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Assessing m-Health success in Bangladesh: An empirical investigation using IS success models

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Abstract

Purpose – Mobile health, i.e. m-Health possesses huge potential, especially to the developing countries and remote locations of developed countries. The success of such systems may create a healthier society through eradicating health incidents, which cannot otherwise be addressed with "brick and mortar" type of health systems. The purpose of this paper is to develop an m-Health success model from users' perspective and validate in a developing country context.

Design/methodology/approach – Epistemologically, positivist approach has been adopted for the current research. An initial research model was developed from existing information system (IS) literature, which was then validated with survey data applying partial least square structural equation modelling (PLS-SEM).

Findings – The results summarise that continuance intention (CI) of m-Health services is dependent on perceived value (PV) and user satisfaction (STF); PV positively influences STF. Moreover, platform quality, quality of medical advice, and interaction quality have positive and direct effect on PV and STF; finally, CI drives to better quality of health life.

Practical implications – The findings of this study provide strategic implications to health managers and practitioners recognising the determinants of m-Health success and comprehending their relationships. It is underscored that, in order to secure the success of an m-Health system in a given society both human and technology-related components are vital and therefore should be taken care of.

Originality/value – This is the first attempt that develops and validates an m-Health system success model, particularly from the context of a country with low-health profile. Moreover, the contextualisation of the related variables and extension of existing IS success models is theoretically original.

Keywords User satisfaction, IS success model, Mobile health, Quality of health life

Paper type Research paper

1. Introduction

Healthcare is a serious concern in every society. In recent times, contemporary developments in information and communication technologies (ICT) introduced improved services both to medical service providers and receivers (Cocosila and Archer, 2010). Now a days, people can get selective general and/or emergency medical advice without visiting a health facility but by using mobile devices, which is popular as m-Health. It comprises the use of mobile telecommunication and multimedia technologies integrated with mobile and wireless healthcare delivery systems (Istepanian and Lacal, 2003). "The definition is now broadened exploring how mobile technologies can be best and most widely used to enhance access to health services and information and also to improve the way health professionals deliver health-related services to general public" (Mechael, 2009, p. 104).

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m-Health improves healthcare delivery through, for example, improved physician-patient relationship. Recently, researchers have started investigating in m-Health systems and the associated services although the number is limited (Kaplan, 2006). Mechael (2009) the observed that propagation of m-Health applications among users is low and slow; hence, Kay (2011) urged for more strategic approach in planning, development, and evaluation of m-Health to increase its impact. Explaining m-Health adoption, Akter *et al.* (2010, 2013a, b) examined it from service quality perspective while some initiatives have been observed from information system (IS) perspective as well (Guo *et al.*, 2013; Cocosila, 2013; Cocosila and Archer, 2010). It is glaringly observed that despite the initial acceptance of m-Health services by wider society in a given country, only a small minority of them continue using the services. Prior studies suggest that continued use is crucial for realising the success of a system. The antecedents and their causal relationships explaining users' continuance intention (CI) is often modelled by using IS success model which has been used in several domains within IS including e-commerce (Wang, 2008), Web, mobile, and internet banking (Koo *et al.*, 2013), etc. (for a review, see Petter and McLean, 2009). However, no success model has been proposed that might investigate the success dimensions of m-Health systems. Nonetheless, Chatterjee *et al.* (2009) has investigated m-Health systems from health workers' perspective; but Scheepers *et al.* (2006) argued that, like any other mobile technologies, success of m-Health services is dependent on users than the organisational workers. Clearly, there is a paucity of research that could examine m-Health success dimensions. The dearth of research is particularly noticeable from developing countries' context where the fundamental health services are not confirmed but could be served better through ICT inventions (Beratarrechea *et al.*, 2014). Hence, in order to close the existing gap in literature, the overall objective of this research is to develop and validate an m-Health system's success model from users' perspective. To be specific, this study is driven by two research questions:

RQ1. What are the dimensions of an IS success model in the context of m-Health?

RQ2. What are the relationships among the dimensions of an m-Health success model?

From current IS literature, this research identifies the dimensions and their associated relationships to develop a research model, which is then validated with survey data. Data analysis is performed using partial least square (PLS). As implications, the findings of this research will not only help advance our understanding of m-Health success in general, but also provide insights how to develop and offer m-Health services in particular.

The remainder of this paper is organised as follows. First, this study reviewed m-Health service contexts and prominent IS success models. Then, a research model has been developed from current literature that explains success of m-Health systems, followed by developing the hypotheses. Next, the methods, measures, and empirical results of the current research are presented. Finally, the results are discussed with practical and theoretical implications.

2. Theoretical background and research model

2.1 m-Health in brief

m-Health is classified as a subset or extension of electronic health (e-Health) (Akter *et al.*, 2010; Mechael, 2009). In traditional healthcare systems customers need to visit a clinic to avail health services. Alternatively, e-Health services are supported by

electronic (communication) devices primarily based on internet technology. Within e-service platform, m-Health delivers healthcare services via mobile communication devices. This definition is still very broad. Now most of the communication devices are mobile, but m-Health services do not necessarily be accessed from a tablet PC without internet connection. Therefore, some researchers refer m-Health generally to mobile devices (which can be combined with web-based interface too), but specifically to cellular phones (Poulcheria and Costas, 2010). In other words, e-Health services that support healthcare functions and delivery, whereas m-Health focuses largely on providing healthcare access. Still, the linkage between e-Health and m-Health is obvious where e-Health operates as the backbone of m-Health projects; both are believed to have the potential to dramatic advances in healthcare industry in terms of mobility, size, speed, and communication (Chan *et al.*, 2008; Deluca and Enmark, 2000). Hence, in the context of the current research, m-Health is defined as the use of mobile technologies to provide medical health and clinical advices in the form of as smallest as SMS or real-time voice communication, even without internet connection but using cellular networks (Kahn *et al.*, 2010; Akter *et al.*, 2010; Chan *et al.*, 2008).

While m-Health offers applications for developed nations, in recent years, this field has emerged more popularly in developing countries particularly for hard-to-reach populations (Beratarrechea *et al.*, 2014). The main incentives of promoting m-Health in developing nations include high population with low-healthcare workforce, large number of rural inhabitants with less access to health services, limited resources (mainly financial) to build and support healthcare infrastructure, and high exposure to disease prevalence. Fortunately, supporting m-Health services, these nations experience quick penetration of mobile phone network – here comes the main incentive for m-Health use (Kaplan, 2006). Consequently, by 2011, the overall global adoption of m-Health reached to 83 per cent (in terms of number of countries); among them, 70 per cent adopted one to nine initiatives, and the rest have ten or more initiatives (Kay, 2011). Particularly, South-East Asia has made noteworthy progress than Africa or Western Pacific region where every country in South-East Asia has adopted at least one initiative (Kay, 2011). For example, most telecom service providers in Bangladesh offer m-Health service (e.g. Healthline, Healthlink, etc.). Their services offer mostly getting medical advice/assistance from MBBS professionals, pharmacy helps, laboratory test interpretation, and medical emergencies while Aktel (Robi) extended to videoconferencing. Going one step ahead, MAMA (a global alliance for improving maternal and child health through mobile technology) introduced safe (maternity) delivery at home as well as ensuring the basic but important healthcare services. Taking advice from MAMA 32 per cent of the registered subscribers chose safe (maternity) delivery at home, while 96 per cent regularly take BCG immunisation and 100 per cent take Pentavalet. It is a good start for one of the countries with lower health index – Bangladesh. This current study is performed in Bangladesh. There are growing concerns about m-Health use in Bangladesh where many people start using the services, however, do not continue in a long run (Akter *et al.*, 2010). This phenomenon is termed as "discontinuance" that hinders utilisation of an IS to its full potential (Bhattacherjee, 2001). This current study defines users' CI as users' perception of the likelihood that they will continue using m-Health service in the future.

2.2 IS success

M-Health studies have been investigating users' adoption and diffusion behaviour (see Table I). For instance, Hung and Jen (2012) applied original technology acceptance model (TAM) whereas Guo *et al.* (2013) added technology anxiety and resistance to

Theory/model applied	Antecedents	Dependent variables	Reference
Expectation-confirmation model	Perceived usefulness, confirmation, trust, service quality	Satisfaction, continuance intention	Akter *et al.*, (2013b)
Service quality (SERVQUAL)	Reliability, responsiveness, assurance, empathy, benefits, efficiency, privacy	Satisfaction, continuance intention	Akter *et al.* (2010, 2013a, b)
Trust theory	Ability, benevolence, integrity, predictability	Trust, trustworthiness, continuance	Akter *et al.* (2011)
IS success model	System quality, content quality, service quality	Use, satisfaction, benefits	Chatterjee *et al.* (2009)
Motivational model	Perceived risk, extrinsic and intrinsic motivation	Behavioural intention	Cocosila (2013) and Cocosila and Archer (2010)
TPB	Perceived value, behavioural control; attitude, subjective norm	Behavioural intention	Deng *et al.* (2014)
TAM	Perceived ease of use, usefulness, technology anxiety, resistance to change	Adoption intention	Hung and Jen (2012) and Guo *et al.* (2013)
UTAUT	Effort expectancy, performance expectancy, social influence, facilitating conditions, perceived value, hedonic motivation, habit, waiting time, self-concept	Behavioural intention, actual behaviour	Dwivedi *et al.* (2016)

Table I.
Existing literature on m-Health adoption diffusion domain

change as significant barriers for m-Health adoption. Similarly, the proponents of theory of planned behaviour (TPB) such as Deng *et al.* (2014) used typical TPB variables including perceived value (PV), behavioural control, attitude, and subjective norm. Integrating both TAM and TPB Wu *et al.* (2011) investigated m-Health adoption from the perspective of hospital's professionals and included perceived service availability and personal innovativeness of IT. The common theme these studies investigated is the adoption behaviour. However, Bhattacherjee (2001, pp. 351-352) argues that, "while initial acceptance of IS is an first step towards realizing IS success, long-term viability of an IS and its eventual success depend on its continued use rather than first-time use". Similarly, Kim and Malhotra (2005) demonstrated that "although initial use is an important indicator of IS success, it does not necessarily lead to the desired managerial outcomes unless the use continues" (p. 741). Also, Banchs *et al.* (2014) confirmed that higher adoption may end up with limited use. Furthermore, Wang (2008) believes that "reuse" is a closer measure of system success. Hence, it is evident that prior studies considered "continuance" as a proxy variable of "IS success" although the adoption factors are worth studying in a success model. However, Seddon (1997) warned not to assume that greater IS use ensures IS success; but greater perceived usefulness and user satisfaction (STF) "probably" do (p. 251). Interestingly, IS success models (discussed in the next section) cover most of the variables that are incorporated in m-Health adoption diffusion studies.

2.3 IS success models

IS success model, one of a few original theories in IS domain, was first proposed by DeLone and McLean (1992). D&M IS success model established interrelationships between six variables. In a causal setting, system quality and information quality individually as well as jointly influence STF and use, which then affect individuals;

individual use-behaviour affect organisational performance. Moreover, use influences STF and vice versa. Ten years later from proposing the initial model, in 2003, Delone and McLean revised their model, which is even more popular. One of the most significant modifications in their revised model is the addition of service quality along with the other two independent variables – system quality and information quality; use intention and STF are dependent on these three variables. Moreover, greater satisfaction leads to greater intention to use; or, more actual use drives to greater satisfaction; and, satisfaction and use influence net benefits. Recursively, greater benefits using the system may drive users to be more satisfied and drive for more use. Consequently, the models have been contextualised, modified, and adapted; see Table II for the seminal development in IS success model.

Seddon (1997) criticised that D&M model creates "unnecessary confusion" because of "the inclusion of both variance and process interpretation" in a same model. Therefore, Seddon "respecified and extended" and instead focused on causal (variance) aspects. The dependent variable of Seddon's model is IS use, which is dependent on STF; satisfaction is directly influenced by perceived usefulness; both usefulness and satisfaction are dependent on system quality, information quality, and net benefits. More distinctively, Seddon claims that use is not a measure of success, but the perceived usefulness is. Despite of their difference, many studies use both models, sometimes interchangeably, believing their "reasonable fit" (Rai *et al.*, 2002). Recently, D&M model was further "respecified" by Wang (2008) who claimed that reuse intention successfully explains IS success. His e-commerce success model consists five determinants: information quality, system quality, service quality, PV, and STF. Wang's model is consistent with other IS theories. For instance, expectation-confirmation model (ECM) (Bhattacherjee, 2001) too realises that CI determines the success of an IS and CI is dependent on post-purchase perceived usefulness (a comparable concept to PV) and STF; and, STF is dependent on perceived usefulness. In m-Health domain Akter *et al.* (2013b) applied ECM. Similarly, the SERVQUAL dimensions of m-Health used by Akter *et al.* (2010, 2013a), can be explained by the antecedents of IS success model; for instance, reliability, responsiveness, assurance, and privacy are captured by system quality, empathy denotes service quality, whereas benefits can be viewed as PV. Therefore, Wang's IS success model is considered as the theoretical basis of the current study.

3. Research model and hypotheses

The research model developed in this study examining m-Health success is adapted from Wang's e-commerce success model. The model suggests that a successful

Table II. The variables of major IS success models

Model	Exogenous variables	Intermediate variables	Endogenous variable(s)
Delone and McLean (1992) model	System quality, information quality	User satisfaction, use	Individual and organisational impact
Seddon's (1997) model	System quality, information quality	User satisfaction, perceived usefulness	IS use
Revised Delone and McLean (2003) model	Information quality, system quality, service quality	User satisfaction, intention to use, use	Net benefit
Wang's (2008) model	Information quality, system quality, service quality	User satisfaction, perceived value	Intention to reuse

m-Health system would enhance users' perceived quality of health life (QoHL), which is influenced by CI of m-Health services. Further, CI is dependent on STF and PV, which are dependent on three quality dimensions (platform, advice, and interaction).

3.1 Quality dimensions

System quality or back office quality (Parasuraman *et al.*, 2005) – a well-accepted quality dimension of IS success model – refers to overall perception on quality of the system in regards to technical issues such as ease of use, reliability, accessibility, and so on (Akter *et al.*, 2013a; Mechael, 2009; Zarmpou *et al.*, 2012). In m-Health context Akter *et al.* (2010) termed it as platform quality by arguing that the overall platform of m-Health services (including mobile network infrastructure and limitations/facilities of hand-held devices) influence quality perceptions in a pervasive healthcare system (Varshney, 2005). Such platform would respond to (via audio/visual or text data) a number of users at a given time, accurately and quickly after analysing a huge array of data (Chatterjee *et al.*, 2009; Poulcheria and Costas, 2010). We adopted Akter *et al.*'s (2010) notion of platform quality.

The next quality dimension is quality of advice, which can be defined as the degree to which the received advice from an m-Health provider is well-explained to apply/practice (adapted from Chatterjee *et al.*, 2009). Quality of advice possibly is the most important factor for a successful m-Health service – good quality of advice would have positive effect on a given case whereas the opposite is disastrous. Medical advice, especially in distance and non-face-to-face communication (e.g. m-Health) should be complete, relevant, accurate, reliable, timely, and easily understandable (Delone and McLean, 2003). Therefore, quality of advice from an m-Health service provider is considered as an important variable in our m-Health success model.

The final quality-specific dimension of Delone and McLean (2003) and Wang (2008) models is service quality. The current study, however, has not considered the same but replaced it with interaction quality with a context-based rationale. In face-to-face health services, the functional and behavioural quality of the provider (e.g. receptionist, nurse or the doctor) is vital and generally termed as service quality. However, in m-Health, service quality perception actually starts from an user dials the phone number till hangs up – the total experience or "combined effect" of mobile network, advice and interaction Ivatury *et al.*'s (2009) study that investigated on mobile telemedicine services in some developing countries found that service quality perceptions are better explained by information systems (i.e. platform quality), interaction between doctors and patients (interaction quality), and overall service outcome obtained from using the service (i.e. quality of advice). Akter *et al.* (2010, 2013a) too demonstrated that service quality can be better explained as a multidimensional construct reflected by system quality, information quality, and interaction quality. Supporting the notion of interaction quality, in e-service domain, Parasuraman *et al.* (2005) observed that, quality of the people from front office – interaction quality – is vital. Shaw and Ivens (2002) too postulated that, the overall service quality perception in electronic environment mostly is influenced by "all moments of contact". However, unlike other IS services such as e-Commerce (where users do not necessarily come in a direct contact with the service provider), m-Health service are highly interactive and hence a meaningful interaction between the parties is crucial. A wrong product can be returned in e-commerce but any incorrect advice/interpretation can cause a threat to a life; therefore, interaction quality has been considered as an important dimension in our research model. Here, interaction quality indicates "the dyadic interplay between a service provider and a user over mobile platform" (Akter *et al.*, 2010, p. 214).

3.2 The outcome variables

The outcome variables of the current study are: user satisfaction (STF), perceived value (PV), continuance intention (CI), and quality of health life (QoHL).

STF is one of the two most dominating research streams in IS (Scheepers *et al.*, 2006) and is defined as "the extent to which users believe the IS available to them meets their information requirements" (Ives *et al.*, 1983; emphasis inserted). However, over the period, the definition of STF encompasses more perspectives (than "information" only) including users' evaluation of their overall experience with the system. This current study captures the latter notion of STF but considers information or derived advice as a substantial part of it.

Seddon's (1997) IS success model posits that STF is dependent on perceived usefulness whereas Delone and McLean (2003) relied on net benefits perceived from using the service. More recently, taking support from marketing studies Wang (2008) argued that PV is "a more comprehensive and reliable measure of net benefits" that "involves a trade-off between give and get components", whereas perceived usefulness taps only the "get" component (p. 536). The current study adopts this notion. Here, in m-Health context, PV investigates whether the time and effort paid to avail a health service is worthwhile from a user perspective (Deng *et al.*, 2014).

Then, numerous studies in IS considered CI as an endogenous variable (e.g., Bhattacherjee, 2001) that is defined as a behavioural pattern reflecting continued use of a particular IS. Health practitioners urge that health service initiatives are of least use if are not continued. The current study supports that a system can be considered as successful when it is used in a continued fashion, at least for a reasonable period of time till it is replaced by a better system, and therefore CI is used as an outcome variable.

Lastly, Straub and Watson (2001) suggest that, one of the goals of any technology should be to increase the quality of users' lives. Substantially, Choi *et al.* (2007) examined quality of life in mobile services. This notion is captured by m-Health researchers too; Akter *et al.* (2010) and Guo *et al.* (2013) support that m-Health systems should have some impact on the QoHL of the user. Fortunately, m-Health offers service for both communicable and chronic or non-communicable disease (Kahn *et al.*, 2010), for general health issues (e.g. diarrhoea, cough), in emergency situation (e.g. heart attack, burn, or poisoning) (Akter *et al.*, 2010; Aloudat and Michael, 2011), for health-risk habits (e.g. smoking, drug use) (Cocosila, 2013), for psychological issues, and so on. Particularly people in Bangladesh feel serious social constraints discussing private and sensitive health issues (e.g. HIV, AIDS, gonorrhoea, or unwanted pregnancy) with a physician; most of the times they hide the issue and try to solve in perilous way. In m-Health system patients do not need to interact face-to-face, they may take a photograph of a wound/illness and allow a remote physician to have the primary diagnosis to help treat or refer for further treatment as to a hospital/clinic. Hence, m-Health has huge potential to an user as well as to a community (Chan *et al.*, 2008). Hence, the current study considers QoHL as the final outcome variable.

Based on the discussion in preceding sections, this study develops m-Health system success model presented in Figure 1.

3.3 Hypotheses

The hypothesised relationships between the three quality dimensions and STF are based on the existing literature. Several IS studies suggest that system quality and quality of advice are antecedents of STF (Petter and McLean, 2009; Delone and McLean, 2003; Koo *et al.*, 2013; Fang *et al.*, 2011; Landrum and Prybutok, 2004; Wang,

2008) whereas Akter *et al.* (2013a) demonstrated that "interaction" is an important dimension of m-Health service quality, and service quality has significant role explaining STF. Therefore, this study develops the following hypotheses:

H1. Platform quality will positively affect STF in the context of m-Health system.

H2. Quality of advice will positively affect STF in the context of m-Health system.

H3. Interaction quality will positively affect STF in the context of m-Health system.

Prior studies that used D&M models support that the antecedents of PV of an IS are system quality and information quality (Wang, 2008; Koo *et al.*, 2013; Landrum and Prybutok, 2004) while Kuo *et al.* (2009) claimed that service quality have significant positive impact on PV. The argument made in developing *H3* can be repeated and assumed that, users' perceive value recurred from an IS use is dependent on interaction quality (Akter *et al.*, 2013a). Therefore, this study examines the following hypotheses:

H4. Platform quality will positively affect PV in the context of m-Health system.

H5. Quality of advice will positively affect and PV in the context of m-Health system.

H6. Interaction quality will positively affect and PV in the context of m-Health system.

IS success models proposed that net benefits or perceived usefulness of an IS positively affects STF (Delone and McLean, 2003; Fang *et al.*, 2011; Akter *et al.*, 2013b; Koo *et al.*, 2013). However, some studies replaced net benefit or perceived usefulness with PV, and proved that PV is more related with STF (Wang, 2008; Lin and Wang, 2006; Kuo *et al.* 2009)—the current study captures the same spirit leading to the *H7*. With a similar argument, extant literature supports that CI is dependent on PV (Petter and McLean, 2009; Delone and McLean, 2003; Wang, 2008; Lin and Wang, 2006; Fang *et al.*, 2011; Kuo *et al.*, 2009), which leads to develop *H8*:

H7. PV will positively affect STF in the context of m-Health system.

H8. PV will positively affect continued use in the context of m-Health system.

IS and marketing theories reached to an unison, more or less, that users' reuse or customers' repurchase intention is largely dependent on the satisfaction derived from using the IS or product, respectively (Hossain and Quaddus, 2012). IS success models

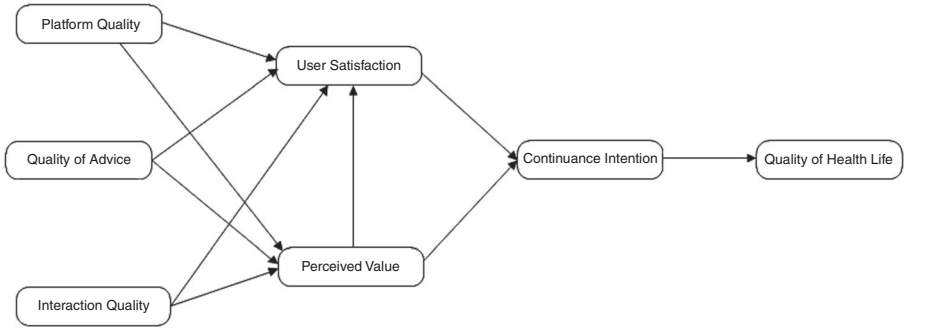

Figure 1.
The research model understanding the use and effect of m-Health

too demonstrate that IS users' "after use" evaluation is reflected through the reuse of the system (Delone and McLean, 2003; Lin and Wang, 2006; Wang, 2008; Petter and McLean, 2009). In m-Health context, Akter *et al.* (2010, 2013a, b) found that, people intent to use an m-Health system in a continued fashion once he or she is satisfied with its service(s). Therefore, this study postulates that:

H9. STF will positively affect continued use in the context of m-Health system.

Finally, receiving m-Health services in a continued manner may enhance the QoHL of a user, which collectively would improve QoHL of a society (Beratarrechea *et al.*, 2014). For instance, getting advice at emergency (e.g. heart attack, or labour and birth), or on private health issues (e.g. AIDS, gonorrhoea), or general health issues (e.g. weight loss) may reduce a number of incidents and improve the overall quality of a society. Therefore, this study proposes that:

H10. Continued use will positively affect QoHL of the users in the context of m-Health system.

4. Research methodology

4.1 Research design

Driven by the "discover" nature, this study applied positivist research philosophy assuming that m-Health success factors can be expressed in causal relationships, and such relationships and the associated variables can be measured with data in a representative and accurate manner. Moreover, positivist research discovers underlying patterns of a given phenomenon and can describe such patterns in cause-effect relationships. Furthermore, it is believed that positivist approach is useful to predict the success (or failure) of a system (Cecez-Kecmanovic, 2005). Methodologically, this study applied quantitative method. In order to measure the variables measurement scales were adapted from prior studies; accordingly the questionnaire was developed. Then, in order to validate the research model, data collected from a survey were analysed using structural equation modelling (SEM) technique. The steps taken to conduct this research process are presented in Figure 2: identifying the research gap (Section 1), specifying the research context and scope (Section 2.1), developing the research model (Section 3) and measurement scale (Section 4.3), data collection (Section 4.4), data analysis (Section 5), and discussion on results (Section 6.1).

4.2 Instrument construction

In order to ensure content validity of the constructs, the items have been adapted from prior IS studies. First, in order to measure platform quality of m-Health services, this study used six items: system availability, reliability (e.g. Delone and McLean, 2003; Fang *et al.*, 2011; Parasuraman *et al.*, 2005), privacy, versatility (Akter *et al.*, 2010), personalisation (Zarmpou *et al.*, 2012; Ahmad *et al.*, 2013), and ease of use (Snowden *et al.*, 2006; Alharbi *et al.*, 2013). Next, quality of advice combined six dimensions that include completeness, understandability, relevance (Delone and McLean, 2003), accuracy (Fang *et al.*, 2011; Landrum and Prybutok, 2004), reliability (Landrum and Prybutok, 2004; Wang, 2008), and currency (Fang *et al.*, 2011; Landrum and Prybutok, 2004). Then, six items have been examined under interaction quality: assurance, empathy, responsiveness (Akter *et al.*, 2010; Delone and McLean, 2003), trustworthiness (Akter *et al.*, 2013b; Zarmpou *et al.*, 2012), credibility, and courtesy (Fang *et al.*, 2011; Landrum and Prybutok, 2004). PV has been measured using five

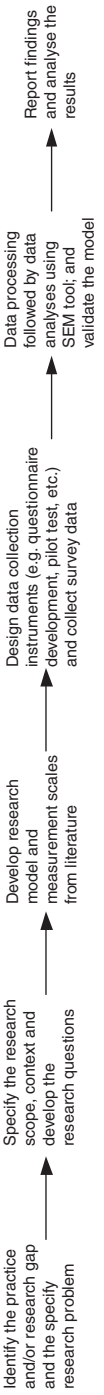

Figure 2.
The sequential presentation of the research approach

items: value for money, acceptable price (Wang, 2008), "not wasting my time and money" (Cocosila, 2013; convenience Fang *et al.*, 2011), and gaining social value or social recognition, i.e. image (Venkatesh *et al.*, 2003; Khalifa and Shen, 2008; Snowden *et al.*, 2006). In order to measure STF many studies used four items: satisfied, contented, pleased, and delighted (e.g. Akter *et al.*, 2010; Bhattacherjee, 2001); however, the current study adapted the scale used by Fang *et al.* (2011). Similarly, the items of CI were taken from Akter *et al.* (2013b). Finally, QoHL has been adapted from Akter *et al.* (2010) with the support of Guo *et al.* (2013): using m-Health improves QoHL (Guo *et al.*, 2013; Akter *et al.*, 2010), provides convenient life (Guo *et al.*, 2013), and effectiveness in life (Guo *et al.*, 2013).

4.3 Questionnaire development and data collection

For collecting data, a survey was conducted in Bangladesh, a developing country from South-East Asia. The rational for a survey is very strong for this study. Adoption diffusion behaviour of m-Health is a subjective issue because each user may possess own perceptions, perspectives, expectations, and experience. Further, there could be multiple factors that contribute to such perceptions. Thus, conducting field study, for instance, among a number of users that can represent a population is time consuming, effort-driven, and not much an effective way, and also can generate social desirability bias. Instead, a survey could perform this job efficiently. The questionnaire was primarily developed in English. However, for the respondents who were more comfortable answering in national language, Bangla, the questionnaire has been translated into Bengali. The survey used Likert-based questionnaire ranging from 1 = "strongly disagree" to 5 = "strongly agree".

Survey data for this study were collected from people from Bangladesh who have (been) used/using m-Health services. Survey respondents were contacted at universities, café, and shopping centres. Moreover, an online survey in social networking groups was utilised to collect data. After exhausting several attempts 245 responses were collected, but 46 were unusable; hence, 199 responses were used for data analyses. Standard demographic measures were analysed in order to characterise the sample (see Table III). Briefly, the sample is well-representative in regards to gender; however, it is likely that young and educated people would be more in a position to using m-Health services, at

Table III.
Demographic data of the respondents

Items	Categories	Statistics (%)
Gender	Male	59
	Female	41
Age	18-25	38.4
	26-33	29.5
	34-41	18.5
	42-49	7.5
	50+	6.1
Education	High school/O-level	11.4
	College/A-level	42.1
	Tertiary	46.5
Profession	Student	35.4
	Employed	26.2
	Business	21.9
	Others	16.5

least at the initial stage as now. Overall, it is observed that, m-Health is increasingly being exposed to the aged groups than 18-25, and female are larger user than male; different observation was experienced by Akter *et al.* (2010) in the same population.

5. Data analyses and results

5.1 Data analysis technique

Component-based SEM using PLS has been adopted for this study considering its suitability over covariance-based SEM with regard to model complexity, sample size, and distributional properties. This research utilized SmartPLS software (version 2.0.M3) because of its availability and graphical interface over PLS graph. As par the PLS procedure, both assessment of the measurement model and structural model have been examined. Additionally, the mediating effect of STF between PV and CI has been examined. Because this research applied two methods of data collection (i.e. direct and online survey), there could be "systematic bias" or common method bias (CMB), which can be a threat to the validity of the results. In order to examine the common method variance (CMV), this study applied Lindell and Whitney's (2001) methods. First, CMB can be identified if at least one correlation between constructs equals 0 – this study passes this test. Then, an unrelated (marker) variable was introduced to the existing model; any high correlation among any of items of the study's constructs and the maker variable would be an indication of CMV. The results indicated that the largest variance explained by an individual factor is 3.8 per cent, and thus rejects any CMB.

5.2 Assessment of measurement properties

The initial research model consisted of 33 observed variables. Referring to Igbaria *et al.* (1995), this research adopted the minimum cut-off level of 0.6 for item loading, and all items exceeded the reliability criteria (see Table IV). Then, the composite reliability (CR) and average variance extracted (AVE) were checked to assess the internal consistency of the model. Referring to Table IV, all constructs met the acceptable criterion for CR (0.7 or more) and AVE (0.5 or more) (Henseler *et al.*, 2009).

Moreover, this study assessed the square root of the AVE and cross-loading matrix to assess the discriminant validity as suggested by the scholars (Igbaria *et al.*, 1995; Chin, 2010). The square root of AVEs exceeds the inter-correlations of the constructs with the other constructs in the model, which indicates that all items demonstrate higher loadings in their respective constructs in comparison to their cross-loadings in other constructs (see Table V). Moreover, the cross-loading matrix was developed (see Table AI); no item loads higher value on other constructs than on the construct it represents. The results, therefore, confirms that the measurement model has strong discriminant validity at item as well was construct level.

5.3 Assessment of the structural model

To test the hypotheses, this study used standard bootstrap method using 200 subsample, no sign change, performing two tailed test, and with 0.05 significance level. Overall, this model accounted for 35 per cent of the variance in QoHL, and 43 per cent of continued use of m-Health service. Similarly, 59 per cent of the variance in STF while 65 per cent of the variance in PV was explained by platform quality, quality of advice, interaction quality, and PV, respectively. The obtained R^2 values are substantial (0.67) to moderate (0.33), and all are acceptable for the current study (Henseler *et al.*, 2009).

The structural properties of the causal paths including standardised path coefficients, *t*-values for each equation in the hypothesised model are presented in Table VI.

Constructs	Items	Loadings	CR	AVE
Platform quality	This platform is always available	0.658	0.860	0.507
	This platform is reliable	0.776		
	Personalised service is offered	0.777		
	Does not share my personal information with anybody else	0.737		
	Provides service in various of health-need	0.641		
	Overall, m-Health services are easy to use	0.670		
Quality of advice	Advice delivered by the provider is complete	0.724	0.894	0.587
	Advice delivered by the provider is easy to understand	0.808		
	Advice delivered by the provider is relevant	0.829		
	Advice delivered by the provider is accurate	0.814		
	Advice delivered by the provider is reliable	0.772		
	Advice delivered by the provider is current/timely	0.631		
Interaction quality	Instils confidence	0.731	0.870	0.527
	Physicians give me individual attention	0.740		
	Provides prompt service	0.763		
	This service is trustworthy	0.675		
	Gives reliable advice	0.717		
	Courteous/treat with respect	0.726		
Perceived value	Cost saving	0.770	0.870	0.530
	Not wasting my time /good value for money	0.730		
	Time saving	0.671		
	Convenient	0.602		
	Image/symbol of prestige	0.801		
	Serves medical purpose very well	0.776		
User satisfaction	I like taking advice/information	0.832	0.858	0.668
	Taking m-Health services is a good idea	0.794		
	Overall, I am satisfied with m-Health services	0.826		
Continuance intention	I intent to reuse it	0.846	0.889	0.727
	I intent to continue rather than using alternative means	0.860		
	I will not discontinue my use of this service	0.852		
Quality of health life	Improves my life quality	0.811	0.875	0.701
	Makes my life more convenient	0.866		
	Makes me more effective in my life	0.834		

Table IV.
Item loadings, composite reliability, and AVE of the measures

Construct	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Quality of health life (1)	*0.837*						
Continuance intention (2)	0.499	*0.853*					
Perceived value (3)	0.742	0.423	*0.728*				
User satisfaction (4)	0.082	0.050	0.167	*0.818*			
Platform quality (5)	0.082	0.050	0.167	0.233	*0.712*		
Quality of advice (6)	0.524	0.552	0.611	0.385	0.358	*0.766*	
Interaction quality (7)	0.554	0.622	0.716	0.578	0.308	0.591	*0.726*

Note: Italics diagonal values are square root of AVE of relevant construct

Table V.
Inter-correlations of the constructs

The results summarise that, CI of m-Health services is dependent on PV and STF; PV positively influences STF. Moreover, platform quality, quality of advice, and interaction quality have positive and direct effect on PV and STF. Finally, PV increases STF, and CI drives to better QoHL. Thus, all ten hypotheses are supported (Figure 3).

Additionally, this study checked the mediating effect of STF; the indirect effect of ($a \times b$) has to be significant for the PV → ICU link. In this regard, the z-statistic (Sobel, 1982) is calculated; z-value greater than 1.96 ($p < 0.05$) will support the mediating effect; however, the result refuses any mediating effect of STF between PV and ICU. The z-value is formally calculated as follows:

$$z_{\text{Perceived value} \rightarrow \text{continuance}} = \frac{a \times b}{\sqrt{\left(b^2 S_a^2 + a^2 S_b^2 + S_a^2 S_b^2\right)}} = 1.60$$

where a is the path coefficient between PV and STF; b the path coefficient between STF and CI; S_a the standard error of path a; and S_b the standard error of path b.

6. Discussion and implications

6.1 Key findings

This study investigated the factors that are important for the success of an m-Health system. Data analyses confirm that the quality dimensions (i.e. platform, advice, and interaction quality) along with STF and PV represent an insightful theoretical lens for investigating IS success in m-Health context.

The empirical data clearly finds that, continued use of m-Health services may enhance QoHL of the users ($\beta = 0.49$, $t = 6.39$). For continued use of m-Health services, PV exerts stronger effect ($\beta = 0.403$, $t = 3.003$) than STF ($\beta = 0.302$, $t = 2.258$). It implies that users intent to (dis)continue m-Health service based on the PV it offers than their satisfaction judgement. Wang (2008) too realised that, increasing value-perceptions might deter users to switch somewhere else. However, the role of STF should not be underestimated rather both STF and PV are significantly important in the relationship to CI. This finding is further confirmed by the mediation analysis that reveals that STF does not mediate the relationship between PV and CI.

All the quality dimensions (platform, advice, and interaction) have significant effect on STF. Among them, quality of advice has the strongest effect ($\beta = 0.47$, $t = 4.21$); next, platform quality ($\beta = 0.304$, $t = 2.405$) is more important than interaction quality ($\beta = 0.32$, $t = 2.23$). M-Health systems should address multipurpose health needs – from emergency to general. In every case, the provided advice has to be with good quality. Getting good service on cold-relief may satisfy a user, however, later if s/he does not get valued advice on an emergency may result dissatisfaction. Therefore, m-Health systems should provide accurate information for versatile problems – limitation on any unavailable service or information should be mentioned on the first place. Next, platform

	Perceived value	User satisfaction	Continuance intention	Quality of heath life
Platform quality	0.242 (2.008)*	0.304 (2.405)*		
Quality of advice	0.263 (2.096)*	0.47 (4.21)***		
Interaction quality	0.378 (3.387)***	0.322 (2.230)*		
Perceived value		0.343 (2.502)*	0.403 (3.003)**	
User satisfaction			0.302 (2.258)*	
Continuance intention				0.499 (6.396)***

Notes: t-values for standardised path coefficients are presented in parentheses. Significance level *$p < 0.05$; **$p < 0.005$; ***$p < 0.001$

Table VI. Path coefficient and t-statistics of the relations in the developed model

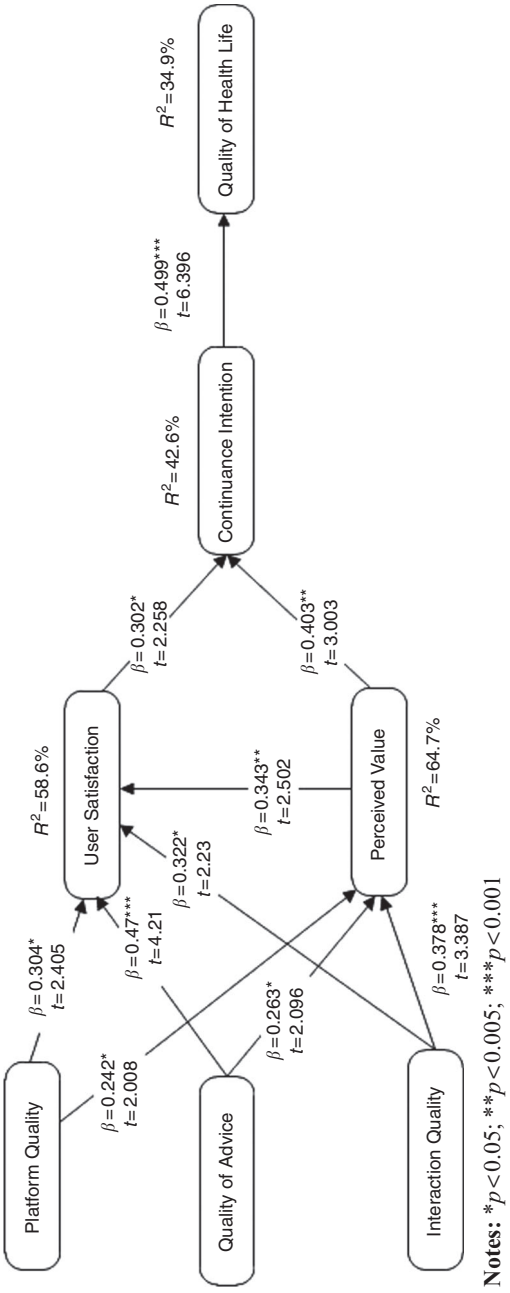

Figure 3.
The m-Health success model with the results

quality plays a significant and direct effect on STF. It is intuitive that the quality of the system is essential to go to the next phase, i.e. getting advice/consultation – a system which is down at most times or at on user's emergency, surely would have an adverse impact on STF (Aloudat and Michael, 2011). Finally, users receive healthcare services through interactive audio/video session; any ill handling (e.g. impolite or haste behaviour) may affect STF negatively. Therefore, interaction quality is important.

Next, understanding the antecedents of PV of m-Health service the results show that interaction quality ($\beta = 0.378$, $t = 3.387$) had the greatest reflection, which implies that better interaction may drive users to perceive a service with higher value. Next, platform quality ($\beta = 0.242$, $t = 2.008$) and quality of advice ($\beta = 0.263$, $t = 2.096$) have almost same and significant effect on PV. Finally, higher PV results greater satisfaction ($\beta = 0.343$, $t = 2.502$). Prior studies in IS (e.g. Wang, 2008; Kuo *et al.*, 2009) too find that STF and users' PV are directly and positively related.

6.2 Theoretical implications

This study contributes to existing knowledge. It is the first reported initiative that extended existing IS success theories in the context of m-Health services by capturing users' perception on three quality dimensions (platform, advice, and interaction) and investigating their impact on IS success factors. It therefore confirms the newness of the theory through its application in a new research setting (i.e. m-Health in a developing country) – "the common element in advancing theory development by applying it in new settings […] new about the theory itself as a result of working with it under different conditions" (Whetten, 1989, p. 493). Specific to m-Health domain, this study argued that service quality of healthcare system is a bigger concept that integrates platform quality, quality of advice, and interaction quality. Specifically, "interaction" is a fundamental and vital constituent of healthcare systems, supported by the empirical results. Besides, this study added novelty by extending existing IS success variables (e.g. satisfaction, continuance) to a new outcome variable (i.e. QoHL) which has not investigated before but is deemed more appropriate (than behavioural intention) realising the ultimate success of a technology (Choi *et al.*, 2007). Also, this study confirms the knowledge-society that there is no mediating role of STF between users' PV and CI, which emphasises to incorporate both of these antecedents while investigating continuance behaviour of m-Health systems. The theoretical contribution is further confirmed ensuring the four "essential elements" for theoretical contribution suggested by Whetten (1989). First, answering the "what" question, the m-Health success factors have been developed in this study that are "right" having both comprehensiveness and parsimony. Second, how the factors are related is answered by "using 'arrows' to connect the 'boxes'" that assists understanding the causality and effect of the factors. "Together, the What and How elements constitute the domain of the theory" (Whetten, 1989, p. 491). Complying with the third dimension, "why", this research presented the underlying dynamic of the explored factors, and the causal relationships that are supported by prior studies. "What and How describes" the research (description) while "Why explains" such research (explanation). Finally, the limitations of the study are presented along with the future research direction – suggesting how the current research can be used in other applications ("who, when, where").

6.3 Practical implications

The findings offer the following practical implications.

First, m-Health service providers should recommend and encourage the users not to discontinue m-Health services. It is frequently found that patients discontinue a

previously taken service before getting full recovery. For instance, smoking and quitting happen recursively, therefore, the motivation to quit is required to be continued. Similar interpretation can be derived for most psychological problems too (e.g. suicidal tendency). As a strategic implication, diversely, service providers may develop anonymous profile of the users which would guide the providers delivering health services (e.g. sending reminder SMS for heath check) so that the users are not left alone but in reach to a continued-advising system (Mechael, 2009; Cocosila and Archer, 2010). This would additionally assist the service providers to exploit the full potentials of m-Health system by updating the users with new services or health-related advises. More strategically, in order to ensure better QoHL in a society, government and agencies should monitor the continued usage behaviour of the users of a given m-Health service and reflect to the associated provider. Additionally, a central database (for a person or a society) can be created, which can be used by the physicians to warn the person or the society about a potential disease (outbreak).

Second, the current study established the importance of PV as a strategic weapon for service providers – they should evaluate the offered value against the associated and potential values, and emphasise on value-dimensions because higher PV results higher STF which then affect CI. Hence, in order to retain users/customers, managers who previously focused on other issues including quality dimensions should also contemplate both value creation and STF measures.

Third, the quality dimensions and their relative impact to PV and STF provide implications for operational manager. When managers intent to provide improved value, for instance, interaction quality is the priority and hence should be the focal area of improvement, followed by advice and platform quality. Similarly, to ensure higher STF managers need to ensure quality of advice followed by platform and interaction quality. Managers should also realise that PV plays stronger role on CI, where interaction quality contributes most on PV. Similarly, STF is required for m-Health continuance where information quality is the main predictor of satisfaction. This means, better interaction and quality of advice would have more influence on continuance. These findings suggest that managers should confirm operational quality at service level; neither satisfactory interaction with incomplete advice nor appropriate service from an ill-behaved physician does contribute to satisfaction or value perception of the user. Most psychological health advices demand trustworthiness and credibility of the physicians; therefore, they should interact in such a manner that instils confidence of the patient – the crucial role of interaction quality is to play. Managers should understand that m-Health services are non-face-to-face and, therefore, they should train the consultant to deliver advice in such a way that it is easily and completely consumed by the user. Likewise, managers should ensure quality of advice by conducting regular data audit or exploit contemporary (technological) innovations such as expert systems, knowledge management systems, cloud computing, and intelligent mechanisms (Laudon and Laudon, 2012). Such systems additionally may develop automated systems that can entertain general and non-critical health issues (anti-smoking tips, cold, headache), that would make the physicians available for handling more interaction-required issues.

6.4 Limitations and future research direction

Some limitations of the current study are worthwhile to mention, which may produce research in future.

First, the empirical survey data have been collected from a specific country, i.e. Bangladesh where the overall health system is not confirmed to a vast majority of the

population. This sample is chosen purposefully. Because of its limited infrastructure (e.g. huge traffic jam, river-based transportation to a major locality), accessing traditional health system is not always confirmed in Bangladesh. Therefore, m-Health systems possess huge potential for countries like Bangladesh. Still, the model can be modified and tested in developed countries, which would present a unified view on m-Health system success. Second, this study adopted cross-sectional survey to collect information from a given sample of a population at a given time. Future longitudinal data would confirm the variance of perceptions and examine how the perceptions would affect the model. Third, the meta-analysis conducted by Petter and McLean (2009) revealed that many studies successfully established the relationship from platform quality and information quality to continued use. This study leaves a quest for future investigation to check such relationships in m-Health context. Fourth, considering the small population of m-Health service user, the respondents have been considered who have used at least one m-Health service in their lifetime. However, this study did not segregate the respondents who actually have been using the service in a continued fashion. As the number of user increases, future research could compare the users who have been continuing vs the users who discontinue the service. Fifth, this study considers quality dimensions as first order constructs measured with reflective items. However, these manifest variables can be better explained as multi-order constructs; for instance, Akter *et al.* (2010) examined interaction quality as a second-order construct that is reflected with responsiveness, assurance, and empathy. Finally, future study investigating the moderating effect of different dimensions including age, gender, and experience would provide us a better picture on the success factors of m-Health systems (Ahmad *et al.*, 2013).

7. Conclusion

The revolutionary m-Health systems may create a healthier society through eradicating health incidents in mass level, which cannot otherwise be addressed with traditional location-specific health systems. This research is a quest to responding the success of m-Health system – a new and better complimentary, if not a substitute, to the traditional healthcare systems. In order to develop and validate a causal model, this study used seven success measures and investigated their interrelationships: system quality, quality of advice, interaction quality, PV, STF, and QoHL. This study validated that, quality of people's health life can be improved through continued use of m-Health systems; intention to continue m-Health system is dependent on users' PV and STF. This study provides clear insights for academic and practice in the m-Health context.

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Appendix

	PltQ	AdvQ	IntQ	PV	STF	CI	QoHL
PltQ1	0.658	0.377	0.440	0.432	0.478	0.631	0.296
PltQ2	0.776	0.458	0.472	0.507	0.464	0.625	0.453
PltQ3	0.777	0.591	0.547	0.548	0.523	0.419	0.722
PltQ4	0.737	0.566	0.640	0.549	0.525	0.474	0.710
PltQ5	0.640	0.472	0.478	0.510	0.420	0.320	0.448
PltQ6	0.670	0.552	0.493	0.495	0.408	0.333	0.415
AdvQ1	0.588	0.724	0.617	0.523	0.496	0.423	0.512
AdvQ2	0.648	0.808	0.640	0.581	0.540	0.402	0.500
AdvQ3	0.540	0.829	0.616	0.532	0.531	0.367	0.501
AdvQ4	0.535	0.814	0.625	0.534	0.441	0.377	0.516
AdvQ5	0.540	0.772	0.478	0.510	0.420	0.320	0.448
AdvQ6	0.393	0.632	0.610	0.470	0.446	0.236	0.463
IntQ1	0.511	0.607	0.731	0.554	0.519	0.421	0.482
IntQ2	0.500	0.465	0.740	0.549	0.564	0.441	0.500
IntQ3	0.586	0.633	0.763	0.524	0.447	0.434	0.568
IntQ4	0.428	0.482	0.675	0.517	0.389	0.370	0.477
IntQ5	0.450	0.457	0.717	0.557	0.503	0.460	0.440
IntQ6	0.555	0.553	0.726	0.573	0.606	0.397	0.499
PV1	0.570	0.415	0.622	0.771	0.489	0.445	0.543
PV2	0.492	0.605	0.592	0.730	0.507	0.357	0.488
PV3	0.474	0.484	0.512	0.671	0.491	0.497	0.352
PV4	0.456	0.345	0.373	0.602	0.356	0.429	0.429
PV5	0.590	0.504	0.593	0.801	0.631	0.474	0.651
PV6	0.528	0.551	0.570	0.776	0.585	0.495	0.554
Stf1	0.534	0.503	0.542	0.591	0.832	0.381	0.564
Stf2	0.506	0.565	0.607	0.546	0.794	0.444	0.517
Stf3	0.579	0.484	0.574	0.597	0.827	0.593	0.469
CI1	0.553	0.463	0.576	0.539	0.563	0.846	0.447
CI2	0.557	0.319	0.456	0.468	0.453	0.860	0.328
CI3	0.672	0.404	0.444	0.558	0.476	0.853	0.481
QoHL1	0.619	0.521	0.502	0.558	0.460	0.402	0.811
QoHL2	0.553	0.485	0.602	0.535	0.520	0.440	0.866
QoHL3	0.591	0.614	0.601	0.561	0.597	0.410	0.834

Notes: PltQ, platform quality; AdvQ, quality of advice; IntQ, interaction quality; PV, perceived value; STF, user satisfaction; CI, continuance intention; QoHL, quality of health life

Table AI.
Cross-loading matrix

About the author

Dr Mohammad Alamgir Hossain received PhD in Business Information Systems from Curtin University. He is working in RMIT University. Mohammad's major research expertise and interests are: behavioural modeling in information systems, RFID technology, e-Commerce, m-Commerce, m-Health, open data, and supply chain management. Dr Hossain has published papers in *Information Technology & People, Information Systems Frontiers, Australasian Journal of Information System, International Journal of Information Management, Journal of Organizational Computing & Electronic Commerce, Journal of Enterprise Information Management, Safety Science, Business Process Management Journal, Total Quality Management & Business Excellence,* and *International Journal of Information Systems and Supply Chain Management*. He received the best paper award in 2013 IFIP WG8.6. Dr Mohammad Alamgir Hossain can be contacted at: mohammad.hossain@rmit.edu.au