PHYSICIANS' ADOPTION OF MOBILE HEALTH MONITORING SYSTEMS IN SPAIN: COMPETING MODELS AND IMPACT OF PRIOR EXPERIENCE

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ABSTRACT

The aim of this two-phase research is to evaluate the perceptions and adoption of mobile phone-based diabetes monitoring (MDM) systems among physicians in Spain. In comparison with Okazaki et al.'s [2012] MDM adoption model based on DeLone and McLean's [2003] information systems success model, we propose an alternative model based on technology acceptance model 2. An empirical survey is conducted in attempting to address two key questions: (1) Which model exhibits superior parsimony and predictive power?, and (2) How does physicians' prior experience with mobile Internet moderate the hypothesized relationships among the constructs? In total, 495 primary care physicians participated in the survey in Spain. Our findings suggest that Okazaki et al.'s model is more parsimonious and better explains the main drivers of the intention to use MDM. Overall quality, net benefits, and perceived value of the system also contribute to its acceptance, albeit with effects being moderated by the user's experience with mobile Internet. In closing, important theoretical and managerial implications are drawn, while limitations are recognized and future research directions are suggested.

Keywords: Health monitoring systems; Mobile health; Physicians; Service; Technology acceptance

1. Introduction

Among the diverse range of information and communications technology (ICT) tools in the health-care field [Kummervold et al. 2008], smartphones have received increasing attention from physicians [Norris et al. 2009]. Mobile-based applications (apps) help doctors to diagnose, treat, and monitor patients' medical or physical conditions in a timely and flexible manner [Sun et al. 2013; Burner et al. 2014; Lee et al. 2014]. According to a study by MIT Enterprise Forum [2011], the sector of mobile health, or *mHealth*, is expected to grow tremendously in the coming years, from $4.6 billion in 2014 to $12 billion by 2020. Broadly, mHealth has been defined as "mobile computing, medical sensor, and communications technologies for health care" [Istepanian et al. 2004, p. 405].

One of the patient groups that may benefit the most from mHealth is those people with type 1 and type 2 diabetes. It is often difficult to monitor their blood sugar levels on a daily basis, due to distance from the nearest health center [Chomutare et al. 2011]. Such a physical and spatial impediment can be overcome by using a mobile phone-based diabetes monitoring (MDM) system that enables physicians to remotely control and manage this illness in real time [Martínez-Sarriegui et al. 2011].

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From the patients' perspectives, an MDM system provides important value to their psychological well-being. Recent studies have demonstrated that the use of mobile phones in diabetes control generates both interest and satisfaction among patients, who in turn express their intention to recommend the system to others [García-Sáez et al. 2009; Martínez-Sarriegui et al. 2011]. However, such a system requires active collaboration with physicians who are mainly responsible for day-to-day control and treatment [Huh & Langteau 2007]. In this light, Okazaki et al. [2012] recently extended DeLone and McLean's [2003] information systems success model (D&M model) and explored the factors that determine the acceptance of MDM among Japanese physicians. They found that perceived quality, perceived benefits, and peer pressure are the major determinants of user acceptance. The objective of this article is to replicate and extend Okazaki et al.'s [2012] study by exploring the acceptance of MDM systems among medical professionals in the Spanish health-care system.

Theoretically, we attempt to make two specific contributions. First, we compare the explanatory power of Okazaki et al.'s [2012] MDM adoption model with technology acceptance model 2 (TAM2) [Venkatesh & Davis 2000]. TAM2 is based on one of the most widely recognized new technology adoption models, TAM [Davis et al. 1989], but incorporates additional constructs from diffusion of innovation [Rogers 2003; Moore & Benbasat 1991]. TAM2 posits three direct antecedents of information technology (IT) usage intention: subjective norm, perceived usefulness, and perceived ease of use. Through perceived usefulness, the model assumes indirect effects of subjective norm, image, job relevance, output quality, and result demonstrability on usage intention. Compared with another extension of TAM, TAM3, which includes more determinants of IT adoption [Venkatesh & Bala 2008], TAM2 seems to be a more balanced model in terms of parsimony and predictive power [Bradley 2012]. Comparative research on competing explanatory models has been an established field in the IT literature [e.g.,Brown et al. 2008; Martinez & Williams 2010], and thus serves as a compelling justification for our research objective. Second, we explore how physicians' prior mobile Internet experience moderates their usage intentions. Prior research has found that the adoption of mobile services is shaped by individuals' prior experience on the Internet, with greater experience leading to greater intention to use this technology [de Reuver et al. 2013]. Technological experience improves individuals' perceptions of the utility of new technology and encourages them to use these systems continuously over time [O'Cass & Fenech 2003].

In what follows, we report two-phase research as depicted in Figure 1. We first present our background on public health-care systems and related research on mHealth. In Study 1, we propose two competing models and assess each model with PLS separately to determine which model exhibits better predictive power and parsimony. In Study 2, based on Study 1, we posit and test our moderation hypotheses associated with physicians' prior mobile Internet experience. Finally, we conclude the study by drawing theoretical and managerial implications, while recognizing important limitations and suggesting future research directions.

2. Literature Review
2.1. Public Health-Care Systems

In one of the pioneering studies on MDM acceptance, Okazaki et al. [2012] examined Japan, a country whose health-care system has been classified as a *Bismarck model* of health care. In contrast, the Spanish health-care system is known as a *Beveridge model* of health care. These models are two polar cases in the redistributive character of social protection systems [Cremer & Pestieau 2003]. Besides these models, there is one extreme approach—the entirely liberal model in the U.S. The key characteristics of these health-care models can affect medical professionals' decisions to accept new technologies. Figure 2 summarizes major characteristics of these three health-care models.

Originally implemented by German Chancellor Otto von Bismarck, the Bismarck model is an insurance-based open framework [Chinitz et al. 2004]. In this model, everything is private, and patients can freely choose from a broad range of doctors and hospitals. Patients consult medical specialists directly and pay for their insurance premium. This system can lead to greater patient satisfaction as it offers a wider range of alternatives, direct access to specialists, and virtually no waiting time. Yet, this approach is generally more costly to operate [Or et al. 2010].

The Beveridge model was named for Sir William Beveridge, who implemented the UK Social Security system in the 1940s. In contrast to the Bismarck model, this model is a tax-funded public system [Chinitz et al. 2004]. Here, the government owns hospitals and employs medical specialists. While the Beveridge model ensures more equitable access as well as universal coverage through national health systems, it provides much less choice to patients, since their medical needs must be addressed by primary health-care providers. This model is known for generating significant waiting lists to see specialists and thus provoking patient dissatisfaction. Since physicians are employed by the government, their salary is not linked to productivity; this means there is generally less incentive to achieve greater efficiencies [Or et al. 2010].
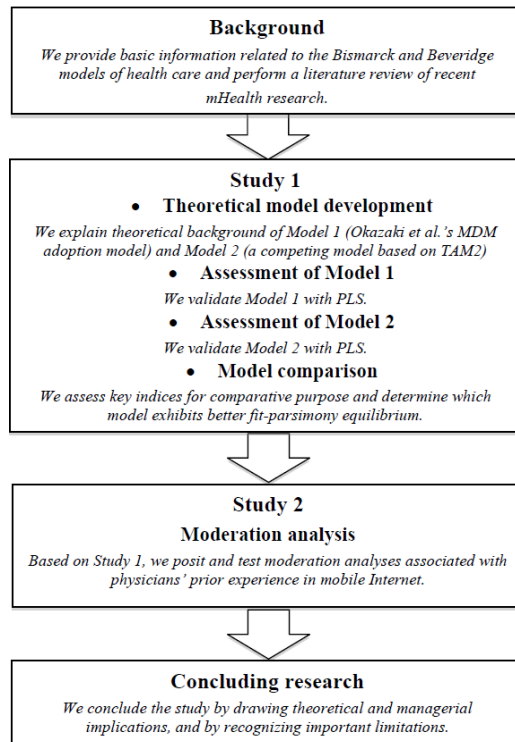
Background

We provide basic information related to the Bismarck and Beveridge models of health care and perform a literature review of recent mHealth research.

Study 1

- **Theoretical model development**

We explain theoretical background of Model 1 (Okazaki et al.'s MDM adoption model) and Model 2 (a competing model based on TAM2)

- **Assessment of Model 1**

We validate Model 1 with PLS.

- **Assessment of Model 2**

We validate Model 2 with PLS.

- **Model comparison**

We assess key indices for comparative purpose and determine which model exhibits better fit-parsimony equilibrium.

Study 2

Moderation analysis

Based on Study 1, we posit and test moderation analyses associated with physicians' prior experience in mobile Internet.

Concluding research

We conclude the study by drawing theoretical and managerial implications, and by recognizing important limitations.

Figure 1. Researcceh Produre

Beveridge Model	**Private Insurance**	**Bismarck Model**
Spain, UK, Italy, Sweden, Denmark, Norway, Finland, Canada	U.S.A.	Japan, France, Germany, Austria, Switzerland, Belgium, The Netherlands

- Financed through tax revenues
- National health service
- Predominantly public providers

- Private health insurance
- Medicare/aid + Managed care
- Predominantly private providers

- Financed from employment taxes
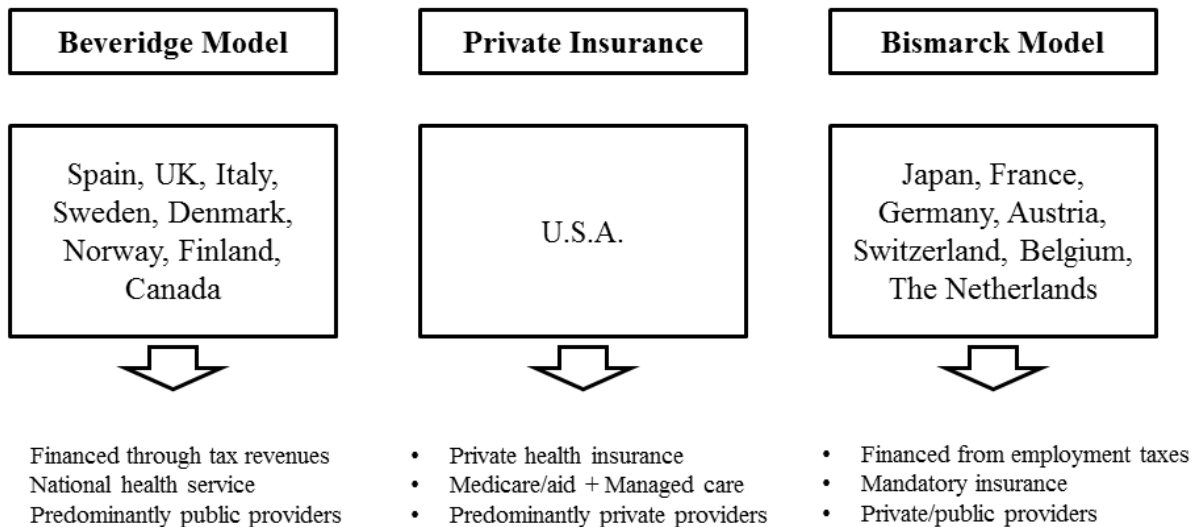- Mandatory insurance
- Private/public providers

Figure 2: Overview of Three Health-Care Systems
Source: Based on Lameire et al. [1999]

Or et al. [2010] compared the Beveridge and Bismarck models and concluded that the Beveridge model outperforms on cost containment and affordability, whereas the Bismarck model is better at access to care in terms of availability of services when required. On the other hand, little or no clear systemic differences exist in performance on health outcomes and responsiveness. These comparisons make us wonder if physicians' perceptions toward MDM in Japan, which is governed by the Bismarck model, can be applied in Spain, which is governed by

the Beveridge model. In particular, MDM is very much related to access to care in a particular health-care model. Ensuring that all segments of the population can obtain medical attention at the right time and place is also an important objective of a health-care system. For example, compared with Germany (Bismarck model), Sweden (Beveridge model) is reported to perform quite poorly on this measure with "one third of the population reporting that access to generalists is difficult and with this proportion rising to two-thirds for specialist care" [Or et al. 2010, p. 274]. Consistent with this finding, a prior survey reported difficult access to certain types of specialist care in France because of the unequal distribution of specialists [ESPS 2004].

Such differences between the two models make us wonder about the applicability of Okazaki et al.'s [2012] MDM adoption model in Spain. Key differences affecting the doctor–patient relationship—such as access to care—might lead to important perceptual differences regarding the needs of a remote health control system from the physicians' point of view.

2.2. Relevant Research on mHealth Adoption

In this study, we envisage mHealth as a subset of eHealth that employs mobile telecommunication technology to monitor, control, and deliver health solutions for a particular medical problem [Sun et al. 2013]. Compared with general eHealth, mHealth provides two major advantages. First, it enables health-care professionals as well as patients to obtain health-care services at any place and at any time. This ubiquitous capability makes mHealth unique and distinct. In this light, mHealth offers a pragmatic solution for patients with chronic diseases who live in rural or remote areas with scarce health-care services. Second, mHealth offers more enhanced personalization so that the system can accommodate different types of users for different types of health-care needs. In particular, customization and adaptation of the user interface is a unique feature of mHealth that supports everyday interactions between the patient and the system [Sultan & Mohan 2013].

In clearly positioning our research, we conducted a comprehensive literature review based on major online databases, including ABI/INFORM, Business Source Complete, and PubMed. A summary of selected publications is shown in Appendix A. While literature on health care provides systematic reviews of mHealth [e.g., Kahn et al. 2010; Chou et al. 2013; Lewis & Wyatt 2014], this topic has not been fully explored in e-commerce journals. More specifically, our literature review found a limited number of empirical explorations on MDM adoption in our discipline, especially from physicians' perspectives.

Sun et al. [2013] examined the adoption of mHealth services among 204 elderly consumers in China. Using Partial Least Squares (PLS), the authors found that coping appraisals, compared with threat appraisals, play a central role in predicting mHealth acceptance. From patients' perspectives, response efficacy was found to be the most influential factor, followed by subjective norm, self-efficacy, and perceived ease of use.

In Bangladesh, Akter et al. [2010] reported on an investigation associated with a service quality model for mHealth services. The authors performed a questionnaire survey with 283 actual users. Service quality was specified as a third-order reflective construct. Their PLS modeling revealed that service quality significantly and positively affects satisfaction, continuance intentions, and quality of life in the context of mHealth services. Akter et al. [2013] followed up this research and examined the continuous use of mHealth in Bangladesh. The authors found that both service quality and perceived trust have significant explanatory power in the prediction of continuance usage intentions.

Similarly, Sultan and Mohan [2013] examined seven diabetic patients' perceptions of the MediNet patient interface in Trinidad and Tobago. MediNet is an mHealth system that delivers personalized health-care services to patients. The authors examined the patient usage data to construct a system usage model and drive the day-to-day patient interactions with the system.

In contrast, Okazaki et al. [2012] examined physicians' perceptions of an MDM system. Based on 471 respondents from a nationwide survey in Japan, they concluded that net benefits strongly and positively influence intention to use MDM. To their surprise, overall quality of the system did not affect intention directly—it is perceived value of the system that strengthens the effects of overall quality and intention to use MDM. Furthermore, there was a strong impact of subjective norm on intention to use MDM. This may be because many physicians are not particularly Internet-literate, and they may rely more on their peers' help and suggestions. Besides this attempt, mHealth adoption research from physicians' perspectives has been quite limited so far.

3. Study 1

3.1. Model 1—Okazaki et al.'s MDM Adoption Model

Our first model is Okazaki et al.'s [2012] MDM adoption model, which was originally based on the updated version of the D&M model [DeLone & McLean 2003]. We omitted privacy and security risks, as this construct was found to be an insignificant driver of usage intention in the MDM adoption model. This seems consistent with prior research that indicates a "privacy paradox"—apparently inconsistent results with regard to users' privacy-related

beliefs and actual behavior [Norberg et al. 2007]. That is, while privacy concerns were generally found to be a significant predictor of privacy disclosure as a sole indicator [Baek & Morimoto 2012; Stewart & Segars 2002], their impact was weak or even insignificant when included along with other predictors such as trust or risk [Awad & Krishnan 2006; Hui et al. 2007; Li et al. 2011]. A plausible explanation can be found in the economics literature, which suggests that individuals have a tendency to discount "hyperbolic" future costs or benefits [Smith et al. 2011]. Such hyperbolic discounting implies inconsistent personal preference over time, whereby future events may be discounted at different rates than near-term events [Acquisti 2004]. For example, the benefits of accessing patient information may be immediate (i.e., convenient), but the risk of unauthorized access to such information may be invisible or spread over time. This widely known phenomenon prompted economists to define privacy as a commodity that can be traded if enough incentives, such as convenience, are given [Dinev 2014].

As shown in Figure 3, Okazaki et al.'s [2012] MDM adoption model addresses three quality dimensions of information systems: system quality, information quality, and service quality. System quality focuses on the characteristics of the information-processing system itself, and is measured in terms of "ease-of-use, functionality, reliability, flexibility, data quality, portability, integration, and importance" [DeLone & McLean 2003, p. 13]. Information quality centers on the characteristics of the information produced by the system. Its evaluation addresses the extent to which it is usable, concise, comprehensible, pertinent, available, and appropriately formatted [Éthier et al. 2006]. Service quality captures the level of service delivered by the information system department and the staff that provides support for end-users [DeLone & McLean 2003]. However, given the fact that MDM adoption is still in its infancy, it may be difficult for physicians to assess these quality dimensions without actual usage experience. Thus, we argue that these constructs should actually be interpreted as *expected* quality dimensions. Overall quality determines, directly and positively, the intention to use MDM. Although this path was not statistically significant in Okazaki et al. [2012], we contemplate this relationship in our model because we think that a general, rather than specific, quality measure could better capture physicians' expectations for a new medical technology, due to the aforementioned lack of actual usage experience. For the same reason, real-life use of the system is excluded in the proposed model.

DeLone and McLean [2003] assert that satisfaction is an important measure of success in the adoption of information systems, as it captures the trade-off between the positive and negative impacts of their use. Satisfaction is a post-consumption experience [Ueltschy et al. 2007], conceived as an overall emotional response to the entire experience following product use or purchase [Ekinci et al. 2008]. One immediate antecedent of satisfaction is the value perceived by the individual, and thus value was included in the model to explain the acceptance of MDM. Furthermore, according to previous studies, this variable predicts behavioral intentions more successfully than satisfaction [Gardner 2001]. Zeithaml [1988] considers perceived value to be the consumer's overall assessment of the utility of a product as a result of their perceptions of what they receive and what they have to sacrifice. In marketing literature, perceived value is regarded as the primary driver of purchase intention and behavior [Eisend 2008]. In the present research, value is conceived as the improvement in performance delivered thanks to adopting an MDM system, in terms of utility, effectiveness, functionality, efficiency, productivity, and practicality.

Previous research suggests that value creation translates into a strong intention to adopt an information system [Vlahos & Ferratt 1995]. The importance of perceived value as a predictor of use/purchase intention has been extensively demonstrated, both in the classic service marketing literature and in more recent studies on technological innovation [Kuo et al. 2009; Lee 2009]. In the area of mobile communications, studies by Kleijnen et al. [2007], Kuo et al. [2009], and Ruiz et al. [2010] also evidence the direct and significant influence of perceived value on the intention to use services via mobile phone. Okazaki et al.'s [2012] findings were consistent with these studies.

DeLone and McLean [2003] suggest that net benefits should be determined by the particular context in which the information system is to be implemented and the objectives the user hopes to achieve. The present research, focusing on the use of MDM systems, takes net benefits to refer to both clinical advantage and the advantage offered by the mobile device itself. Earlier studies show that ubiquity, referring to flexibility in time and space, is the key advantage offered by the use of mobile devices [Okazaki et al. 2009]. Similarly, as suggested by various experiments [García-Sáez et al. 2009; Martínez-Sarriegui et al. 2011], improvement in the control of the patient's health is the main clinical advantage specialists seek when using new systems. As in the case of "overall quality," "net benefits" are configured as a second-order formative construct covering ubiquitous control and improved control over patients' health. Net benefits have been measured in previous studies as improvements in work performance, and they have a significant impact on the intention to use knowledge management systems [Wu & Wang 2006]. Okazaki et al. [2012] corroborate such a relationship, while similar findings have been reported in the information systems literature [Petter et al. 2008].
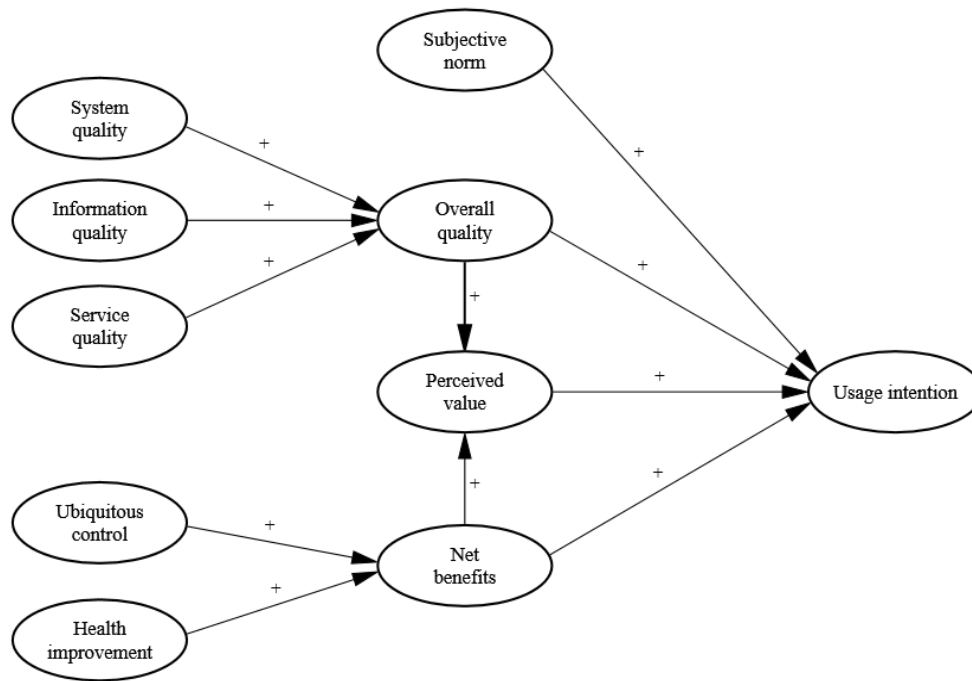
Figure 3: Model 1—Okazaki et al.'s MDM Adoption Model

3.2.   Model 2—Competitive Model Based on TAM2

In order to test the capacity of the proposed model to explain the adoption of MDM by physicians, we compared the parsimony and fit of Model 1 with our alternative model based on TAM2 [Venkatesh & Davis 2000], or Model 2. Model 2 is shown in Figure 4. In research on eHealth, TAM2 has been tested to examine physicians' intention to adopt Internet-based health applications [Chismar & Wiley-Patton 2003] and telemedicine [Kim & Chang 2007], as well as caregivers' adoption of health IT applications [Yu et al. 2009]. The results of these studies support the adequacy of TAM2 as a competitive model to explain physicians' acceptance of an MDM system.

TAM2 was developed due to the need to "include additional key determinants of TAM's perceived usefulness and usage intention constructs, and to understand how the effects of these determinants change with increasing user experience over time with the target system" [Venkatesh & Davis 2000, p. 187]. The new determinants incorporated into TAM2 are classified into two sets of variables related to (1) social influence processes (subjective norm, voluntariness, and image), and (2) cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use). In our study, perceived usefulness is replaced with perceived value, which is measured as the extent to which MDM is useful, effective, functional, practical, sensible, efficient, or productive.

As in Model 1, the first antecedent of perceived value is subjective norm, which also directly determines usage intention. Subjective norm refers to "an individual's normative beliefs that significant others (e.g., family, friends, partners) think that he or she should or should not perform a certain behavior" [Paek et al. 2009, p. 38]. In the original TAM2, subjective norm influences image, which is defined as the degree to which an individual perceives the use of an innovative system as a means of enhancing one's status within his or her social group. Indeed, mobile users may belong to various social circles, because they may think the adoption of these devices enhances not only convenience but also their sense of self-importance [Lu et al. 2005]. However, this affective connotation of image as symbolic of fashion and wealth may not fit our study context, since we address the use of a medical device in a circle of highly skilled professionals. In this case, what subjective norm really enhances is probably a more cognitive aspect, in terms of a better understanding of the unique benefits that MDM offers. For example, the support of peers and colleagues, the provision of adequate technological resources by management, and personal ability all have a significant influence on perceived behavioral control [Cauberghe & De Pelsmacker 2011]. Thus, we propose ubiquitous control as the second antecedent of perceived value.

The third antecedent, job relevance, relates to how an individual perceives the degree to which the target system is applicable to his or her job. In our study context, it addresses physicians' perception regarding the degree to which

the MDM system fits their job. The fourth antecedent is output quality. Communication literature suggests that executional quality favorably affects attitude toward the medium [Lawrence et al. 2013]. Since the main output of an MDM for a doctor is information, our output quality is represented by information quality. The fifth antecedent is result demonstrability, which refers to the extent to which the results of using the innovation are tangible. After all, the final outcome of MDM use that physicians would expect is to increase the level of control over their patients' health condition, resulting in their health improvement. Thus, our research replaces this construct with health improvement, the results physicians would expect as a readily discernable outcome of MDM use. Finally, ease of use affects perceived value.
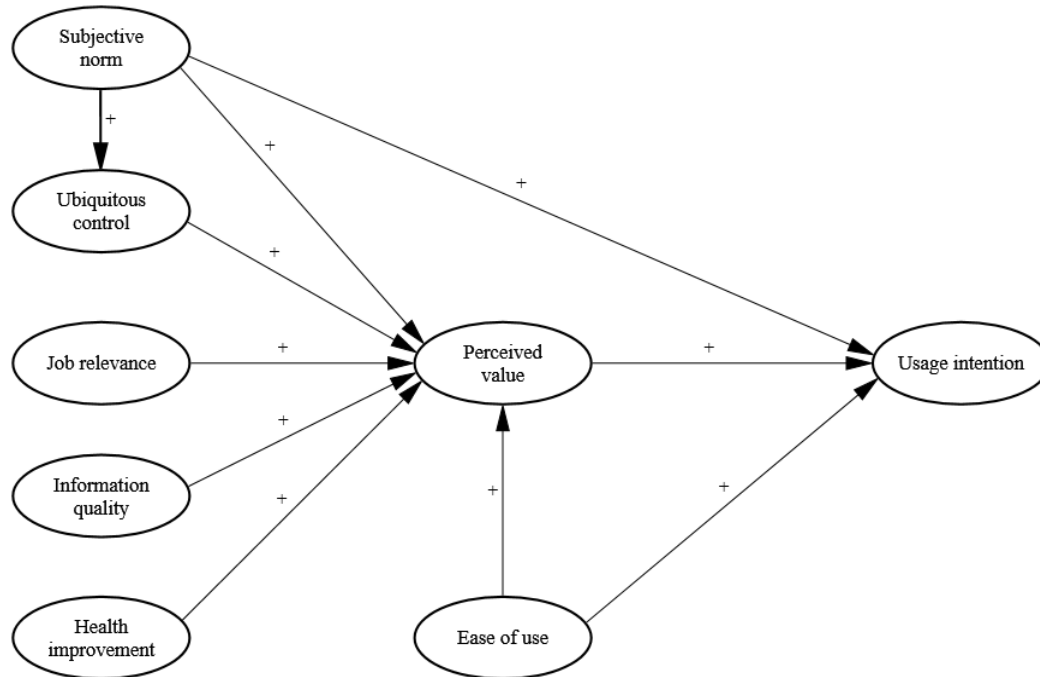

Figure 4: Model 2—Competitive Model Based on TAM2

3.3.   Method

A professional research firm was contracted to administer the survey. A quota sampling was applied in an attempt to ensure the nationally representative sample; the respondents were collected from all 17 autonomous communities in Spain, while the quota of physicians per an autonomous community was weighed by the size of its population. In total, 500 physicians were contacted at primary health-care centers. The survey was undertaken in March and April, 2012. In total, 495 usable responses were obtained.

Prior to completing the questionnaire, the subjects received an information leaflet describing an MDM system for self-monitoring of blood sugar levels among diabetic patients, including a graphic image explaining the workings of the system (Appendix B). An MDM system offers the following functions: (1) self-monitoring of blood sugar levels, weight, physical activity, diet, administration of insulin and medication, and blood pressure; (2) submission of data to the physician, and physician–patient communication; and (3) synchronization between the individual's personal medical records and the health-care system database [Chomutare et al. 2011].

The beginning of the questionnaire asked general questions related to usage and number of years of experience with an MDM system. Only five respondents had used MDM before. For the constructs of Model 1 and Model 2, the following measures, detailed in Appendix C, were adapted from prior research on information systems, health care, and consumer behavior: system quality [Gorla et al. 2010; Hong et al. 2001; Parasuraman et al. 2005]; information quality [Lee et al. 2002; Tan & Chou 2008]; service quality [Chen 2010; Wu & Wang 2006]; perceived value [Kleijnen et al. 2007]; ubiquitous control [Okazaki et al. 2009]; health improvement [Kelley et al. 2011; Landon et al. 2007]; subjective norm [Taylor & Todd 1997]; job relevance [Meuter et al. 2005]; and intention to use MDM [Taylor & Todd 1997]. The respondents were asked to use their perceptions if they did not have any actual experience. All of these constructs were measured on a 7-point, multi-item Likert scale, except perceived value, which was measured on a 7-point semantic differential scale. To measure the "physician's experience with mobile

Internet" moderating variable, an ordinal scale was used, capturing whether the respondents used this technology for personal purposes or not. Some 59% of respondents did have access to mobile Internet, while 41% were not users of this technology.

The end of the questionnaire included some demographic questions. The basic profiles of the respondents can be seen in Table 1.

Table 1: Basic Profiles of the Respondents

Criteria	Categories	%
Mobile device	Smartphone	49.1
	No smartphone	48.7
	Does not know	1.2
	Does not have mobile device	1.0
Frequency of mobile Internet use	10 or more times a day	8.1
	5 to 9 times a day	9.1
	2 to 4 times a day	16.3
	Once a day	10.3
	Every 2 or 3 days	3.9
	Once a week	2.9
	Lower frequency	8.2
	Does not use mobile Internet	41.1
Gender	Male	52.1
	Female	47.9
Age	25 to 34	13.7
	35 to 44	22.9
	45 to 54	38.3
	55 and older	23.9
	DK/NA	1.2

Note: $n = 495$

3.4. Preliminary Model Assessment

PLS was used to test both models—M1 (Okazaki et al.'s MDM adoption model) and M2 (Competitive model based on TAM2). PLS is suitable for exploratory studies and prediction-based models [Ringle et al. 2012], and has been widely employed in the areas of electronic commerce, information systems, and marketing [O'Cass 2002; Sun et al. 2013; Akter et al. 2010]. We employed SmartPLS 2.0 M3 software [Ringle et al. 2012].

The reliability and validity of the measures were tested using the criteria formulated by Ringle et al. [2012]. Internal consistency reliability was estimated using Cronbach's alpha (α) and Jöreskog's rho (ρ_c). All the constructs showed adequate levels of internal consistency, exceeding the recommended level of 0.70 [Nunnally 1978]. Convergent validity was evaluated using average variance extracted (AVE), and in every case it was above 0.50 [Fornell & Larcker 1981], indicating that all the constructs were one-dimensional. Table 2 summarizes these measures.

Table 2: Reliability and Validity of the Measures

Construct	# of items	α	ρ_c	AVE
Health improvement	4	0.94	0.95	0.65
Information quality	11	0.94	0.96	0.84
Intention to use MDM	3	0.95	0.96	0.67
Perceived value	8	0.93	0.96	0.88
Service quality	9	0.97	0.98	0.57
Subjective norm	3	0.96	0.96	0.77
System quality	10	0.95	0.96	0.71
Ubiquitous control	6	0.96	0.97	0.93
Job relevance	3	0.90	0.94	0.84
Ease of use	3	0.96	0.96	0.77

We compared each construct's AVE with its largest squared correlation to show that Fornell and Larcker's [1981] criterion was met. Therefore, discriminant validity was also confirmed (Table 3).

Finally, prior research suggests that common method variance is a potentially serious biasing threat in behavioral research. Thus, we examined common method bias using a single-factor method suggested by Podsakoff et al. [2003]. A measurement model and a unidimensional one-factor model were tested with AMOS 20. Compared with the chi-square value of the measurement model, the fit of the one-factor model was considerably worse, suggesting that common method bias was not a serious threat in the study.

Table 3: Discriminant Validity of Model 1

Construct		Construct correlations								
		1	2	3	4	5	6	7	8	9
1	Health improvement	**0.92**								
2	Information quality	0.72	**0.82**							
3	Intention to use MDM	0.48	0.52	**0.94**						
4	Perceived value	0.67	0.74	0.60	**0.88**					
5	Service quality	0.70	0.74	0.49	0.64	**0.84**				
6	Subjective norm	0.49	0.56	0.85	0.62	0.54	**0.96**			
7	System quality	0.68	0.85	0.46	0.70	0.69	0.49	**0.80**		
8	Ubiquitous control	0.71	0.71	0.59	0.71	0.65	0.59	0.70	**0.84**	
9	Net benefits	0.53	0.57	0.75	0.59	0.54	0.69	0.50	0.59	**0.92**

Note: In construct correlations, diagonal elements in bold are the square root of average variance extracted (AVE) between the constructs and their indicators. Off-diagonal elements are correlations between the constructs. Discriminant validity of Model 2 is provided in Appendix D.

3.5.   Validation of Competing Models

We validated Models 1 and 2 with PLS separately. The results of Model 1 are summarized in Table 4. Two of the constructs, overall quality and net benefits, were modeled as second-order constructs, using the repeated indicator approach [Ringle et al. 2012]. Bootstrapping was applied with 500 samples in order to achieve statistical inference. The estimated model confirmed the suitability of the model initially proposed to explain acceptance of an MDM system among physicians.

Table 4: Coefficients for Model 1

Path	Coefficient	p
System quality → Overall quality	0.35	**
Information quality → Overall quality	0.41	**
Service quality → Overall quality	0.33	**
Overall quality → Intention to use MDM	-0.06	0.20
Overall quality → Perceived value	0.44	**
Net benefits → Perceived value	0.39	**
Perceived value → Intention to use MDM	0.09	*
Ubiquitous control → Net benefits	0.61	**
Health improvement → Net benefits	0.47	**
Net benefits → Intention to use MDM	0.12	*
Subjective norm → Intention to use MDM	0.75	**

Note: $* < 0.05$, $** < 0.01$

The quality of the system, the information, and the service contributed to forming overall quality. However, overall quality had no significant, direct influence on physicians' intention to use an MDM system. Meanwhile, overall quality was found to have an indirect effect on usage intention via its positive and significant effect on perceived value.

Another direct antecedent of perceived value is the perception of the net benefits delivered by using the system. The results of the analysis show that this influence was positive and significant. Perceived value also had a direct influence on the intention to use MDM.

Elsewhere, net benefits were influenced positively and significantly by improvements in health and by the possibility of having ubiquitous control. In this case, the effect of net benefits on usage intention not only operated via perceived value, but also had a direct and significant effect on usage intention.

Finally, the subjective norm had the greatest direct impact on physicians' intention to use MDM.

Overall, the R-squared of the final dependent variable, usage intention, achieved a value of 0.73, while for perceived value it was 0.63. This indicates that the variations in physicians' acceptance of MDM technology can be explained in large part by this model.

Next, following the same procedure used to estimate Model 1, we validated Model 2. The coefficients and their bootstrap *p*-values for Model 2 are shown in Table 5.

The coefficients for all the relationships are statistically significant, excluding the paths from job relevance to perceived value ($p = 0.10$) and the direct effect of ease of use on the intention to use MDM.

Table 5: Coefficients for Model 2

Path	Coefficient	*p*
Subjective norm → Ubiquitous control	0.59	**
Subjective norm → Perceived value	0.18	**
Ubiquitous control → Perceived value	0.19	**
Job relevance → Perceived value	0.07	0.10
Information quality → Perceived value	0.23	**
Health improvement → Perceived value	0.14	**
Ease of use → Perceived value	0.15	*
Ease of use → Intention to use MDM	0.00	0.94
Perceived value → Intention to use MDM	0.12	**
Subjective norm → Intention to use MDM	0.77	**

Note: $* < 0.05$, $** < 0.01$

3.6.   Model Comparison

In PLS, comparison between competitive models is an underdeveloped area. The traditional indices used to evaluate PLS structural models are R^2 and GoF. Nonetheless, these measures are not valid to compare competitive models, given their dependence on the number of parameters and relationships included in each model [Henseler et al. 2014]. With these issues in mind, Sharma and Kim [2012] introduced the use of several information theoretic model selection criteria for PLS, which can help to guide multiple model comparison. McQuarrie and Tsai [1998] categorized these criteria into two groups attending to the underlying assumptions they made regarding the inclusion of the true model in the set of competitive models. The first group of model selection criteria assumes that the true model (reality) is not in the set of competitive models. These selection criteria include Akaike's [1969] Final Prediction Error (FPE), Mallows' *Cp* [Mallows, 1973], Akaike's [1973] Information Criterion (AIC), Sugiura's [1978] corrected AIC (AICc), and McQuarrie and Tsai's [1998] unbiased AIC (AICu). It's possible to compare models in terms of relative distance to the true model, selecting the closest one. (Lower values in the criteria are preferable.) The second group of model selection criteria assumes that the true model is one of the competitive models. Examples of such criteria include Akaike [1978] and Schwarz's [1978] Bayesian Information Criterion (BIC), Geweke and Meese's [1981] criterion (GM), Hannan and Quinn's [1979] criterion (HQ), and McQuarrie and Tsai's [1998] corrected HQ criterion (HQc). Generally, researchers select a model with the least value on these criteria. These all-model selection criteria penalize model complexity in the interest of the principle of "parsimony."

The information criteria for both Model 1 and Model 2 are summarized in Table 6. Given that SmartPLS 2.0 M3 does not include any information criterion index, the R package semPLSic was used [Monecke & Leisch 2012].

The indices included in the table are useful to compare models. The lower values of all the information criterion indices seem to show the superiority of Model 1 over Model 2 in terms of fit–parsimony equilibrium. While the differences are not substantial, in light of the two most commonly accepted information criteria (BIC and AIC), there is "modest support" for the superiority of M1 over M2: BIC difference < 2 [Raftery 1995] and AIC difference of 4–7 [Burnham & Anderson 2002]. Thus, we can conclude that, compared with Model 2, Model 1 better explains the acceptance of MDM systems among medical professionals in a health-care system characterized by the Beveridge model.

Table 6: Information Criterion (IC) Indices for the Intention to Use MDM

IC	Model 1 (Okazaki et al.'s MDM adoption model)	Model 2 (Competitive model based on TAM2)	Difference (Model 1 - Model 2)
FPE	0.27	0.28	-0.01
Mallows' *Cp*	85.89	109.84	-23.95
AIC	-642.24	-636.30	-5.94
Unbiased AIC	-638.22	-633.29	-4.93
Corrected AIC	-145.12	-139.21	-5.91
BIC	-625.42	-623.68	-1.74
GM	597.72	617.46	-19.74
HQ	-635.64	-631.34	-4.3
Corrected HQ Criterion	-635.46	-631.23	-4.23

Note: AIC = Akaike Information Criterion; BIC = Bayesian Information Criterion; FPE = Final Prediction Error; GM = Geweke-Meese Criterion; HQ = Hannan-Quinn Criterion

4. Study 2

Given the model comparison results in the preceding section, we employed Model 1 to posit our moderation hypotheses associated with prior usage experience in mobile Internet.

4.1. Moderating Effect of Prior Mobile Internet Experience

One of the characteristics that defines Internet users is the level of knowledge regarding online browsing, as the ability to find desired information on the Internet requires a certain degree of skill and know-how. Prior research confirms that an individual's previous experience with using the Internet shapes their adoption of new systems or services and improves their intention to use them [Dholakia 2012].

To our knowledge, there is no published study that examines the effect of experience on the acceptance of mobile Internet technologies in the area of health care. However, there are arguments supporting the relevance of evaluating the effect of experience, as this has become one of the most widely documented variables in behavioral research on technology acceptance [Zhou et al. 2007; Dai et al. 2014].

Individuals who are experienced in using information technology are more skilled at looking for the information they need, interacting with others, finding their way around the medium, making decisions, and using specific products or services. They also handle complex situations with more ease and perform better than non-expert users [Al-Gahtani et al. 2007]. By contrast, those who are less experienced tend to evaluate information technology superficially [Koufaris et al. 2002], and their intention to use is driven by the information they receive about both system quality [Koufaris et al. 2002] and information quality [Alba et al. 1997].

In this light, prior research indicates that consumers tend to adopt mobile Internet services if they have already used similar services on the fixed Internet [de Reuver et al. 2013]. Thus, it seems logical to assume that physicians with the most experience in using mobile Internet technology—even for personal use—may find it easier to assess the overall quality of an MDM system as their expertise will help them to better understand how it works. They will more readily be able to handle the system correctly; find, access, and process all available information; trust the system and their own capacity to make decisions based on it; and fully use it. By contrast, physicians with no experience in using mobile Internet will base a major part of their decision to use this technology on the information they receive about the system and their perceptions of its quality. The following hypothesis is thus proposed:

H1: The influence of overall quality on the intention to use MDM is weaker among users with previous experience in using mobile Internet technology than among those without such experience.

System quality in this context should be understood in terms of characteristics that facilitate the physician's work, such as system flexibility and availability, technical support provided for the system, and instructions that are comprehensive, personalized, and easy to understand. These aspects of system quality influence perceptions of its utility [Al-Gahtani et al. 2007; Pavlou 2003; Venkatesh & Davis 2000]. Given that experienced mobile Internet users have already acquired the necessary skills, they may not find the use of MDM to be overly difficult, and thus do not place much importance on the device's overall quality. In addition, experienced Internet users tend to form more positive attitudes toward the interactive medium [Liu & Shrum 2009]. Based on these observations, these experienced users may not relate overall quality to their perceived value of MDM as strongly as those without such experience do. The following hypothesis is therefore proposed:

H2: The influence of overall quality on the perceived value of MDM is weaker among users with experience in mobile Internet use than among those without such experience.

Users with Internet experience have a more positive perception of utility (perceived value) [O'Cass & Fenech 2003] and expect to receive greater benefits, thus incentivizing its use [Castañeda et al. 2007]. Previous studies have demonstrated that individuals seek more functional or utilitarian relationships as they gain experience in the medium; this, in turn, fosters relationships with the medium and heightens the perceived benefits [Chen & Chaiken 1999]. In this way, users with more mobile Internet experience will perceive greater value in using the new health monitoring system (in terms of utility, effectiveness, efficiency, and productiveness, for instance) and greater benefits (ubiquitous control and health improvement) than users without this experience. This scenario will increase the effects of both net benefits and perceived value on the intention to use MDM. The following hypotheses are thus proposed:

H3: The influence of the net benefits of MDM on the intention to use is stronger among users with mobile Internet experience than among those without such experience.

H4: The influence of the perceived value of MDM on the intention to use is stronger among users with mobile Internet experience than among those without such experience.

If the relationship between benefits and intention to use the system is stronger for experienced mobile Internet users than for novices, it would be logical to assume that there is also a stronger relationship between benefits and perceived value among these "expert" users, given that value is the trade-off between costs and benefits [Payne & Holt 2001]. The following hypothesis is therefore proposed:

H5: The influence of the net benefits on the perceived value of MDM is stronger among users with previous mobile Internet experience than among those without such experience.

According to earlier studies, having sufficient information helps to reduce uncertainty [Wicks et al. 1999]. Hence the more information a user has, thanks to their experience with a given medium, the less relevant they will find the comments of others when deciding whether or not to use a new medium and related services. As commented upon earlier, the user with experience handles complex situations more effectively, performs better, and has less difficulty in processing information than the user with no such experience [Al-Gahtani et al. 2007; Hartwick & Barki 1994]. Past works, such as those of Al-Gahtani et al. [2007] and Venkatesh and Davis [2000], show how the direct and positive effect of subjective norm on usage intention weakens as the level of user experience increases. The following hypothesis is therefore proposed:

H6: The influence of subjective norm on the intention to use MDM is weaker among users with previous mobile Internet experience than among those without such experience.

In short, it is proposed that physicians' experience with the technology that supports MDM—in particular, mobile Internet—will moderate the effect of all the direct determinants of value attributed to the system, and of the intention to use it.

4.2.   Method

Given the categorical nature of the moderating variable, a multi-group PLS analysis was undertaken [Henseler 2007], differentiating between two groups: those physicians who were unaccustomed to using the Internet via a mobile phone, and those who had experience with this technology (outside of work). Differences between groups for each relationship were calculated using 500 bootstrap subsamples. Each centered bootstrap estimate of the second group was compared with each centered bootstrap of the first group across all the bootstrap samples. The number of positive differences divided by the total number of comparisons indicated the probability that the second group's population parameter would be greater than that of the other group [Sarstedt et al. 2011]. The process described was free from distributional assumptions and easy to perform.
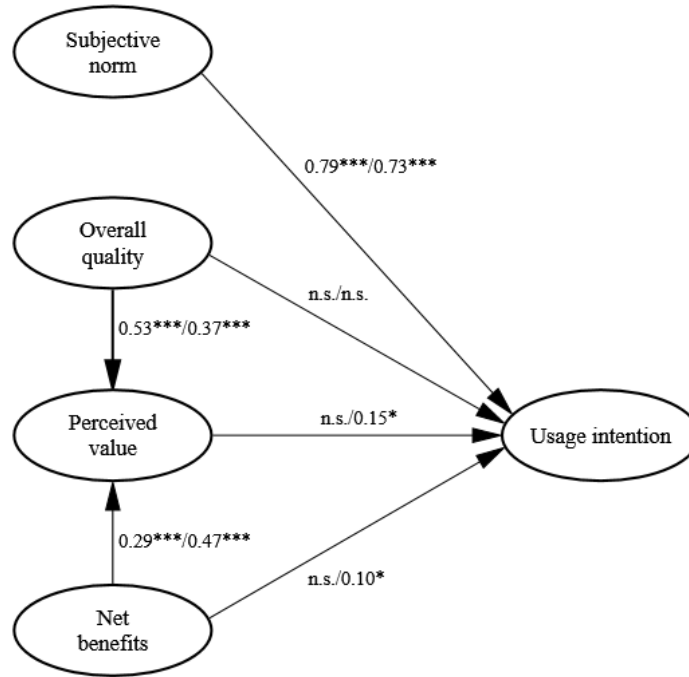
4.3.   Results

First, the measurement model of the two groups was compared. The invariance of the model was tested using pairwise comparison, as proposed by Chin [2000]. The results indicated that fewer than 10% of the loads were significantly different when compared between groups. This, in turn, indicated that the outer model was essentially invariant between groups. Next, the relationships in the structural model were analyzed by comparing physicians with no mobile Internet experience and those with experience in using this technology.

The relationship between overall quality and intention to use MDM remained insignificant for both groups of physicians. Thus, Hypothesis 1 was rejected. However, the effect of overall quality as perceived by the physicians in their evaluation of value was significant and positive in both groups (with and without experience). Taking the approach recommended by Henseler [2007] to estimate differences between coefficients, it was found that the coefficient for non-users was significantly greater than that for users of the technology behind MDM ($p < 0.10$), thus providing empirical support for Hypothesis 2.

The perceived benefit or advantage of using an MDM system had a direct and significant effect on intention to use the system only among those physicians who already used mobile Internet outside of work. However, there were

no significant differences from the coefficient pertaining to non-users. Although the result was along the lines of the proposed hypothesis, the absence of differences led to Hypothesis 3 being rejected.

Note: The coefficients are juxtaposed for Non-users/Users. n.s. = nonsignificant, $* p < 0.05$, $*** p < 0.001$

Figure 5: PLS Results for Non-users versus Users

By contrast, perceived value was an antecedent of intention to use MDM for those physicians who already used mobile Internet, but became insignificant for non-users. Differences were significant between both groups ($p = 0.072$), giving support to Hypothesis 4.

The relationship between net benefits and perceived value, which was significant for both groups of physicians, did present significant differences ($p = 0.089$). The coefficient was greater for current users of mobile Internet technology than for non-users, as proposed in Hypothesis 5.

Finally, the construct "subjective norm" continued to be the most important antecedent of intention to use the system between both groups, with no significant differences being found between them. Hypothesis 6 was therefore rejected. Table 7 summarizes our hypotheses testing results.

Table 7. Hypotheses Testing Results for Moderating Effect of Prior Mobile Internet Experience

H#	Key variables	Predicted direction	Results
H1	Influence of overall quality on the intention to use MDM	Experienced users < Inexperienced users	Rejected
H2	Influence of overall quality on the perceived value of MDM	Experienced users < Inexperienced users	Supported
H3	Influence of the net benefits of MDM on the intention to use MDM	Experienced users > Inexperienced users	Rejected
H4	Influence of the perceived value of MDM on the intention to use	Experienced users > Inexperienced users	Supported
H5	Influence of the net benefits on the perceived value of MDM	Experienced users > Inexperienced users	Supported
H6	Influence of subjective norm on the intention to use MDM	Experienced users < Inexperienced users	Rejected

5.   Discussion
5.1.   Theoretical Implications
    While much prior research focuses on the acceptance of MDM from patients' perspectives, few studies have approached this issue from physicians' perspectives. Our research makes significant contributions to the literature in several ways.
    In Study 1, we successfully validated two competing models: the MDM adoption model based on Okazaki et al. [2012] and an alternative model based on TAM2. The former was proved to have a better fit–parsimony equilibrium, as all the structural coefficients of the variables were statistically significant in the expected direction, with the exception of overall quality. Our findings suggest the robustness of the MDM adoption model, regardless of the health-care model.
    Applied in a Spanish context, the MDM adoption model demonstrates that there are two variables that contribute to physicians' value perception: (1) the expected net benefits in terms of improved clinical conditions of the patients (health improvement) and the capability of monitoring patients ubiquitously (ubiquitous control); and (2) the expected system, service, and information quality of the MDM system. Furthermore, bearing in mind that it is typical for colleagues to share recommendations and opinions in the medical environment, subjective norm is a direct antecedent of physicians' intention to use the MDM system. These findings are consistent with those of earlier studies that demonstrated that peer comments and opinions [Kim & Han 2009], perceived value [Kleijnen et al. 2007; Ruiz et al. 2010], and net benefits [DeLone & McLean 2003] are all significant predictors of behavioral intentions. Overall quality has no direct influence on usage intention, but it does have an indirect influence via perceived value; hence it only contributes to the process of MDM adoption if it is capable of creating value for clinical practice, as was also found in Okazaki et al. [2012]. Thus, the perception of quality becomes a major antecedent of perceived value.
    In Study 2, our moderation analysis provided partial support for our thesis—the medical specialist's past experience with mobile Internet technology moderates the process of adopting the MDM system. Physicians with prior experience in using mobile Internet technology, even if only in a non-professional context, will base their intention to use MDM on the perceived value of the system—relationships that are not significant when the specialist lacks such prior experience. Consistent with prior studies, the present research demonstrates that experience with technology (not necessarily with the system in question) improves perceptions of utility for new systems, which translates into usage intention [O'Cass & Fenech 2003].
    The level of experience also has a significant effect on the expected benefits. The net benefits–perceived value relationship is stronger among those individuals with mobile Internet experience than among those with no such experience. Thus, for physicians with experience in using mobile Internet technology, the value they attribute to the system is reinforced due to the increased benefits they perceive in using it. Conversely, those specialists with no such experience attribute value on the basis of the perceived quality of the system. Such moderation can also be found for the relationship between overall quality and the perceived value of MDM. That is, the overall quality–perceived value relationship is stronger among those individuals with mobile Internet experience than among those without such experience. This seems consistent with the literature, in that, in scenarios characterized by a lack of skill and experience, the perceived value depends on the user's evaluation of system quality (such as ease of use), as the technology is perceived to be more useful if it is easier to use [Pavlou 2003; Venkatesh & Davis 2000].
    Yet, while our multi-group PLS analysis supported these predictions, half of the hypotheses were rejected. This may deserve some additional explanation. All three rejected hypotheses are related to the direct antecedents of intention to use MDM; namely, overall quality, net benefits, and subjective norm. First, with regard to overall quality–intention to use MDM, our moderation analysis found that there was no difference on this path strength between those with and without prior mobile Internet experience. In other words, overall quality plays a central role in the formation of behavioral intentions, regardless of familiarity with, or knowledge in the use of mobile Internet technology. Second, with regard to the net benefits and subjective norm, these antecedents equally affect intention to use MDM, regardless of mobile Internet experience. That is, even inexperienced users may appreciate the benefits driven by such a device, if it provides flexible and adaptable remote monitoring capability for patients' health. The same can be said of subjective norm: Even experienced users may consult or seek advice from their peers and superiors for their recommendations on the use of MDM.
5.2.   Managerial Implications
    Our findings offer several managerial implications. Our research replicates Okazaki et al.'s [2012] MDM adoption model in a country whose health-care system is based on the Beveridge model. While we found only marginal variations in most of the coefficients, subjective norm exhibits a clearly greater influence in Spain than in Japan (0.75 and 0.41, respectively). This may be due to the difference in the physician–patient relationship. In Spain, because access to specialists is quite difficult, the health-care system bestows significant power to medical

professionals, which encourages a strong sense of corporatism. This might be the reason why the opinions of peers and colleagues have a greater influence on usage intention. Thus, health-care managers should bear in mind that the implementation of MDM would best be associated with participative workshops or seminars, where appropriate social influence can be created through discussions and opinion exchange among peers. In this light, it is advisable to pay special attention to the internal communication among physicians by identifying opinion leaders who can create a climate that fosters acceptance of the new system. This is particularly relevant for physicians with no prior mobile Internet experience.

Some physicians may have had experience with the technology behind MDM, namely mobile Internet devices. When differentiating between those who had experience in using the Internet via their mobile phones and those who did not, we found that the effects of the antecedents of perceived value and intention to use the MDM system were different between groups. The net benefits of the system had a greater effect on perceived value among those physicians who had used mobile Internet before, compared to those who had no such experience. However, in the case of overall quality, it was the latter group that demonstrated the greatest impact on perceived value. With regard to usage intention, physicians with no prior mobile Internet experience only showed one direct and significant effect, that of subjective norm. By contrast, among those with previous experience, along with subjective norm, net benefits and perceived value of the MDM system were also found to be antecedents of the intention to use the system.

In targeting physicians who have previously used mobile Internet technology, public decision makers can choose from a broader range of routes via which to achieve acceptance. In addition to creating subjective norm, it is also important to clearly communicate the benefits of the system, both in the *what* and also the *how* of professional performance. The *what* refers to the improved health control for patients that the system provides. The *how* emphasizes the fact that the system makes it possible for health control to be managed at any time and from any location, thus improving service delivery on the part of the physicians while making their job easier. In terms of service delivery, the system allows for continual monitoring of patients, while avoiding waiting times and unnecessary travel.

The ubiquitous medical device may provide a pragmatic solution to issues related to a shortage of medical professionals in areas where depopulation and aging are accelerating. In Spain, rural depopulation has left a legacy of abandoned villages with little access to health care. Old people are especially vulnerable due to their physical limitations. In fact, the largest increase in diabetic patients in industrialized countries is occurring among the elderly population, and this trend will continue for the next 50 years [Laiteerapong et al. 2011]. Thus, it seems that the effective use of remote health control devices, such as MDM, is a necessity for our moral well-being. In doing so, however, physicians must be knowledgeable about this type of technology, since they are often decision makers with regard to clinical equipment acquisition and introduction. While health-care managers should organize educational programs to help elderly patients become familiar with MDM, they should also encourage physicians to employ this device as a realistic tool for detecting, controlling, and treating diabetes among the aging population.

6. Limitations and Future Research Directions

Our study suffers from three important limitations. First and foremost, the majority of the respondents had no previous usage experience with MDM systems. Thus, the results might contain a self-reported bias. This limitation is especially crucial in three quality dimensions—namely system quality, information quality, and service quality—since our results were not based on the respondents actually having experienced the system. Thus, any generalization of our findings should be treated with caution. Second, while our sample consisted mainly of physicians specialized in general internal medicine, we did not measure the familiarity or knowledge level of diabetes, which might have affected their responses. Third, a fact that only half of the moderation hypotheses were supported may indicate that we should take into account not only the access frequency of mobile Internet, but also the access motive of mobile Internet. For example, the moderating effects may differ between frequent users who only check e-mails and moderate users who skillfully manage applications. These issues should be overcome in future studies.

A logical extension of this research is a randomized control experiment with a prototype system. In doing so, a multidisciplinary approach would be needed in cooperation with scholars in medicine as well as medical informatics. Such a collaborative team would truly be able to examine accurate perceptions of the effectiveness and suitability of the system, while improving both the face validity and external validity of the study. Furthermore, future research should also address other antecedents that may affect the adoption of MDM systems. For example, privacy and security are factors that have been recognized as significant negative determinants of ICT adoption, although the original study by Okazaki et al. [2012] concludes that the absence of real-life use of an MDM system prevents these risks from being properly assessed.

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APPENDIX A. Selected Empirical Research on mHealth

Authors (year)	Main objective	Method	Theoretical base	Major findings
Akter et al. (2010)	To test a service quality model for mHealth services in Bangladesh	Questionnaire survey (sample size: 283)	ERVQUAL, IT quality model, electronic services quality model, and health service quality model	Service quality has strong positive effects on satisfaction, continuance intentions, and quality of life in the context of mHealth services.
Okazaki et al. (2012)	To examine physicians' perceptions of a mobile diabetes monitoring system	Questionnaire survey (sample size: 471)	Information systems success model	Net benefits positively affect usage intention, but overall quality of the system does not. Perceived value of the system strengthens the effects of overall quality and usage intention.
Sun et al. (2013)	To examine mHealth service adoption among elderly Chinese	Questionnaire survey (sample size: 204)	TAM, TPB, and PMT	The unified model outperforms the three alternative models by significantly improving the R-squares.
Guo et al. (2013)	To investigate drivers and obstacles of mHealth service adoption among elderly patients	Questionnaire survey (sample size: 204)	TAM	Resistance to change determines perceived usefulness but does not influence perceived ease of use and adoption intention. Technology anxiety impedes the perception of ease of use but enhances resistance to change.
Akter et al. (2013)	To test two post-adoption expectation beliefs, perceived service quality and perceived trust, among mHealth users in Bangladesh	Questionnaire survey (sample size: 365)	Expectation confirmation theory	Both service quality and perceived trust have significant explanatory power in the prediction of continuance usage intentions.
Sultan and Mohan (2013)	To examine an mHealth system–patient interface among diabetic patients in Trinidad and Tobago	Analysis of patient–interface interaction events based on seven diabetic patients	n.a.	Usage logs built on key interaction events in an mHealth system can be analyzed to understand the patients' usage patterns and behavior over a period of time.
Burner et al. (2014)	To examine motivation, intention, and triggers to action effected by an mHealth intervention to low-income Latinos with diabetes	Qualitative (5 focus group interviews with 24 people)	n.a.	An mHealth intervention is perceived as having positive effects on diabetes management. Increasing personalization of message delivery and content could enhance its use.
Lee et al. (2014)	To develop and test a 7-day mobile phone text message-based cervical cancer screening intervention designed to promote Pap tests	Focus groups; quasi-experiments (sample size: 30 Korean American women aged 21 to 29 years)	Fogg behavior model	The intervention significantly increased participants' knowledge of cervical cancer and guidelines for cervical cancer screening. A total of 23% of the participants received a Pap test.

Note: This review was based on ABI/INFORM, Business Source Complete, and PubMed. Purely clinical experiments are excluded. TAM = technology acceptance model, TPB = theory of planned behavior, PMT = protection motivation theory

APPENDIX B. Graphic Image Explaining the Workings of the MDM System
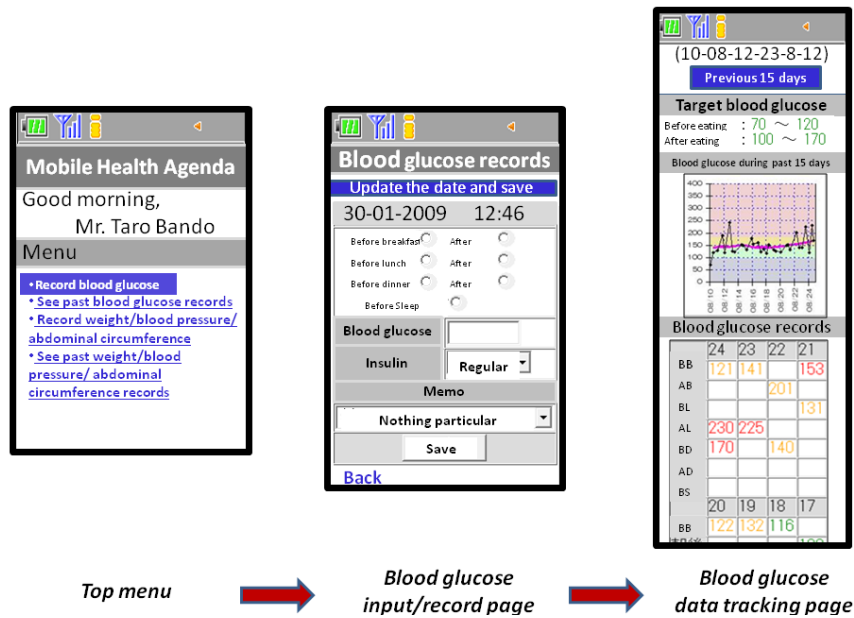
Note: The original screen captures were in Spanish.

APPENDIX C. Construct Items Used in the Questionnaire

The respondents were asked to use their perceptions if they did not have any actual experience.

System quality [Gorla et al. 2010; Hong et al. 2001; Parasuraman et al. 2005]
- This monitoring system is easy to learn.*
- The design of this monitoring system is easy to operate.*
- This monitoring system is flexible so I can adapt/make changes easily.*
- This monitoring system is always available for business.
- This monitoring system launches and runs right away.
- This monitoring system does not crash.
- The screen does not freeze after I enter my inquiry or retrieve information.
- The system commands are clearly depicted by buttons and symbols.
- The layout of the system is clear and consistent.
- This monitoring system is equipped with only useful features and functions.

* This construct item measured ease of use (Model 2).

Information quality [Lee et al. 2002; Tan & Chou 2008]
- The information I obtain from this monitoring system includes all necessary values.
- The information I obtain from this monitoring system is sufficiently complete for my needs.
- The information I obtain from this monitoring system covers the needs of my tasks.
- The information I obtain from this monitoring system has sufficient breadth and depth for my tasks.
- The information I obtain from this monitoring system is easy to understand.
- It is easy to interpret the meaning of the information I obtain from this monitoring system.
- The information I obtain from this monitoring system is easy to comprehend.
- The meaning of the information I obtain from this monitoring system is easy to understand.
- When using this monitoring system, the service/information I receive is specific to my work.
- The information I receive from this monitoring system is likely to be customized to my needs.
- When using this monitoring system, I only receive information relevant to my needs.

Service quality [Chen 2010; Wu & Wang 2006]
- The information system specialists give me personal attention.
- The information system specialists have my best interests at heart.
- The information system specialists understand my specific needs regarding patient information.
- The information system specialists provide prompt service.
- The information system specialists tell me exactly when services will be performed.
- The information system specialists are never too busy to respond to my requests.
- When I have a problem with the system, the information system specialists show a sincere interest in solving it.
- The information system specialists provide their services exactly when they promise to do so.
- The information system specialists are dependable.

Perceived value [Kleijnen et al. 2007]
- Evaluation of the value of the mobile health monitoring system: Ineffective–effective.
- Evaluation of the value of the mobile health monitoring system: Not functional–functional.
- Evaluation of the value of the mobile health monitoring system: Impractical–practical.
- Evaluation of the value of the mobile health monitoring system: Useless–useful.
- Evaluation of the value of the mobile health monitoring system: Not sensible–sensible.
- Evaluation of the value of the mobile health monitoring system: Inefficient–efficient.
- Evaluation of the value of the mobile health monitoring system: Unproductive–productive.
- Evaluation of the value of the mobile health monitoring system: Bad–good.

Ubiquitous control [Okazaki et al. 2009]
- I can obtain patients' health information from this monitoring system on time.
- When I try to follow up and update the patient's health condition, this monitoring system responds quickly.
- This monitoring system makes patients' health information immediately accessible.
- Using this monitoring system enables me to find information wherever I am.
- This monitoring system enables me to overcome spatial limitations.
- This monitoring system is suitable for any location, wherever I go.

Health improvement [Kelley et al. 2011; Landon et al. 2007]

- With this monitoring system, the most recent blood pressure can/will be improved for patients with diabetes or renal failure.
- With this monitoring system, the most recent glucose level can/will be stabilized for patients with diabetes or renal failure.
- With this monitoring system, the most recent glucose level can/will be improved for patients with diabetes or renal failure.
- With this monitoring system, the number of urgent care visits for my patients with diabetes or renal failure will decrease.

Subjective norm [Taylor & Todd 1997]
- Mentors who influence my behavior would think that I should use this monitoring system.
- Colleagues who are important to me would think that I should use this monitoring system.
- People whose expertise I trust would think that I should use this monitoring system.

Job relevance [Meuter et al. 2005]
- Using this monitoring system fits my service needs.
- Using this monitoring system is compatible with the way I normally perform my service transactions.
- The use of this monitoring system is in line with my service preferences.

Intention to use MDM [Taylor & Todd 1997]
- I intend to use this monitoring system if I am asked to do so.
- I intend to use this monitoring system when it is available at my work.
- I intend to use this monitoring system in the near future.

Physician's experience with mobile Internet [original]
- How often do you normally access the Internet with your mobile device?
    1. I don't access the Internet with my mobile device
    2. A few times a year
    3. Every 2–3 months
    4. Once a month
    5. 2–3 times a month
    6. Once a week
    7. Every 2–3 days
    8. Once a day
    9. 2–4 times a day
    10. 5–9 times a day
    11. 10 or more times a day

APPENDIX D. Discriminant Validity of Model 2

Construct		Construct correlations							
		1	2	3	4	5	6	7	8
1	Health improvement	**0.92**							
2	Information quality	0.71	**0.82**						
3	Intention to use MDM	0.48	0.51	**0.94**					
4	Perceived value	0.67	0.73	0.60	**0.88**				
5	Subjective norm	0.49	0.55	0.85	0.62	**0.96**			
6	Ubiquitous control	0.71	0.70	0.59	0.71	0.59	**0.84**		
7	Job relevance	0.53	0.56	0.75	0.60	0.69	0.59	**0.92**	
8	Ease of use	0.61	0.77	0.44	0.65	0.46	0.63	0.49	**0.88**

Note: In construct correlations, diagonal elements in bold are the square root of average variance extracted (AVE) between the constructs and their indicators. Off-diagonal elements are correlations between the constructs.