot of uncertainties in the process of new opportunity exploitation. Many healthcare providers do not have the luxury to experiment mobile health applications due to the sunk costs associated with hardware, software, training and so on. The success of an entrepreneurial endeavor largely depends on whether it is the right time to exploit an opportunity (Schoonhoven, Eisenhardt, and Lyman, 1990).

From the demand-side view, decision makers need to know whether their target customers are ready for the new products and/or services. First of all, whether the patients in a target population are ready for mobile health or not depends on whether they have the access to mobile devices and wireless networks. A patient must at least have a cell phone (preferably a smartphone) in order to use a mobile health application. More advanced mobile health applications may require patients to use additional devices, such as a mobile body monitor to keep track of a patient's health condition (e.g. heart beat rate and blood pressure).

In addition, patients need to be psychologically ready for the changes. Readiness for change has been defined as “the cognitive precursor to the behaviors of either resistance to or support for change efforts” (Armenakis, Harris, and Mossholder 1993, pp. 681-682). Mobile health is still at the early stage of development. Whether patients are open to a certain mobile health application is a big uncertainty that healthcare providers face. For example, some senior patients may stick to a traditional method even when physicians told them that there is a better way. Whereas some patients do not want to try new things, others may be willing to use mobile health applications for convenience.

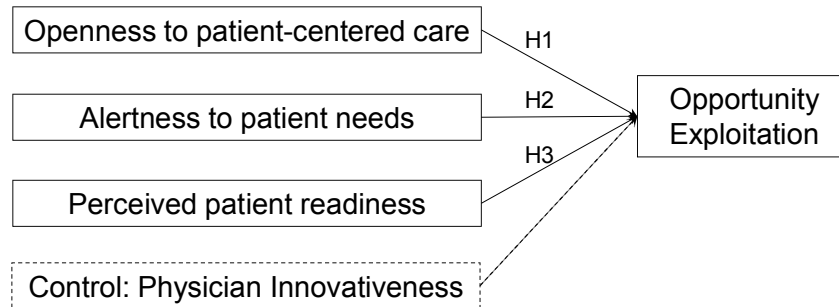
An entrepreneurial healthcare provider evaluates the readiness of his/her patients' readiness before adopting mobile health technology. Therefore, the perceived readiness of patients to use mobile health applications largely determines how likely a healthcare provider is to explore the entrepreneurial opportunity. Here is the third research hypothesis:

H3: Perceived patient readiness to use a mobile health application has a positive effect on the decision to exploit the entrepreneurial opportunity.

Though demand-side factors are important, it is the healthcare providers who will make the final decision to adopt mobile health applications. Innovativeness is a critical personal trait of entrepreneurs. In his seminar work, Schumpeter (1976) described entrepreneurs as the individuals who attempt to “...reform or revolutionize the pattern of production by exploiting an invention...or untried technical possibility for producing a new commodity or producing an old one in a new way...” (p. 132).

Innovativeness has been intensively examined in the entrepreneurship study (Marcati, Guido, and Peluso, 2008). It is related to the cognitive style of individuals that largely determines how open they are to new ideas as well as how creative they are to make their own original decisions (Foxall, 1995; Hurt, Joseph, and Cook, 1977; Midgley and Dowling, 1978). The results of empirical studies strongly support the claim that entrepreneurs who are successful at growing businesses are more innovative than non-entrepreneurs (Sexton and Bowman-Upton, 1986; Buttner and Gryskiewicz, 1993; Tuunanen and Hyrsky, 1997).

In a specific domain, innovative individuals have the predisposition to be the early adopters of innovations (Goldsmith and Hofacker, 1991). Though demand-side factors are the main interest of this study, innovativeness as a salient supply-side factor needs to be taken into account to control for its effect on the decision to exploit the mobile health opportunity. Figure 1 shows the research framework that indicates the relationships between demand-side factors and opportunity exploitation, with the supply-side physician innovativeness as a control variable.

FIGURE 1: Research Model

METHODOLOGY

Measurement

The dependent variable Opportunity Exploitation is measured objectively based on whether a healthcare provider has adopted or decided to adopt an EHR-based mobile health application, such as mobile appointment reminder. All the independent variables are psychological constructs and their measures are adapted from the instruments validated in previous studies, as shown in the Appendix. In the questionnaire, these measurement items are in the Likert scale of five levels.

Openness to Patient-Centered Care are measured with the items adapted from Stewart et al.'s (2003) scale for physician self-assessment related to patient-centered care practices. The scale contains nine items that ask physicians how they tend to work with their patients, such as listening to patients and explaining problems to patient. The measures of Alertness to Patient Needs are adapted from McCline et al.'s (2000) opportunity recognition scale. The seven-item instrument was developed and validated in the context of healthcare industry. The measurement of Patient Mobile Health Readiness comprises four items based on Parasuraman's (2000) Technology Readiness Index. Finally, Physician Innovativeness is measured with the eight-item Innovativeness Scale (Marcati et al, 2008).

Subjects

To test the research model, survey observations were collected from the healthcare providers. The selection criterion of participants was that they were the sole owners or co-owners of small to medium-sized clinics so as to be qualified as healthcare entrepreneurs. Altogether 58 physicians from 33 private clinics in the southwest region of USA were interviewed with a questionnaire. Among the practices, 19 were the primary care (i.e. family doctor) providers, seven were pediatric clinics, four provide dentistry services and three were in the area of obstetrics/gynecology.

Statistical Analysis

First a reliability analysis is conducted. If the result supports that the observations are reasonable in terms of internal consistency and response patterns, index scores are to be calculated by taking average of item scores for each construct. Then the descriptive statistics in terms of mean and standard deviation are obtained for each variable to examine the response patterns. Finally, the independent variables are used in a logistic regression analysis to predict the binary outcome variable of opportunity exploitation. Similar to a hierarchical regression analysis, the control variable of patient innovativeness will be entered first, followed by the main independent variables in the second block. Controlling for the effect of the first variable, the effects of remaining variables are estimated in a more accurate way.

RESULTS

Table 1 gives the reliability coefficients of the measures used in this study. For the psychological constructs measured with multiple items, their Cronbach's alphas were all above the threshold of 0.7, indicating an acceptable level of internal consistency of responses. This justifies the calculation of their index scores by taking the average of item scores.

TABLE 1: Reliability Coefficients and Descriptive Statistics

| Variable | # of Items | Alpha | Mean (St. Dev.) |
|-----------------------------------|------------|-------|-----------------|
| Opportunity Exploitation | 1 | N/A | 0.36 (0.49) |
| Physician Innovativeness | 8 | 0.87 | 3.28 (0.63) |
| Openness to Patient-centered Care | 9 | 0.90 | 2.72 (0.76) |
| Alertness to Patient Needs | 7 | 0.85 | 2.77 (0.77) |
| Perceived Patient Readiness | 4 | 0.81 | 2.62 (0.86) |

Table 1 also gives the descriptive statistics of all the variables used in this study. The dependent variable of Opportunity Exploitation is a binary variable, and the average shows the proportion of responses that indicated the actual or intended adoption of mobile health applications. A little bit more than one third of responses were positive, suggesting that mobile health is still at the early stage of diffusion and presents an entrepreneurial opportunity for healthcare providers. The majority of participants reported somewhat positive innovativeness as the average was above the neutral point of three for the Likert scale of five levels. Yet, the other independent variables saw somewhat negative responses on average. Many participants were a little bit hesitant to embrace the concept of the patient-centered care. Also, they were somewhat conservative regarding patient needs and readiness to use mobile health applications.

Table 2 reports the estimated odds ratios of hierarchical logistic regression analysis. In the first model, only the control variable of Physician Innovativeness was entered,

and it was highly significant to explain the dependent variable of Opportunity Exploitation. This confirms the importance of opinion leaders in the adoption of mobile health applications (Hao, Padman, and Telang, 2011). However, when the demand-side independent variables related to patients were entered, it became not as significant as them. Controlling for the effect of Physician Innovativeness, Openness to Patient-centered Care, Perceived Patient Readiness, and Alertness to Patient Needs were found to have highly significant, significant and marginally significant impacts respectively on the decisions on whether to exploit the mobile health opportunity or not.

TABLE 2: Odds Ratio Estimates of Hierarchical Logistic Regression Analysis

| Variable | Model1 | Model2 |
|-----------------------------------|---------------------|----------------------|
| Physician Innovativeness | 8.62 ^{***} | 2.36 |
| Openness to Patient-centered Care | | 27.14 ^{***} |
| Alertness to Patient Needs | | 4.26 [*] |
| Perceived Patient Readiness | | 6.18 ^{**} |

Note: ^{***}- Sig. at 0.01 level; ^{**}- Sig. at 0.05 level; ^{*}-Sig. at 0.1 level

In terms of model explanatory power, the first model yielded Nagelkerke R-square of 0.35 and the chi-square statistic of 16.89 at one degree of freedom, and the second model yielded Nagelkerke R-square of 0.84 and the chi-square statistic of 55.30 at four degree of freedom. The chi-square difference test ($\Delta\chi^2 = 38.41$, $\Delta df = 3$) was significant at 0.01 level, indicating that the second model greatly enhanced the explanatory power from the first model. In addition, the first model achieved an overall 72.4 percent accuracy in the prediction of the dependent variable, and the second model achieved 87.9 percent. This also indicates that the second model outperformed the first due to the inclusion of three main independent variables.

DISCUSSIONS

The results provide supportive evidence of research hypotheses regarding the importance of demand-side factors in mobile health entrepreneurship. In addition to individual hypothesis testing, their importance was benchmarked with the control variable of Physician Innovativeness. The supply-side variable was highly significant to explain the dependent variable of Opportunity Exploitation by itself, but when the demand-side variables were included, its importance diminished to the least. This result supports the general premise of this study that demand-side factors play a more important role than traditional supply-side factors in mobile health entrepreneurship in which the direct application users were patients rather than physicians themselves.

Among the three independent variables, Openness to Patient-centered Care was found highly significant. This suggests that if physicians believe that empowering patients is the right thing to do, they are likely to adopt mobile health applications for

the benefits of patients. The next significant variable was Perceived Patient Readiness. It is understandable that physicians are somewhat hesitant to adopt a mobile health application if they have the doubt about their patients' capability to use it. Finally, alertness to Patient Needs was found marginally significant, even though it had the highest average score among the three variables. Many physicians see the needs of patients, but they need more motivation and/or assurance to get convinced before taking actual actions.

Of course, this study has limitations. First of all, the observations were collected from the healthcare practices in one region, in which people may have a particular culture and demographics. This may limit the generalizability of the results. Of course, the main purpose of this study is to test a theoretical model, and it is still safe to say that the results support the hypothesized relationships. Yet, it demands more caution to extend specific results to other populations, such as the observed significance level of each independent variable. The second limitation is that the sample size is relatively small due to the difficulty to collect observations from healthcare providers. Many behavioral studies that employ psychological constructs use covariance-based confirmatory factor analysis to test measurement models, which demands large sample size. To mitigate this limitation, this study adapted measures from previously-validated instruments. The reliability analysis supported measurement validity and the calculation of index score for each construct. The sample size requirement for logistic regression, the model testing method used in this study, is 10 cases for each independent variable (Agresti, 2007). There were four independent variables and 58 observations, and the case-variable ratio was almost 15, exceeding the guideline.

CONCLUSION AND IMPLICATIONS

Mobile health poses an entrepreneurial opportunity for healthcare providers, especially physicians who run their clinics individually or jointly. Based on entrepreneurship literature, this study examines the adoption of mobile health technologies in terms of the factors that influence the decisions of physicians to exploit the opportunity. Compared with other health information technologies, the direct users of mobile health technologies are patients rather than physicians. Thus this study hypothesizes the important roles that demand-side factors related to patient-centered care play in physicians' adoption of mobile health technologies. The empirical results support the research model of mobile health entrepreneurship from the opportunity exploitation perspective.

The findings yield some important theoretical and practical implications. The conceptualization of theoretical model takes factors at different levels into account. Physician innovativeness is the traditional supply-side factor that affects opportunity exploitation at the level of individual entrepreneurs. Alertness to patient-needs and perceived patient readiness address the demand-side factors related to the target patient population that each clinic serves. Openness to patient-centered care concerns

the new trend in the healthcare industry. The inclusion of various factors from the aspects of service providers, technology end-users and industrial environment provides a multi-facet lens to understand mobile health entrepreneurship.

The theory development fills the gap in existing technology adoption studies that typically do not differentiate technology adopters and end-users. It also contributes to the entrepreneurship literature that considers mainly the characteristics of entrepreneurs in the investigation of opportunity exploitation. The framework leads to the research design to empirically investigate the phenomenon of opportunity exploitation related to mobile health.

In theory, the supply-side, demand-side and industry factors are at different levels in terms of medical practitioner, patient population, and practice environment respectively. In an empirical study, however, they can all be operationalized as the perceptions of individual entrepreneurs. In the end, it is mostly up to the owners of clinics to make the decision on whether to exploit the mobile health opportunity based on such perceptions. Thus, this study adapted measurement items of these constructs from existing studies on entrepreneurial opportunity exploitation and technology adoption. The model and instruments may be helpful for healthcare practitioners to evaluate whether it is time to exploit the entrepreneurial opportunity of mobile health.

The general findings support the validity of the research model. They reveal the importance of demand-side factors in mobile health entrepreneurship, and provide some useful insights for researchers and practitioners. In the theoretical and practical research on the adoption of mobile health applications, it is important to keep in mind that the decision-makers are physician entrepreneurs and actual users are patients. For the owners of clinics to adopt a mobile health application, they need to be open to the patient-centered care movement, aware of patient readiness, and alert to patient needs. Meanwhile, the specific results may vary across populations of different demographics and cultures.

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APPENDIX: MEASUREMENT INSTRUMENTS

Openness to Patient-Centered Care (Adapted from Stewart et al., 2003)

1. I discuss with my patients about their main problems.
2. The discussion of patients' problems is stratified.
3. I listen to what my patient have to say.
4. I explain the problem to my patient in depth.
5. I discuss with my patients our respective roles.
6. I explain treatment to a large extent.
7. My patients and I explore how manageable treatments would be for them.
8. I understand my patients very well.
9. If needed, I discuss personal or family issues that might be affecting my patients' health.

Alertness to Patient Needs (Adapted from McCline et al., 2000)

1. My focus is on identifying what the patient needs and wants without first getting a lot of instruction.
2. At my job, I have helped identify new ways of performing the things that we must do.
3. I usually can identify what my patients need to make their stay more helpful.
4. I do not hesitate to make the changes that I think are needed at my workplace.
5. I like talking to people to find out how I can provide better services.
6. I enjoy finding new ways my organization can better meet the needs of consumers.
7. I like to interact with clients so I can get their input on our services.

Patient Mobile Health Readiness (Adapted from Parasuraman, 2000)

1. Most of my patients have cell phones.
2. Most of my patients know how to use mobile health applications.
3. Most of my patients are fully capable of using mobile health applications.
4. The steps in the process of using mobile health applications should be clear to most of my patients.

Physician Innovativeness (Adapted from Marcati et al., 2008)

1. I often surprise people with my novel ideas.
2. People often ask me for help in creative activities.
3. I obtain more satisfaction from mastering a skill than coming up with a new idea.
4. I prefer work that requires original thinking.
5. I usually continue doing a new job in exactly the way it was taught to me.
6. I like a job which demands skill and practice rather than inventiveness.
7. I am not a very creative person.
8. I like to experiment with various ways of doing the same thing.