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Distinguishing "mHealth" from Other Healthcare Services in a Developing Country: A Study from the Service Quality Perspective

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Abstract:

Mobile phones' exponential growth is fuelling the emergence of mobile health (mHealth), thus contributing to healthcare services' innovative transformation in developing countries. mHealth's ubiquitous personalised capabilities obviate the access barriers and dismal performance of conventional systems, therefore gaining popularity among patients. Researchers have focused on service quality—a vital element of service adoption—and sustainability. For mHealth to become a robust alternative, how patients perceive mHealth vis-à-vis conventional services must be understood. Comparative analysis studies between mHealth and conventional systems are scarce yet would contribute to theory and strengthen the antecedent phases to service quality, that is, design and operation. mHealth is a viable alternative for fulfiling the unmet goal of *quality of life for all*. Prompted by these insights, this study is the first attempt to discover the differentiating characteristics of mHealth. Patients' perceptions were analyzed by multiple discriminant analysis, a classification technique. The findings show that, in distinguishing between healthcare services, mHealth is a favourable alternative: service differentiation occurs along the dimensions of *ubiquity, information-quality, and value*. The findings' implications for theory and practice and future research guidelines are also discussed.

Keywords: mHealth, multiple discriminant analysis, patients' perception, ubiquity, information quality, value, healthcare service, comparative analysis

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I. INTRODUCTION

Mobile health (mHealth) is transforming healthcare in developing countries by serving the unserved [Akter and Ray, 2010]. This transformation is driven by the dramatic growth in global mobile phone subscriptions which has already topped six billion, a ninefold increase from 0.7 billion in 2000 [Kulkarni and Ozturk, 2007]. The developing world has a surprising share of over 75 percent of these subscriptions or close to 4.5 billion. This dramatic growth in mobile communications has created the potential to transform healthcare delivery by making this service more accessible, affordable, and available. The health service system in the developing world is on a depressing path, with a deadly combination of limited access to care, uneven quality, and high costs [Porter and Teisberg, 2006]. In this context, "the use of mobile and wireless technologies to support the achievement of health objectives (mHealth) has the potential to transform the face of health service delivery across the globe" [World Health Organization, 2011, p. 1]. The potential of mobile phones to deliver various healthcare services has attracted researchers and facilitated the emergence of mobile health or mHealth [Bashshur, Shannon, Krupinski, and Grigsby, 2011]. In this context, the most popular mHealth platform is B2C mHealth which transforms healthcare services in developing countries using the electronic commerce model [World Health Organization, 2011]. In the healthcare sector in developing countries, mHealth is a transformative service system for shifting the care paradigm from crisis intervention to promoting wellness, prevention, and self-management [Kaplan and Litewka, 2008]. As a sub-segment of electronic health (eHealth), mHealth is emerging as a significant contender for the delivery of health services [Ganapathy and Ravindra, 2009; Mishra, Kapoor, and Singh, 2009]. Although B2C mHealth is transforming healthcare delivery around the world, there is a paucity of research which distinguishes mHealth from other existing healthcare platforms. Therefore, to fill this knowledge gap, the main objective of the study was to find out the dimensions of service quality that make B2C mHealth different from other existing healthcare services from users' (or patients') perspectives. This comparative assessment is intended to provide significant insights and strategic input to sustain and scale mHealth in developing countries. One general research question drove this study: What factors make mHealth different from other existing healthcare services in developing countries? In an effort to answer this question, the article is divided into the following sections: Section II provides a brief review of the literature relating to healthcare services, healthcare in developing countries, mHealth, and the service quality challenges of mHealth. Section III provides the research context and summary of the qualitative study. Section IV focuses on developing the quantitative study based on the outcomes of the qualitative investigation. The remaining sections focus on analysis techniques, findings, research contributions, limitations, and future research directions respectively.

II. BACKGROUND

Healthcare Services' Quality in Developing Countries

Health systems in low- and middle-income countries have many hurdles in providing basic healthcare that is affordable and covers their subjects [Lewis, Synowiec, Lagomarsino, and Schweitzer, 2012]. The health service system in the developing world is on a depressing path, with a deadly combination of limited access to care, uneven quality, and high costs [Porter and Teisberg, 2006]. It is a startling fact that populations of the developing nations are in possession of mobile devices, while they still struggle for access to basic healthcare, as is apparent from the selected healthcare system indicators shown in Table 1 [Ivatury, Moore, and Bloch, 2009; Sharma, 2012; World Health Organization, 2012]. Poor people must still travel several kilometres to avail themselves of basic medical services [World Bank, 2004].

In 2003, the National Intelligence Council (NIC) prepared a typology map depicting the healthcare system status around the world [National Intelligence Council, 2003]. It classified the healthcare system into five categories: excellent, good, fair, poor, and unstable. The majority of countries were rated fair or below fair. It was clear also that, for these countries, healthcare was not even a priority of their respective governments. The World Health Organization's (WHO) health indicators show a large divide in healthcare between developed and developing nations [Andaleeb, 2000; Ivatury et al., 2009], which the author has termed the *healthcare divide*.

Assessing the overall situation in terms of healthcare services in developing countries, the World Bank [2004, p. 19] summarized this as follows: *"Services are falling because … they are inaccessible and prohibitively expensive. But even when accessible, they are often dysfunctional, extremely low in technical quality, and extremely unresponsive to the needs of a diverse clientele."* The World Health Organization [2012] estimates that the average per capita expenditure on health varies significantly between rich and poor countries, that is, US$4,692 to US$25. With such

low levels of funding, poor countries cannot ensure universal access to even a very limited set of health services. Thus, richer countries with lower disease burdens consume more health resources than poorer countries with higher disease burdens [Groupe Special Mobile Association, 2012].

Table 1: Sample Health System Indicators for Selected Countries
Sources: World Health Organization, 2012; *Ivatury et al., 2009

Country	Births attended by skilled health personnel (%)	Hospital beds per 10,000 population	Physicians per 10,000 population
	2005–2011	2005–2011	2005–2010
Bangladesh	27	3	3
India	50	9	6.5
Mexico	95	16	19.6
Pakistan	45	6	8.1
Russia	100	97	43.1
United Kingdom*	99	33	27.4
United States	99	30	24.2

mHealth in Developing Countries

mHealth has been broadly understood as health service delivery over a mobile or wireless platform [Istepanian, Jovanov, and Zhang, 2004]. Garawi, Istepanian, and Abu-Rgheff [2006, p. 91] have defined mHealth as "a new paradigm that brings together the evolution of emerging wireless communications and network technologies with the concept of 'connected healthcare' anytime and anywhere." As such, the definition of mHealth has been expanding since its inception due to the massive uptake of mobile communications, dramatic growth in the use of mobile handsets and greater penetration of mobile services throughout the world [Akter and Ray, 2010]. The extant literature defines mHealth as a subset of eHealth which delivers health services over a mobile platform [Mechael, 2009]. Whereas eHealth is defined as "the embryonic convergence of wide-reaching technologies like the Internet, computer telephony/interactive voice response, wireless communications, direct access to health care providers, care management, education and wellness" [DeLuca and Enmark, 2000, p. 4], mHealth is defined as using mobile communications—such as PDAs and mobile phones—for health services and information (see Figure 1). Broadly, mHealth is defined as the use of portable devices with the capability to create, store, retrieve, and transmit data in real time between end-users for the purpose of improving patient safety and quality of care [Vital Wave Consulting, 2008]. These definitions of mHealth have predominantly emphasized "wireless communication" to provide healthcare solutions [Vital Wave Consulting, 2008]. Highlighting the importance of wireless communication devices to support public health and clinical practice, Kahn, Yang, and Kahn [2010, p. 253] defined mHealth as "the use of portable electronic devices for mobile voice and data communication over a cellular or other wireless network of base stations to provide health information." Iluyemi (cf., Vital Wave Consulting, 2009, p. 8) extended the mHealth definition by focusing on "any wireless technologies (e.g., Bluetooth, GSM, GPRS/3G, WiFi, WiMAX) to transmit various health-related data contents and services through mobile devices such as mobile phones, smart phones, PDAs, laptops and Tablet PCs." This definition has targeted only health workers as the sole users of mobile health services; however, there are some popular mHealth services around the world which include both patients and health workers as users, such as mHealth hotline services or mobile telemedicine services in India (HMRI), Mexico (MedicallHome), Pakistan (Teledoctor), and Bangladesh (Healthline) [Ivatury et al., 2009].

Thus focusing on mobile health hotline services, this study defines mHealth as a personalized and interactive health service where the main goal is to provide ubiquitous and universal access to medical advice and information to any user at any time over a mobile phone [Ivatury et al., 2009]. Overall, an assessment of various definitions synthesizes this view that mHealth is all about delivering health services and information over a mobile platform [Akter, 2012].

Types of mHealth Services

mHealth is a dynamic healthcare paradigm of which the applications are constantly expanding. The extant literature has elucidated mHealth solutions in some major areas including diagnostic and treatment support services, health education and awareness, data collection and disease surveillance services, health information systems and point of care services, and emergency medical services [Earth Institute, 2010; Vital Wave Consulting, 2009]. This section briefly synthesizes mHealth solutions in the following areas. Table 2 presents a snapshot of such services.

Figure 1. Interrelationship Among eHealth, mHealth, and mHealth Hotline Services

Alternative Healthcare Systems in Developing Countries

The extant literature has identified four prominent forms of health services in developing countries, namely*: public hospitals (PH)*; *general practitioner (GP)*; *traditional medicine practitioner (TM);* and *mHealth*. This research relies on the following definition for each of these services. A GP is a medical practitioner who treats acute and chronic illnesses and provides preventive care and health education for all ages and both genders [Leck and Leck, 1987]. The term *GP* has a similar meaning across the Commonwealth countries [Leck and Leck, 1987]. GPs provide services usually in the residential suburbs, and they usually establish bonds with the community they serve. GPs may collect their fees per consultation or may bill the patients periodically. Public hospitals (PH) are generally funded by government to serve the public, and they may collect nominal fees from patients. PHs and GPs follow the established scientific form of medicine.

Table 2: Types of mHealth Services

Types	Examples	Countries
Diagnostic and treatment support service	Medical consultation services using voice Chronic disease management using SMS (e.g., blood sugar report for diagnosing diabetes) Infectious disease management using SMS and hotline	Bangladesh, India, Pakistan, Vietnam, Philippines, Mexico
Health education and awareness service	Use of SMS to distribute health information Use of games and quizzes to educate and make patients aware	India, Nigeria, South Africa, Uganda
Data collection and disease surveillance service	Use of SMS, voice, and electronic forms Use of SMS to remind patients for drug adherence	Uganda, Kenya Uganda, Zambia (+ 20 countries in Sub-Saharan Africa) Uganda, Zambia, Peru, Philippines South Africa, Botswana, Rwanda, Brazil
Health information systems (HIS) and point of care service	Mobile phone-based HIS to share data at all levels Using mobile devices at point of care to collect, report and share information at all levels	The Caribbean, Uganda Guatemala, Uganda
Emergency medical service	Emergency medical response using FrontlineSMS Disease and epidemic outbreaks' tracking using FrontlineSMS Disaster management and recovery using SMS	Uganda, India, Peru, India

Sources: Adapted from Akter and Ray, 2010; Earth Institute, 2010.

PH, GP, and TM services require a face-to-face consultation between the patient and the care provider. In contrast to these services, a care provider also can deliver the service over a mobile phone following the definition of mHealth by the WHO. The geographic separation of the patient and the care provider may limit the range of services a provider can offer over wireless communication. Excluding those possibilities, this article relies on the notion that mHealth is similar to the other service alternatives, PH, GP, and TM, except that the consultation is provided over a

mobile phone, whereby mHealth derives its ubiquity due to the underlying delivery channel of mobile/wireless communications.

How is mHealth Distinct from Other Healthcare Platforms in Developing Countries?

Based on the established definitions for PH, GP, TM, and mHealth as discussed above [Leck and Leck, 1987; World Health Organization, 2008, 2011], and the generally observable characteristics of these services, an attempt is made to arrive at a qualitative differentiation of these services [Motamarri, 2013]. This axiomatic analysis attempts to compare the delivery of these different healthcare services on a qualitative scale of Low–Medium–High. Each service is qualitatively assessed to Low, Medium, or High depending on the service's capability along the attribute dimension.

Accessibility to the service (or service outlet) is an important attribute in determining its patronage. Next to accessibility, a service also must be available in the sense that a consumer should be able to interact with the service provider. Apart from accessibility and availability, a service must have adequate capacity to deliver prompt service to meet the service demand. Keaveney's model [1995] treated these characteristics as value proposition determinants. Ease of use or the ease with which the consumer could interact with the service provider, the personal attention extended to the individual consumer, and the empathetic behaviour of the provider in listening to the consumer's needs influence the definition of a successful service encounter [Delone and McLean, 2002; Keaveney, 1995]. When it comes to service consultations that are personal in nature, such as those that are legal or medical, etc., privacy is of utmost importance to the consumer: the provider has to make conscious efforts to provide a consultation that ensures the privacy of the consumer [Parasuraman, Zeithaml, and Malhotra, 2005]. Table 3 presents a qualitative comparative summary of the identified healthcare delivery services. The attributes shown in Table 3 are derived by the authors based on the Healthcare Service Review [Motamarri, 2013] and are motivated by the models of Keaveney, Delone, and McLean, as noted above. The following paragraphs analyze the identified service alternatives on the attribute dimensions.

Table 3: Qualitative Comparison of Healthcare Service Delivery Alternatives

Attribute	PH	GP	TM	mHealth
Accessibility	Low	Medium	Medium	High
Availability	Medium	Medium	Medium	High
Ease of Use	Low	Medium	Medium	High
Privacy	Low	Medium	Medium	High
Empathy	Low	Medium	Medium	High
Promptness	Low	Medium	Medium	High
Capacity	Static	Static	Static	Dynamic
Range of Services	High	Medium to Low	Low	Limited
End-to-end Medical Needs	High	Low	Low	Low

On the dimension of accessibility, PHs fare low, as these are public facilities built to cater to a range of neighbourhoods, and, in instances of developing countries, these establishments could be distant from the rural populace [World Bank, 2004; World Health Organization, 2012]. GPs and TMs establish their practices within neighbourhoods so their accessibility is relatively better than that of the PHs. In contrast to these alternatives, mHealth provides a virtual consultation, and the location barrier has been shattered by wireless mobile communications [World Health Organization, 2011]. Due to this ubiquitous nature, a patient can access mHealth services from wherever he/she is located, rather than having to travel to the service outlets of PH, GP, or TM. Thus, mHealth scores higher on the dimension of accessibility than any other alternative. Similar to this line of discussion, on the dimension of availability, mHealth scores higher than the other alternatives by virtue of the 24x7x365 operation of a health call centre [Ivatury et al., 2009]. While the other alternatives may not in practical terms be available on a 24x7 basis, they may operate a little beyond normal business hours; thus, their availability can be rated as medium.

In developed nations, healthcare professionals respect the privacy of patients and are empathetic to their patients [Moore and Chaudhary, 2013]. In developing nations, the excessive demand for medical services, poverty, and the shortage of trained medical professionals negatively influence privacy and empathy as well as the provision of prompt service to patients [Andaleeb, 2000, 2008; Andaleeb, Siddiqui, and Khandakar, 2007; World Bank, 2004]. Thus, on the dimensions of privacy, promptness, and empathy, PH services score low, while GP and TM services provide moderate attention to this issue. mHealth as an emergent alternative creates a level of better assurance to patients on these fronts, thus; it gets a relatively high score [Akter, 2012; Ivatury et al., 2009].

Any service facility has an upper limit in terms of its ability to handle demand. While there may be opportunities to alter demand in certain segments, generally PH, GP, and TM operate on fixed norms, and there exists less flexibility to dynamically increase capacity to handle the service demand. mHealth is delivered through call centres concentrating on consultation and advice: the general requisite is the provision of qualified professionals to handle the impending service requests. The underlying technology of mHealth may impose certain limitations, but these can be overcome with relatively manageable tweaks, and staffing levels can be dynamically placed based on the observed demand patterns [Ivatury et al., 2009]. This is evident from the fact that Grameen phone's 789 service within a short of span of three years from inception reached the level of 10,000 calls per day [Akter, 2012; Grameenphone, 2006, 2008; Ivatury et al., 2009]. Thus, the capacities of PH, GP, and TM are relatively static, while mHealth capacity can be dynamically modified.

PHs may offer a range of medical services in addition to consultation, such as diagnosis, surgery, post-operative care, etc. In contrast, a GP may offer some of these services, but TM and mHealth cannot offer this full range of possibilities. Thus, on the dimension of range of services, PHs score high, GPs score medium-to-low, TM and mHealth low score low. Thus, on the dimension of meeting the end-to-end needs of patients, PHs score high and the rest of the delivery systems score low.

In summary, the common service offered across the range of delivery systems is consultation and advice. This research attempts to find the distinguishing characteristics for the notion of this commonly offered service. This exploratory analysis shows that mHealth is different from other healthcare services in terms of perceived service quality. Therefore, based on the service quality perceptions of mHealth in developing countries in the context of primary care, we hypothesize that:

> H_1: Patient-perceived service quality of mHealth is significantly different from other primary healthcare services in developing countries.

III. METHODOLOGY

Research Context

This study focused on B2C mHealth hotline (or mobile telemedicine) services in Bangladesh, which is one of the leading developing countries for such services. This study defines an mHealth hotline service as a personalized and interactive health service over mobile phone which provides ubiquitous and universal access to medical advice and information to patients [Akter, D'Ambra, and Ray, 2010a, 2011; Akter and Ray, 2010]. Currently, more than 24 million people in Bangladesh have access to mHealth services provided by *Grameen mHealth* [Akter et al., 2010a; Ivatury et al., 2009; World Health Organization, 2011].

Although the research setting was Bangladesh, the study is representative of developing countries, as similar healthcare platforms are available across the developing world, such as MedicallHome in Mexico and HMRI in India [Ivatury et al., 2009; World Health Organization, 2011]. In recent years, this service has become very popular in low- and middle-income countries (e.g., Bangladesh, India, Mexico, South Africa, etc.) and serves millions by delivering right-time primary health services at an affordable cost [Ivatury et al., 2009]. Under this platform, a patient can easily access this service both in a nonemergency (headache, cold, cough, etc.) and an emergency situation (accident, burn, severe stomach pain, etc.) by simply dialing some unique digits (e.g., 789 in Bangladesh) from his or her mobile phone and can then receive medical information, consultation, treatment, triage, diagnosis, referral, and counseling from health professionals (registered physicians, nurses, and paramedics) [Ivatury et al., 2009; World Health Organization, 2011].

Qualitative Study

The study obtained qualitative data from three *focus group discussions (FGD)* and ten in-*depth interviews* (DI) [Dagger, Sweeney, and Johnson, 2007; Fassnacht and Koese, 2006; Malhotra, 2010; McDaniel and Gates, 2010] conducted with mHealth (hotline) consumers in Bangladesh. A total of twenty-four participants, eight per focus group, were involved in three focus-group sessions. The study conducted FGDs using eight participants per group following the suggestions of Malhotra [2010, p. 174] who stated that "[G]roups of fewer than 8 are unlikely to generate the momentum and group dynamics necessary for a successful session." Screening criteria were used to select respondents for FGDs and DIs. Respondents had to be at least eighteen years of age and to have had Grameen mHealth service experience in the past twelve months. Participants ranged in age from eighteen to sixty-two years and both genders had equal participation. In assigning respondents into each group, the study maintained homogeneity in terms of demographic (e.g., students vs. parents) and socio-economic characteristics (e.g., urban vs. semi-urban). Ensuring homogeneity is conducive to a cohesive and natural discussion as stated by Malhotra [2010]: "commonality among group members avoids interactions and conflicts among group members on side issues." Participants were recruited using purposive sampling in order to ensure productive findings and the richest

data for scale development [Dagger et al., 2007]. Each FGD session was conducted by two moderators and lasted about ninety minutes. In addition, ten DIs were conducted to explore users' insights on the research agenda. In the context of both FGDs and DIs, the moderators were selected based on their proficiency in English and Bangla [Andaleeb, 2000, 2001, 2008].

The study followed a procedure to arrange FGDs and DIs. Firstly, potential participants who met the screening criteria were provided with an invitation letter from a reputable university, which contained the phone number for respondents to check that the study was authentic. The academic purpose of the study was explained in the letter with adequate assurance of anonymity and the freedom to not answer particular questions or to withdraw opinions from the discussion at any stage. Secondly, potential respondents were contacted via mobile phone after one week to fix the schedule for FGD/DI sessions. Thirdly, each participant was provided with an SMS confirming the date, time, and venue of the FGD/DI session. Finally, each participant received a reminder a day before via a mobile phone call about the time and place of the FGD/DI session. In each session, respondents were asked the following questions in the local language (Bangla) to evaluate their mHealth experiences and to identify the service quality dimensions:

- In your opinion, is mHealth different from other health services? If yes, what makes it different?
- What are the primary dimensions of service quality of this health service?
- What technical level of communication is important to you?
- How do you evaluate your interpersonal interaction with physicians over this platform?
- What benefits do you primarily seek from this health service?
- Any positive or negative experience that you have had while consuming this service?

The study translated the discussion questions into the local language (Bangla) and retranslated them into English until a panel of experts, fluent in both English and Bangla, confirmed that the two versions were reasonably comparable [Andaleeb, 2000, 2001, 2008; Fassnacht and Koese, 2006; Liu, Du, and Tsai, 2009; Mullen, 1995; Teo and Liu, 2007].

The answers of both the FGDs and DIs were recorded, synthesized, and sorted into different themes using a manual content analysis system by an analyst who was proficient in both English and Bangla [Dagger et al., 2007]. The objective of this analysis was to identify the dimensions of mHealth service quality [D'Ambra and Rice, 2001]. The analysis was conducted in several steps. Firstly, key responses were identified and highlighted in the transcript. Secondly, responses reflecting different dimensions of service quality were categorized. Thirdly, recurring themes (or sub-dimensions) were extracted under each dimension by two academic judges proficient in English and Bangla [Andaleeb, 2000, 2001, 2008]. These academic judges were not part of the present study in order to ensure their neutral opinion on the development process [Morre and Benbasat, 1991]. In this case, conflicting responses were discussed until agreement was reached and the overall inter-judge reliability was 0.86 exceeding the threshold level of 0.70 [Straub, Bourdeau, and Gefen, 2004]. The details of the inter-judge reliability calculations are presented in Appendix 1. Finally, each dimension was double-checked, refined, and substantiated by revisiting the raw responses. The findings of the qualitative study frequently identified the following dimensions and sub-dimensions of service quality as listed in Table 4.

Table 4: Service Quality Dimensions

Perceived Systems Quality	Perceived Interaction Quality	Perceived Information Quality	Perceived Outcome Quality
1. Reliability 2. Accessiblity 3. Availability 4. Safety 5. Efficiency 6. Privacy 7. Usefulness	1. Helpful 2. Promptness 3. Courtesy 4. Empathy	1. Completeness 2. Accurate 3. Up-to-date 4. Orderliness	1. Ease 2. Convenience 3. Cost 4. Confidence 5. Enjoyable

Perceived Systems Quality

Platform systems or platform quality with respect to mHealth and other healthcare services reflect patients' perceptions about the technical level of communication (or delivery system). In qualitative analysis, seven sub-dimensions were confirmed to be of importance to patients, namely, *reliability, accessibility, availability, safety,*

efficiency, privacy, and *usefulness*. The first sub-dimension *reliability* indicates the degree to which the healthcare platform (PH, GP, TM, or mHealth) is dependable over time [Akter et al., 2010a; Delone and McLean, 2003; Nelson et al., 2005; Parasuraman et al., 2005]. It measures service promise and service dependability as exemplified by the following comments: "It performs smoothly" and "It is dependable." The sub-dimensions *systems availability and accessibility* define the degree to which the healthcare service platform is available on an "anytime" and "anywhere" basis [Akter et al., 2010a; Chae, Kim, Kim, and Ryu, 2002; Parasuraman, Zeithaml, and Berry, 2005]. Generally, it was referred to as the unique and crucial differentiator for mHealth as suggested by the following comments, "I can access the mHealth platform whenever I want" and "I can receive medical service right away." The sub-dimension *systems efficiency* conveys the health service's adaptability to meet diversified user needs and changing user conditions [Akter et al., 2010a; Delone and McLean, 2003; Nelson, Todd, and Wixom, 2005; Parasuraman et al., 2005]. This is reflected by typical customer comments like: "It can flexibly adjust to meet my variety of needs."

The sub-dimension *privacy* refers to the platform's ability to secure the patients' personal information shared via the consultation process [Akter et al., 2010a; Parasuraman et al., 2005; Varshney, 2005]. *Privacy* has been cited as an important differentiator for mHealth over other platforms, as reflected by the comments, "It protects my personal information" and "It does not share my personal information with others." The sub-dimension *safety* measures the degree to which the health service platform is safe [Parasuraman et al., 1988; Sousa and Voss, 2006]. It is an essential factor for inspiring trust and confidence among patients, as reflected by the comments, "I feel safe while consulting with physicians" and "Physicians' behavior stimulates my confidence to deal with this healthcare platform." Research studies in information systems (IS) have found that utilitarian benefit (i.e., usefulness) plays a critical role in developing a positive attitude towards information technology (IT) implementation [Bhattacherjee and Bhattacherjee, 2001; Davis, 1989; Limayem, Hirt, and Cheung, 2007]. Thus, the study considers these are salient indicators of platform quality in the context of healthcare services' comparison.

Perceived Interaction Quality

Services are essentially co-produced, implying that the dyadic interplay of the interpersonal interaction between the service provider and consumer and the quality of the interaction are of paramount value [Dagger et al., 2007]. The qualitative findings suggest that during the consultation with a physician, based on the physician's attentiveness, promptness, and advice, a patient perceives quality in terms of the knowledge and competence of the provider. Four sub-dimensions: *helpful, promptness, courtesy,* and *empathy* underpin patients' perception of interaction quality. The first sub-dimension, *responsiveness*, conveys the willingness of the service provider to help consumers and to deliver prompt service [Parasuraman et al., 1988; Sousa and Voss, 2006]. Participants in the qualitative interview referred to this as willingness and promptness of the provider to deliver the medical consultation, as indicated by the comment, "Physicians show a sincere interest to solve my problems."+

The sub-dimensions *courtesy* and *empathy* reflect the caring and individualised attention of the provider to the patients. They reflect the providers' understanding of the patients' needs and accordingly their ability to tune into and deliver an empathetic service [Parasuraman et al., 1988; Sousa and Voss, 2006]. Comments such as "Physicians understand my specific needs" and "Physicians give me individual care" are evidence of the importance of the care in the interaction quality. The sub-dimension *helpfulness* refers to the degree to which a healthcare service arouses positive feelings [Fassnacht and Koese, 2006]. Comments like "I feel helpful having service from this platform" and "I believe my future health will improve having this service" highlight the importance of the perception that a service really helps in meeting a consumer's needs. These patients' expressions and their corroborations with the service quality research make us believe that these sub-dimensions are salient indicators of interaction quality in the context of healthcare services in developing countries.

Perceived Information Quality

Information quality refers to the degree to which the service is helpful in completing a particular task [Nelson et al., 2005]. The key themes of information quality are *completeness, accuracy, up-to-date,* and *orderliness.* The first variable, *completeness*, refers to the degree to which all possible states relevant to the user population are represented in the information [Akter et al., 2010a: Nelson et al., 2005]. During the exploratory study, *completeness* was frequently discussed as an important parameter of information quality, as indicated by this comment: "It gives me all the information I need." *Accuracy* refers to the correctness in providing the right information to the right person at the right time [Akter and Ray, 2010]. According to Wand and Wang [1996], the notion of accuracy included the idea that the information is not only correct, unambiguous, and objective, but also meaningful and believable. *Up-to-date* refers to the degree to which the information is current. It is a contextual attribute of information quality which is very much dependent on task and user perceptions [Ballou, Wang, Pazer, and Tayi, 1998]. The final variable, *orderliness*, reflects the degree to which information is presented in a manner that is understandable and interpretable to the user and thus aids in the completion of a task. In other words, it is unambiguous, meaningful, believable, and consistent [Akter et al., 2010a: Nelson et al., 2005]. Comments such as "The information provided by mHealth platform is well organized and well presented" support the evidence of its importance.

Perceived Outcome Quality

The study proposes *outcome quality* as a critical dimension of service quality which refers to the outcome perception of a patient as a result of the consultation process with a healthcare service provider [Aharony and Strasser, 1993; Gronroos, 1984]. According to Dagger et al. [2007], *"Outcome does not refer to ultimate result (e.g., care) but rather to the outcomes experienced over a series of service encounters."* In the IS discipline, outcome quality in terms of utilitarian and hedonic benefits drew substantial attention in IT use and continuance (e.g., Fassnacht and Koese, 2006; Kim and Han, 2011; Turel, Serenko, and Bontis, 2007, Venkatesh and Brown, 2001). In a way, outcome quality indicates what the customer is left with while the service is being experienced or once the encounter is over [Brady and Cronin, 2001; Gronroos, 1984; Rust and Oliver, 1994]. The extant literature has highlighted the importance of perceived outcome quality in healthcare in terms of several service benefits, which may have varying importance to the patient [Andaleeb, 2001; Sheth, Newman, and Gross, 1991]. The direct relationship between outcome quality (or service benefits) and service quality is also cited in some healthcare studies [Andaleeb, 2001].

In healthcare, McAlexander, Kaldenberg, and Koenig [1994] identified outcome quality as a basic dimension of overall service quality perception. Studies in traditional healthcare have found that there is a direct relationship between service outcome (service benefit) and service quality (e.g., Dagger et al., 2007; Donabedian, 1988; Ruyter and Wetzels, 1998). In a review study on the impact of mobile devices in healthcare, Prgomet, Georgiou, and Westbrook [2009, p. 792] hinted at such a relationship by connecting the benefits of mHealth in terms of enhanced productivity, improved information access, improved communication, reduced medical errors, greater mobility, and improved service quality. In the context of mHealth hotline services, Ivatury et al. [2009] mentioned that poor service benefits led to poor service quality perception, hence poor healthcare outcomes. Although outcome quality appeared in mHealth studies as a significant construct, "the extent to which handheld devices provide benefits due to their mobility has been significantly underinvestigated" [Prgomet et al., 2009, p. 799]. As such, studies in mHealth have underscored the importance of measuring the perceived outcome of such services (e.g., Kuziemsky, Laul, and Leung, 2005; Martins and Jones, 2005). Thus, to fill this knowledge gap, this study puts forward outcome quality as one of the dimensions of overall mHealth service quality.

The qualitative study identified five sub-dimensions, namely: *ease, convenience, cost, confidence,* and *enjoyable*. The sub-dimensions *ease, convenience,* and *enjoyable* refer to the degree to which a healthcare service results in an emotional satisfaction that produces a positive feeling in the perceptions of the patient [Akter et al., 2010a; Delone and McLean, 2002; Keaveney, 1995; Limayem et al., 2007]. During the exploratory study, these were frequently referred to as important parameters, as indicated by the comments, "It is easy to access a mHealth hotline," "It is very inconvenient to go to a public hospital," and "mHealth is enjoyable as there are no queues or waiting." Consumers in the marketplace always try to maximize their return by choosing an option that delivers better overall value. A product that instills confidence in the provider and is of relatively cheaper cost will be viewed by patients as a better outcome alternative [Keaveney, 1995]. This is reflected in patients' comments like, "It costs less to consult a mHealth hotline than visiting a GP" and "I am confident of a better outcome by consulting a GP than visiting a PH." Thus, we consider outcome quality as an important dimension in the comparative assessment of healthcare services.

IV. QUANTITATIVE STUDY

The research hypothesis and the associated research questions required examination of the group differences by healthcare service users, that is, patients. This could be achieved through a survey of patients who have used the services in question. By developing a model to relate the survey items and the patients' specific rating of the respective service they have used, it is possible to see whether significant group differences are observable. Thus, the proposed hypothesis was examined through a quantitative survey of patients. The investigation intended to build a quantitative statistical model not only to help in understanding the phenomenon but also to serve as a predictive aid. Thus, this research conforms to the quantitative research paradigm. The epistemologically and ontologically quantitative positivist paradigm naturally applies to this kind of investigation [Bhattacherjee, 2012; Gregor, 2006; Straub et al., 2004]. A field study was conducted in March 2010. The survey was designed to collect data from a target population only once, thus conforming to cross-sectional design [Malhotra, 2004]. In order to maximize the survey response rate, minimize missing data, avoid delays, and improve accuracy, especially in a developing country context, the study adopted a combination of location intercept and in-home survey techniques [Andaleeb, 2001; Malhotra, 2004].

Data Collection

Data were collected from Bangladesh, one of the leading mHealth service providers among developing nations, under a global mHealth assessment project in March 2010. At present, more than 24 million people in Bangladesh have access to B2C mHealth services provided by the leading mobile operator *Grameenphone* [Akter and Ray, 2010]. Under this platform, a customer (or a patient) can access health services at any time by dialling "789" from

his/her own mobile phone and receive services in the form of medical information, consultation, treatment, diagnosis, referral, treatment, and counselling from registered physicians [Akter et al., 2010b; Ivatury et al., 2009; Mechael, 2009]. In the absence of lists from which to draw a random sample, 280 interviews were planned from Dhaka City using area-wise cluster sampling. Areas were selected in a manner such that different socio-economic groups were represented. After a quick screening question on whether the respondent had used mHealth services in the past twelve months, the interviewers then proceeded with the survey questions. Both self-completion and interviewer-filled survey techniques were used in order to receive a higher number of valid responses. A total of 212 surveys were ultimately completed, of which 200 surveys were usable.

Measurement Instrument

The questionnaire was originally developed in English and then was translated into the local language (Bangla). The local version went through several revisions until both the English and Bangla versions were judged to be similar by a group of experts [Andaleeb, 2001]. Patients were asked to provide their rating on a range of questions related to healthcare service determinants: systems, interaction, information, and outcome quality. Except for the demographic information in the questionnaire, all the items were measured in a structured format on a 7-point Likert scale, ranging from "*strongly disagree*" to "*strongly agree*." The questionnaire was designed based on the outcomes of the qualitative study and consisted of twenty dimensions as listed in Table 4. The measurement instrument is included in Appendix 2. A pretest of over ten samples was conducted in order to ascertain the content, wording, sequence, layout, format, simplicity, and clarity of the survey instrument [Akter et al., 2010a]. The pretest was helpful in fine-tuning the instrument and facilitated a smooth data collection.

Table 5 presents descriptive statistics and the demographic profile of the respondents. There were no missing data and all 200 cases contained valid information. Each group was of equal size consisting of fifty cases or 25 percent of the total sample. In all, 49 percent of the respondents were male and the remaining 51 percent were female; 40 percent were aged eighteen to twenty-five years; and 50 percent were low-income patients. Among the mobile health users' group, 60 percent were from low-income families and 64 percent had secondary education. On the whole, a third of the respondents were students and close to 50 percent of the respondents for mHealth were involved with different educational and training institutions.

Table 5: Demographic Profile of Respondents

Item	Categories	%		Item	Categories	%
Total Sample Size: 200						
Health service	Public hospital	25.0		**Age**	18–25	42.0
	General practitioner	25.0			26–50+	58.0
	Traditional practitioner	25.0		**Education**	>= SSC	80.0
	Mobile health	25.0				
Income	Below 5000	48.0		**Gender**	Male	49.0
	Above 5000	52.0			Female	51.0

V. ANALYSIS TECHNIQUE—DISCRIMINANT ANALYSIS

The study applied *discriminant analysis (DA),* which is a widely used *multivariate technique* to estimate a linear relationship between a set of dependent variables (DVs) and independent variables (IVs). The research questions of the study were suitable for DA as they intended to differentiate the categories of healthcare services (DVs) with a set of predictors. Thus, the goal was to find out the factors that helped to distinguish between a range of competing healthcare services (dependent variable, DV). As DA is a classification technique, it helped us in identifying the factors (or independent variables, IVs) that differentiated the cases into various categories of a categorical DV [Hair, Black, Babin, and Andersoon, 2010; Malhotra, 2004; McLachlan, 1992]. When more than two categories exist for the DV, the technique is referred to as *multiple discriminant analysis (MDA)* [Hair et al., 2010]. In DA, the existence of the groups is known *a priori*.

This study applied DA to gain critical insights into patients' perspectives about the competing healthcare services (e.g., public hospital, general practitioner, traditional medicine, and mHealth). Lim and Zallocco [1988] applied MDA to study patients' attitudes towards four healthcare systems: hospitals; home healthcare, nursing homes, and outpatient clinics. Andaleeb [2000] applied DA to model patient hospital choice between public and private hospitals in Bangladesh. Siddiqui and Khandaker [2007] applied DA to distinguish between public and private hospital services within Bangladesh and then between private hospitals and foreign hospitals. In this study, we examined the four healthcare services with the primary objective being to distinguish mHealth which is gaining popularity over GPs

or PHs in Bangladesh. It is interesting to note that in the short span of three years from its inception, a commercial mHealth service in Bangladesh is currently handling over 10,000 calls per day from patients [Ivatury et al., 2009]. The next sections will look into the outcomes of the survey experiment conducted in order to gauge the reasons for mHealth's popularity and to explore the implications for other service providers as well as the rest of the world.

Measurement Requirements and Sample Size Validation

As noted in the descriptive statistics (Table 5), the analysis sample had a total of 200 cases, with four groups of fifty cases each. The DV, health service, is a categorical variable with four distinct categories, namely: public hospital, general practitioner, other medical practice, and mobile health or mHealth. All IVs were rated on a 7-point Likert scale. Thus, both the DV and IVs met the measurement requirements for DA.

The minimum sample size criterion stipulates that the smallest group size shall be more than the number of IVs [Hair et al., 2010]. While there is no specific criteria for the maximum sample size, a preferred ratio of 1:20 between IV and total sample size is generally stated [Hair et al., 2010; Schwab, 2006] without much reference to the number of IVs and the total resultant sample size. The current research sample has a total of 200 cases, four groups each consisting of fifty cases. Thus, the sample as well as the subgroups met the minimum sample size requirement. With 20 IVs and 200 cases, the ratio between IV:N was 20:200 or 1:10, and this was adequate taking into consideration the absolute size of the sample and the number of IVs [Hair et al., 2010]. The other generally cited criterion on subgroup size is that the smallest subgroup shall have at least twenty cases [Schwab, 2006]. The subgroups were each of the same size with fifty cases, so the subgroups met the minimum size criterion. Thus, the sample met the measurement and sample size requirements and hence the data set was suitable for conducting DA.

VI. RESULTS—DISCRIMINANT FUNCTIONS AND THEIR VALIDITY

The principal objective of this analysis was to identify the variables that would differentiate well between the health service groups. Accordingly, a stepwise method for selecting variables was chosen for the computation of *discriminant functions* (DFs). The number of DFs to be interpreted was the minimum of either the number of IVs or one less than the DV categories. The number of IVs was twenty and one less than the DV categories was three (4 – 1), thus to distinguish the four healthcare service groups, three significant DFs were required. Tables 6 and 7 present a summary of the canonical discriminant functions and Wilks' Lambda values. As can be seen in the summary, the analysis extracted three DFs as required for the data set. The Wilks' Lambda as shown in Table 7 shows that each function is significant ($p < .001$). The chi-square statistic corresponding to Wilks' Lambda was statistically significant. This implied that there was a relationship between the DV groups and the IVs. The eigenvalues on Table 6 show how much of the variance in the DV, health service, was accounted for by each function.

Table 6: Summary of Canonical Discriminant Functions—Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	1.693	50.4	50.4	.793
2	1.076	32.0	82.4	.720
3	.592	17.6	100.0	.610

The first three canonical discriminant functions were used in the analysis.

Table 7: Summary of Canonical Discriminant Functions—Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	Degrees of Freedom	Significance
1 through 3	.112	418.690	33	.000
2 through 3	.303	228.949	20	.000
3	.628	89.081	9	.000

Classification Accuracy

The DFs served a similar function to that of a regression equation; however, they were not able to tell how good the functions were in classifying the cases, which was the intended objective of DA. In order for DA to be effective, the computation should extract the necessary number of DFs, and they should be statistically significant prior to proceeding to the classification performance [Hair et al., 2010; Schwab, 2006]. As noted above, there was an adequate number of DFs and all of them were significant. The performance of the DFs was established through their ability in reclassifying the original cases. The analysis provided a matrix that consolidated the classification results. In order to determine the accuracy of the classification, the baseline accuracy needed to be established based on by-chance criteria. For example, for our research data set, as the DV consisted of four groups, all of which

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happened to be of equal size, the by-chance classification accuracy was 25 percent. This was because there was a probability of one-quarter being correct when arbitrarily assigning a case to a particular group. Therefore, in order to ascertain the validity of the model, the proportional chance criterion recommended 25 percent more accuracy than that of by-chance criteria. This worked out to be 31.25 percent (1.25 * .25 = .3125 = 31.25 percent) accuracy at baseline.

Table 8 summarizes the classification results. The output shows that DFs had successfully classified 77.5 percent of original cases accurately. DA provided another mechanism to ascertain classification accuracy through referring to *cross-validation*. In the case of classification, after building the DA model, each of the cases was classified on the DFs. In the case of cross-validation, the computational procedure recursively computed the DFs omitting a case, and then classified that particular case with the DFs computed. This approach is unique to DA whereby cross-validation in a way not only ascertains the power of the model in modelling the phenomenon but also shows its predictive performance for new cases [Hair et al., 2010; Schwab, 2006]. As shown on Table 8, it is interesting to note the high level of cross-validation accuracy achieved of 75.5 percent. These classification accuracies were far higher than the baseline by-chance classification accuracy of 31.25 percent. Thus, these checks on classification accuracy established not only the model's ability to achieve accuracy in classifying but also in the predictive power of the model to distinguish new cases.

VII. INTERPRETATION OF DISCRIMINANT FUNCTIONS

Having established the validity of the DFs and their ability in classifying cases, the next stage of DA was to interpret the DFs and thereby assign meaningful names to them. To achieve this, DA provided standardized canonical DF coefficients and the structure matrix as shown in Table 9. These statistics summarized the final set of factors entered into the DF model and their relationships. The canonical correlation coefficients measured the association between the DFs and the selected factors. The structure matrix provided the important information about the factors and their loadings on each DF. The factor loadings assisted in identifying the most influential factors associated with each function. This in turn helped in assigning a meaningful name to each DF [Hair et al., 2010; Malhotra, 2004; Schwab, 2006]. The DA identified eleven variables (IVs). To improve the readability, the variables were grouped in order of their association with the DF and then were sorted by their influential loading.

Table 8: Classification Results

	Health Service	Total Cases		PH		GP		TM		mHealth	
		Predicted Group Membership									
		Cases	%	Cases	%	Cases	%	Cases	%	Cases	%
Original	PH	50	25.0	35	70.0	8	16.0	4	8.0	3	6.0
	GP	50	25.0	11	22.0	36	72.0	1	2.0	2	4.0
	TM	50	25.0	5	10.0	3	6.0	35	70.0	7	14.0
	mHealth	50	25.0	0	0.0	0	0.0	1	2.0	49	98.0
		200	100								
Cross-validated	PH	50	25.0	33	66.0	9	18.0	5	10.0	3	6.0
	GP	50	25.0	11	22.0	36	72.0	1	2.0	2	4.0
	TM	50	25.0	5	10.0	4	8.0	34	68.0	7	14.0
	mHealth	50	25.0	0	0.0	0	0.0	2	4.0	48	96.0
		200	100								

a. Cross-validation is done only for those cases in the analysis. In cross-validation, each is classified by the functions derived from all cases other than from that case.
b. 77.5% of original grouped cases correctly classified.
c. 75.5% of cross-validated grouped cases correctly classified.

Multicollinearity for DA was assessed through the very small tolerance values for the variables, for example, less than .10. Based on the "*Variables Not in Analysis"* output of SPSS software, the smallest tolerance for any variable not included was .322, supporting a conclusion that multicollinearity was not a problem for this solution. The group means for the eleven extracted factors (Table 9) were computed and the group means versus health service graph is shown in Figure 2. mHealth had the highest mean for all of the factors, reflecting that patients have relatively weighted mHealth over other conventional services.

Table 9: Standardised Canonical Discriminant Function Coefficients and Structure Matrix						
	Discriminant Function Coefficients			Structure Matrix		
Function / Variables	1 Ubiquity	2 Information-quality	3 Value	1 Ubiquity	2 Information-quality	3 Value
Ease	.394	-.399	-.047	.728*	-.290	-.160
Accessibility	.525	.145	.187	.703*	.166	.036
Promptness	.306	-.084	-.349	.584*	-143	-.393
Confidence	.270	.631	-.125	.511*	.458	-.371
Orderliness	-.162	.512	.220	.492*	.382	-.278
Completeness	-.374	-.360	-.296	.409*	.289	-.393
Up-to-date	.497	.329	.081	.470	.529*	-.256
Safety	-.119	.376	.378	.362	.495*	-.148
Cost	.246	-.224	.795	.396	-.359	.629*
Helpful	.033	-.424	-.342	.455	-.034	-.504*
Empathy	-.093	-.428	-.322	.465	-.027	-.469*

Pooled within-group correlations between discriminating variables and standardised canonical discriminant functions. Variables ordered by absolute size of correlation within function.
Largest absolute correlation between each variable and any discriminant function.

VIII. DISCUSSION

The attitude shift of patients towards the emerging mHealth over other services seems to be quite natural as the conventional services are dysfunctional, inaccessible, unresponsive, of poor quality, and costly in many parts of the developing world including Bangladesh [Andaleeb, 2008; World Bank, 2004]. A well-designed and well-delivered service will naturally generate better satisfaction for a consumer. It is common sense that consumers generally opt for the services that are easy to use, are accessible, provide prompt service, are organised and fulfil the consumers' original need to their satisfaction.

Summary of Findings

The research set out to test whether patients distinguished between different healthcare services and, if so, to discover what factors contributed to such a differentiation. As noted in Tables 4 and 5, the MDA extracted three DFs which were significant. This indicated that patients differentiated between the four different forms of healthcare services (PH, GP, TM, and mHealth) as being distinct.

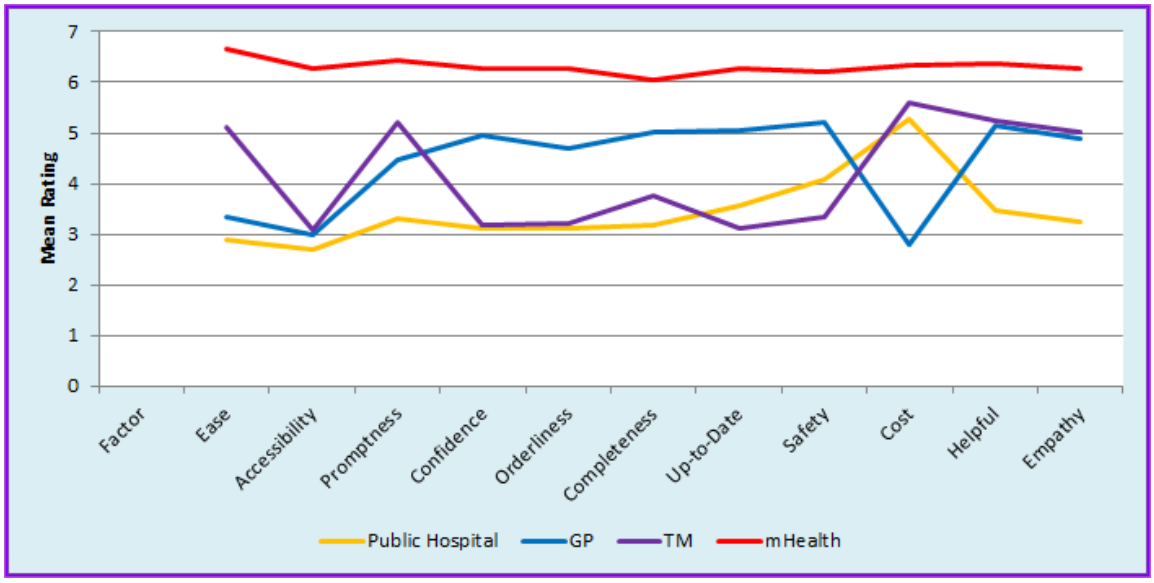

Figure 2. Group Means of Selected Variables vs. Health Service

In case the different healthcare services were distinguishable from each other, MDA extracted eleven factors (*ease, accessibility, promptness, confidence, orderliness, completeness, up-to-date, safety, cost, helpful,* and *empathy*) out of twenty factors that constituted the DF constructs as shown in Table 9. Thus, as shown on Table 9, it was

concluded that along the dimensions of the higher-order constructs, *ubiquity, information-quality,* and *value,* the four healthcare services were distinguishable from each other.

The group means for the eleven factors selected as shown in Figure 2 revealed interesting facts about patients' perceptions. From Figure 2, it was evident that mHealth was consistently rated over six for all of the eleven factors whereas no other service consistently performed well in all the dimensions. The distinct deviation of the mHealth rating curve implied that mHealth was viewed as distinct by patients over the other services, providing an affirmative answer to the research question that mHealth was distinct. These findings supported the view that patients perceived mHealth as a distinct healthcare service alternative. Thus, MDA has helped in answering the research questions and has supported the hypothesis, H_1.

Contribution to Theory

This study extends service quality research by identifying the service characteristics of an emerging IT artefact, that is, mHealth. By encompassing the combined explanatory power of each DF, the mHealth quality model advances service quality theory in IS research while presenting a parsimonious structure. According to Whetten [1989, p. 493], *"[t]his approach adds the qualities of completeness and thoroughness to theoretical work."* Specifically, this study contributes in several ways to service quality research in the health service domain. Firstly, the study has differentiated mHealth from other healthcare systems against the backdrop of service quality research. Secondly, the study has identified a comprehensive, yet parsimonious, set of DFs that help to identify the quality of mHealth. Thirdly, the study has explored characteristics that are specific to the mobile electronic platform, which provides a solution to the new and difficult service delivery challenges of this innovative healthcare paradigm. Fourthly, in the extant literature, there has not been much focus on healthcare service design. The scope of the current research focuses on a subset of the theme of healthcare services design as per the House of Quality (HoQ) matrix, that is, the evaluation of competing services. As such, this article focuses on Room-6: evaluation of competing services on the HoQ Matrix (Appendix-3), which is a basic service design tool. It is the first phase of the quality function deployment (QFD) approach and is fundamental and of strategic importance [Chan and Wu, 2005]. The study also extends HoQ theory in this context by inter-linking customer requirements, their rankings, engineering characteristics, performance measures, and competitive products/services and thereby elicits in a single diagram the areas of improvements required to win in the market [Chan and Wu, 2002, 2005; Hauser, 1993; Hauser and Clausing, 1988]. As a result, the research confirms the specific attributes that differentiate between alternate services which can be successively cascaded up and down through the HoQ matrix to achieve a well-performing mHealth service.

Contribution to Practice

In comparison to other healthcare services such as PH, GP, and TM, mHealth is much easier to use. The patient or his/her care provider simply has to dial the prescribed number from his/her mobile phone or from a designated community phone. From the IS perspective, the user acceptance testing (UAT) models empirically ascertain that usefulness and accessibility will influence the acceptance of IT [Davis, 1989; Venkatesh, Morris, Davis, and Davis, 2003]. In terms of ubiquity, to avail themselves of the service of PH, GP, or TM, a patient has to make a physical trip to these places. Furthermore, the trip is meaningful only during the operating hours of the provider while the mHealth helpline can be reached from a location convenient to the patient and also at the very moment that he/she requires the service; that is, it could be midnight, the weekend, or a holiday [Akter and Ray, 2010]. In developing countries, health services are in general overcrowded. It is imperative that patients are required to queue up to be serviced as the capacities of these institutions are much lower than the demands [Ivatury et al., 2009]. Thus, as with the SERVQUAL model of responsiveness, promptness is an important aspect from the patients' perspective in differentiating between services.

When customers seek services from a provider, they want to be assured that the provider has the right knowledge, can inspire trust, and can completely deliver the service rather than leaving the customer in a state of bewilderment. Thus, we see that confidence, orderliness, and completeness influenced the behaviour of patients in choosing services that better fulfil their needs. In analyzing the attributes, ease to completeness for DF-1, and ease and accessibility have higher loadings (> .7). Due to the strong association of ease and accessibility, DF-1 can be termed as *ubiquity*.

Since health services deal with human life, any incorrect out-of-date information may compromise the safety of a patient. We notice that *up-to-date* and *safety* were rated by the patients as the second-most important discriminating construct. In comparison to conventional healthcare services, the patients perceived that mHealth could offer much more accurate and up-to-date information. Furthermore, the mHealth setting offered privacy to the patients. In developing countries, privacy for the patient is lacking in other settings like PH, GP, and TM, due to the excessive demand and the inadequate number of qualified medical professionals [Andaleeb, 2000; Ivatury et al., 2009; World Bank, 2004]. In these countries, service providers have not undertaken any concrete steps to ensure that safe and

up-to-date medical consultation is a priority [World Bank, 2004]. Therefore, a consultation that provides accurate information and the assurance of safety would be viewed by patients as useful. Thus, DF-2 comprising up-to-date and safety can be interpreted as *information-quality,* a determinant in comparing competing alternatives.

As noted earlier, health services deal with human life: therefore, patients look for providers who listen to their concerns attentively and serve them with a caring attitude. Like all consumers in a marketplace, patients also look for services that are cost-effective and fulfil their needs. DF-3 consisting of *cost, helpful,* and *empathy* can be termed as *value*. In comparison to other services, mHealth was viewed as less costly and as helping to alleviate their health concerns in an empathetic manner. In essence, our DA presented three important constructs: *ubiquity, information-quality,* and *value* as the determinants in differentiating mHealth from other services.

The eleven variables constituting these three constructs had a considerably higher means for mHealth. Group statistics provided the average mean ratings for these functions as perceived by the patients. Cost has been coded from highest to lowest, meaning the higher the score, the less costly the service was from the patient's perspective. While the generic notion was that mobile health was costlier, the patient's perception was that it was cheaper than the other alternatives. Table 10 presents a summary of these averages rolled up to DF level: ubiquity, information-quality, and value. The higher means for mHealth (> 6) confirmed the effective role of these DFs in distinguishing the various health services and how mHealth was viewed as distinct from the rest of the service alternatives. Public hospitals were perceived as the most difficult to use, provided lowest value, and, in terms of information-quality, were slightly higher than TM. These results confirmed similar outcomes about PHs and their apathy when it came to serving the people in need [Andaleeb, 2000; Andaleeb et al., 2007]. TM was viewed as providing the next best overall value after mHealth while their ubiquity or information-quality was lower than for GP. In all the measures, GP was viewed as the second most preferred alternative to mHealth. The competing alternatives to mHealth could utilize these insights to adequately respond by improving their service portfolio in order to meet or exceed the overall experience required by their patients.

Table 10: Group Statistics—Mean Values of Factors vs. Health Service

Health Service / Function	Public Hospital	GP	TM	mHealth	Total (200)
Ubiquity	3.05	4.24	3.93	6.32	4.39
Information-quality	3.82	5.12	3.23	6.24	4.60
Value	4.00	4.28	5.28	6.33	4.97
Overall Score	10.87	13.64	12.44	18.89	13.96

Limitations and Future Research

Several limitations are worth noting. Firstly, this research was conducted within the specific domain of the mHealth service and in one country. Secondly, the labelling of constructs (e.g., systems quality, interaction quality, information quality, and outcome quality) was entirely based on the research context of the study, that is, mHealth (hotline) services in Bangladesh. Future research could further explore and differentiate such constructs from other related constructs (e.g., systems adaptability) or add some new constructs based on the dynamics of the research context. Thirdly, data were collected under a cross-sectional design, so the study contains typical limitations associated with this kind of research methodology. For example, the model represents the static nature of service evaluation as the findings are confined to a single point of time. To gain deeper understanding, future study could undertake a longitudinal study to evaluate users' perceptions and evaluations of mHealth service quality over time. Finally, the sample represented only consumers from a developing country (i.e., Bangladesh), thereby there is a limitation regarding the generalizability of findings to other consumers in developed countries. There might be a variation in the perceptions of quality in Eastern and Western countries, developing and developed nations, and individualistic and collectivist communities.

Future work could investigate the present study in cross-cultural settings by incorporating respondents from both developed and developing countries. There is always a difference between developed and developing countries with regard to the level of educational and communication systems, financial and technological sophistication, and the level of service expectation [Malhotra, Ulgado, Agarwal, and Baalbaki, 1994; Raajpoot, 2004; Reynolds and Smith, 2010; Witkowski and Wolfinbarger, 2002]. Information on these differences across cultures might be of considerable interest and significance to both researchers and practitioners for critical managerial decision making [Reynolds and Smith, 2010]. However, some issues should be taken into account, such as consistency in instrument development and validation, response bias with regard to measurement equivalence, demographic profile of respondents, and response style.

IX. CONCLUSIONS

Our research identified three dimensions along which healthcare services are viewed as distinct. It also helped in establishing mHealth as the preferred alternative over other existing healthcare services. The findings supported the view that patients perceived mHealth as an effective alternative. Its large-scale deployment and adoption can substantially bridge the healthcare divide. mHealth service providers could take a hint from these conclusions and work towards continual differentiation. The other existing service providers could utilize these inputs in developing long-term plans to improve their relevance and performance. Ultimately, the future of any discipline very much depends on the codification and dissemination of the critical knowledge and evidence base that can influence policy makers and health administrators [Mechael, 2009]. Our comparative analysis of patient perceptions of healthcare services and their positive attitude towards mHealth over the other services also serves the goal of establishing mHealth as an effective alternative to the delivery of healthcare services in developing countries.

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APPENDIX 1: INTER-JUDGE RELIABILITY CALCULATION METHOD

Inter-judge Reliability Calculation Method			
Raw Agreement	**Round 1**	**Round 2**	**Avg. (2 Rounds)**
1. Reliability	0.86	0.82	0.84
2. Accessibility	0.84	0.86	0.85
3. Availability	0.88	0.94	0.91
4. Safety	0.84	0.92	0.88
5. Efficiency	0.86	0.86	0.86
6. Privacy	0.78	0.92	0.85
7. Usefulness	0.85	0.88	0.87
8. Helpful	0.82	0.86	0.84
9. Promptness	0.84	0.88	0.86
10. Courtesy	0.86	0.90	0.88
11. Empathy	0.82	0.86	0.84
12. Completeness	0.84	0.88	0.86
13. Accurate	0.86	0.82	0.84
14. Up-to-date	0.84	0.86	0.85
15. Orderliness	0.88	0.94	0.91
16. Ease	0.84	0.92	0.88
17. Convenience	0.86	0.86	0.86
18. Cost	0.78	0.92	0.85
19. Confidence	0.85	0.88	0.87
20. Enjoyable	0.82	0.86	0.84
	0.84	0.88	0.86

APPENDIX 2: SURVEY INSTRUMENT

Questionnaire on Health System in Bangladesh for primary health information Services

For **primary health information services**, which health system did you use in the past one year?

1. Public hospital 2. General Practitioner 3. Other medicine practitioners *(Pharmacists, Homoeopaths, Kabiraj etc.)*
4. Mobile Health (789 of Grameenphone)

Code	To aid me in receiving primary health information services, overall, I feel this **healthcare system** is:						
SYS1	Unreliable 1	2	3	4	5	6	Reliable 7
SYS2	Not always accessible 1	2	3	4	5	6	Always accessible 7
SYS3	Not always available 1	2	3	4	5	6	Always available 7
SYS4	Unsafe 1	2	3	4	5	6	Safe 7
SYS5	Inefficient 1	2	3	4	5	6	Efficient 7
SYS6	Having Less privacy 1	2	3	4	5	6	High privacy 7
SYS7	Quite useless 1	2	3	4	5	6	Quite useful 7
	To aid me in receiving primary health service, overall, I feel **physicians of this healthcare system** are:						
INT1	Unhelpful 1	2	3	4	5	6	Helpful 7
INT2	Providing Delayed service 1	2	3	4	5	6	Prompt service 7
INT3	Not courteous at all 1	2	3	4	5	6	Very Courteous 7
INT4	Providing less individual attention 1	2	3	4	5	6	High individual attention 7
	To aid me in receiving primary health service, overall, I feel **information** from this healthcare system are:						
INF1	Incomplete 1	2	3	4	5	6	Complete 7
INF2	Inaccurate 1	2	3	4	5	6	Accurate 7
INF3	Not up-to-date 1	2	3	4	5	6	Very up-to-date 7
INF4	Disorganized 1	2	3	4	5	6	Organized 7
	To aid me **in receiving primary health information**, overall, I feel this healthcare system is:						
OUT1	Difficult to receive service 1	2	3	4	5	6	Easy 7
OUT2	Inconvenient 1	2	3	4	5	6	Convenient 7
OUT3	High cost 1	2	3	4	5	6	Low cost 7
OUT4	Confidence degrading 1	2	3	4	5	6	Confidence enhancing 7
OUT5	Not Enjoyable 1	2	3	4	5	6	Enjoyable 7

Gender: 1. Male 2. Female

Age: 1. 18-25 2. 26-33 3. 34-41 4. 42-49 5. 50+

Income: 1. below 5000 2. 5001-10000 3. 10001-150000 4. 150001-20000 5. 20001-25000 6. 250001-30000 7. 30000+

Education: 1. primary 2. SSC 3. HSC 4. Honours 5. Masters 6. Others

Occupation: 1. Student 2. Housewife 3. Business 4. Public service 5. Private service 6. Others

Location: 1. Urban 2. Suburban 3. Local

APPENDIX 3: HOUSE OF QUALITY (HOQ) MATRIX

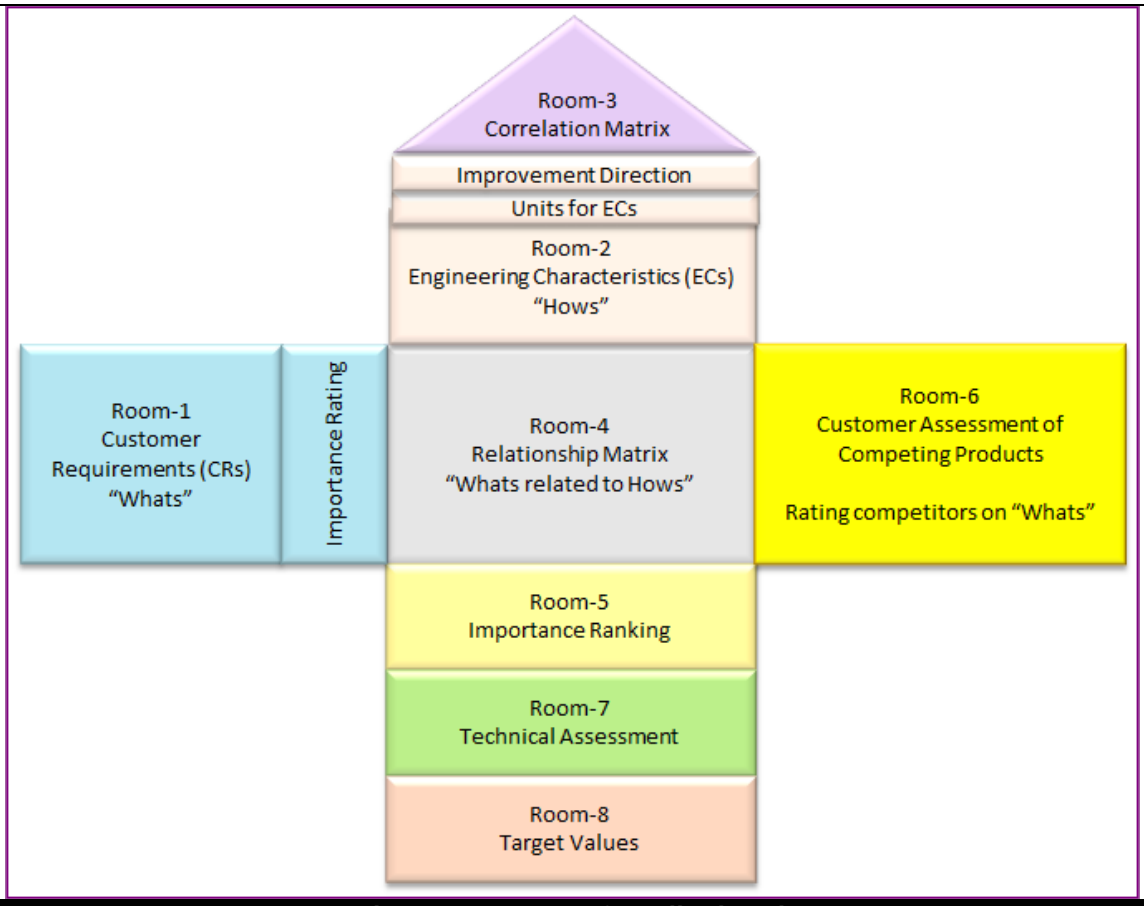

Figure A3: House of Quality (HoQ)
Source: Dieter and Schmidt, 2008

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