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Patrick Ndayizigamiye
University of KwaZulu-Natal, patrickndayizigamiye@gmail.com

Manoj Maharaj
University of KwaZulu-Natal, maharajms@ukzn.ac.za

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The determinants of mobile health in Burundi

Research Paper

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Patrick Ndayizigamiye
University of KwaZulu-Natal
patrickndayizigamiye@gmail.com

Manoj Maharaj
University of KwaZulu-Natal
maharajms@ukzn.ac.za

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ABSTRACT

Mobile health (or mHealth) can be broadly defined as the use of mobile devices and technologies to provide healthcare services. The potential of mHealth interventions to address healthcare issues, particularly in developing countries, is widely recognised. Although mHealth has yielded positive outcomes in various contexts, there is a need for designing mHealth interventions that are specifically tailored to the context of individual countries to increase the prospects of adoption. It is in this context that, using the Diffusion of Innovation (DOI) theory, this paper investigates the determinants for the adoption of mobile health by healthcare professionals in Burundi. From a sample of 212 primary healthcare professionals, this paper analyses what can influence Burundi's primary healthcare workers to adopt mobile health. The results indicate that the relative advantages associated with mHealth interventions are perceived as predictors of mHealth adoption in Burundi. Moreover, work-related factors coupled with one's experience with mobile devices are the DOI compatibility factors that influence the adoption of mHealth by Burundi's healthcare professionals. mHealth being a new concept with the Burundi's healthcare system, trialability and observability were found to have a significant influence on its adoption. However, mHealth complexity was found to have no influence on mHealth adoption. This paper advocates for education and awareness programs tailored specifically towards mHealth adoption by primary healthcare workers. It further recommends that the country leverage its East African Community (EAC) membership by forging partnerships with other EAC members in order to be acquainted with and learn from evidence-based outcomes of successful mHealth interventions within the region.

Keywords

Diffusion of Innovation, mobile Health (mHealth), primary healthcare, Burundi, East African Community.

INTRODUCTION

In line with achieving universal health coverage[1], there has been an increase in demand for affordable, high quality health services. Developing countries are facing the burden of combating diseases such as malaria and tuberculosis with scarce resources and limited budgets. Many African countries have adopted mhealth- enabled interventions as a cost-effective means to address healthcare systems challenges that impede the universal dispensation of healthcare. mhealth has been used as a tool that could assist in expanding treatment outreach, helping patients comply with medical regimens, raising awareness of epidemics, and promoting behaviours that limit the spread of diseases (Qiang et al., 2011). Odigie et al. (2012) and Zurovac et al. (2012) attest that mhealth-enabled interventions have proved to be successful when they are adapted to the local context. As mhealth is an emerging topic in the Burundian context, there is a need to investigate factors that may influence its adoption by healthcare professionals. The knowledge of such factors will assist decision makers in devising strategies that may encourage the adoption of mhealth by healthcare professionals.

Studies in the field of mhealth have been conducted using different theoretical frameworks. However, a literature review suggests that the diffusion of innovation theory (DOI) is amongst the most commonly used theoretical frameworks in mhealth research. Thus, in the same vein, using rogers (2003) diffusion of innovation theory, this paper analyses how mhealth could be adopted in Burundi taking into consideration the persuasive factors (of the DOI model) that influence their decision to adopt mhealth.

THE USE OF MOBILE HEALTH APPLICATIONS

The interactive nature of mobile health communication empowers users with the ability to self-monitor their health and other health-related knowledge (Bakshi *et al*. 2011; Sidney *et al*. 2011; Cole-Lewis and Kershaw, 2010; Cocosila, Archer and Yuan, 2009; Moskowitz, Melton and Owczarzak, 2009). mHealth applications also help to overcome the traditional geographical barriers such as lack of physical access to public healthcare facilities. mHealth-enabled interventions have also been deemed useful in reducing delays in diagnosis, treatment and diseases outbreak reporting (Kahn, Yang, Kahn, 2010). The infrastructural costs related to implementing traditional types of ICTs such as desktop computers and landline phones make mobile technology a cost effective option especially in limited resource settings (Schweitzer and Synowiec, 2012; Mishra and Singh, 2008). The installation of landline phones requires telephone wires and desktop computers necessitate significant investment in electrical resources and may not be easily portable from one location to another (Marshall, Lewis, Whittaker, 2013). Kelly *et al*. (2013) argue that smartphones equipped with GPS capabilities can be used for real-time monitoring and mapping of regions with diseases and epidemics outbreaks. Mobile technologies can be used to provide training electronically, thus reducing the cost and time required for travel to access such training (DeRenzi *et al*., 2012). They can also be used for the dissemination of healthcare information to rural communities (Chang *et al*., 2011). mHealth applications may help government departments monitor the performance of health programs and identify areas that need more focus (Broens *et al*., 2007). In this case, automated processes within mHealth applications could be used for data analysis and quality checks, thus overcoming shortcomings of paper-based systems (Mechael *et al*., 2010) such as inaccuracy, data duplication, and loss of critical data. Aggregated data (collected through mHealth applications) could be made public in order to increase transparency and public confidence (Sinha, 2010; Mechael, 2009). Healthcare

[1] Universal health coverage aims at ensuring that all people get access to health services they require including health promotion, prevention and treatment, rehabilitation and palliative care (WHO, 2014).

professionals' collaboration through mHealth applications, allows them to access and share information and seeking guidance that could be used for decision making (Knight and Holt, 2010).

In 2014, more than 30% of the global innovative healthcare delivery programs were implemented in the East African region with Kenya ranked second after India for its innovative eHealth programs (Excelsior Group, 2014). Several such programs are mHealth-enabled initiatives. The wide adoption of mHealth in the EAC is fuelled by the large number of mobile subscribers in EAC member states as depicted in table 1.

COUNTRY	**POPULATION SIZE (2016 ESTIMATES)**[2]	**MOBILE SUBSCRIBERS**	**INTERNET USERS**
Kenya	46,790,758	37,800,000[3]	31,985,048
Tanzania	52,482,726	40,170,000[4]	7,590,794
Uganda	38,319,241	19,500,000[5]	11,924,927
Rwanda	12,988,423	8,921,533[6]	3,216,080
Burundi	11,099,298	4,800,000[7]	526,372

Table 1: State of mobile subscriptions and Internet use in East Africa

A literature review on the performance of some of the mHealth projects implemented within the EAC region reveal positive results on health outcomes. The *Text to Change* mHealth intervention in Uganda which uses an SMS-based quiz for HIV/AIDS awareness for rural residents was discussed in detail by Vital Wave Consulting' report (2009). In this report, it is observed that the SMS-based system led to a 40% increase in HIV testing over a period of six weeks. The paper (ibid.) also discusses the *Episurveyor* system implemented in Kenya and Uganda for remote data collection, which enables healthcare professionals to get timely access to healthcare data, thus making immunisation programs and responses to disease outbreaks more efficient. In addition, as part of the *Episurveyor* implementation process, healthcare workers were trained to be self-sufficient in designing, programming and deployment of health surveys which eliminated a subsequent need for outside consultants. Benefits associated with the *Uganda Health Information Network* (*UHIN*) project implementation in Uganda include a 25% savings in the first semester of the project's inception coupled with an increase in job satisfaction and staff retention (op. cit.).

[2] Source : http://www.internetworldstats.com/stats1.htm#africa
[3] Source : http://www.ca.go.ke/images/downloads/STATISTICS/Sector%20%20Statistics%20Report%20Q1%202015-16.pdf
[4] Source : http://www.cnbcafrica.com/news/2017/02/14/tanzanias-mobile-phone-subscribers-up-0-9-pct-in-2016/
[5]Source :http://www.monitor.co.ug/Business/Technology/Mobile-phone-users-grow-19-5m/688612-2636032-xhy53bz/index.html
[6] Source : http://www.rura.rw/fileadmin/docs/statistics/Subscription_Monthly_report_December_2016_.pdf
[7] https://www.gsmaintelligence.com/markets/385/dashboard/

In Burundi, there are only two documented mHealth interventions; Sida info is a toll-free service that provides information on HIV/AIDS upon request (El Gaddari, 2014) and the "Kiramama" Rapid SMS system is a text-based mHealth intervention still in its pilot phase. Sida allows Burundians to call a toll-free number to ask any questions pertaining to HIV/AIDS. The program has contributed to educating people on issues pertaining to prevention and management of the disease for the past 22 years (ibid). The Rapid SMS system was first introduced in Rwanda and was successful within the Rwandan Health Ministry's Infant and Maternal Health department contributing to more than 50% decrease in maternal and new born deaths (Burundi Ministry of Health, 2014). This paper posits that mHealth interventions tailored to the Burundi's specific context can have similar health outcomes as in Rwanda and will assist the country overcome health system challenges.

BURUNDI'S MOBILE TELECOMMUNICATIONS LANDSCAPE

In 2014, Burundi had an estimated market penetration rate of 34% for mobile telecommunication, 0.1% for fixed landline telephones, and 4.9 % for the Internet (Research and Markets, 2015). In the same year, Burundi had 6 mobile telecommunication companies: Leo U-com, Econet, Smart telecom, Tempo Africell, ONAMOB and Vietel Telecom. Burundi had a 13% increase in mobile telephone users (Research and Markets, 2015) at the end of the year 2013 (from 2.24 million users in 2012 to 2.53 million users in 2013). This is largely due to the network expansion of some mobile telecommunications companies (that previously covered the capital city only) to cover a large part of the country (Telegeography, 2014). In addition, according to the Burundi's National Telecommunications Regulator Agency (ARCT), the increasing competition amongst mobile telecommunications companies has led to a decrease in mobile handset costs and call prices which could also justify the increase in the number of mobile users (Telegeography, 2014). Such competition has led to the adoption of innovative mobile banking applications (by mobile telecommunications companies) such as Ecokash and Buddie Econet (Econet Wireless, 2014); and Leo Manoti (Telecompaper, 2013). It is anticipated that accessing mHealth applications and mobile banking applications on the same mobile platform would allow access and payment for mHealth services through one integrated solution.

BURUNDI'S HEALTHCARE SYSTEM HIERARCHY

The country's healthcare coordination is organised into three pyramidal and hierarchical levels: the central, intermediate and peripheral levels (Government of Burundi, 2011). The central level is primarily mandated to formulate policies, mobilise and allocate resources, strategic planning, coordination, and evaluation. This level consists of the office of the minister, a general health inspectorate, two general directorates, 6 departments, 9 health programs and related services (Government of Burundi, 2011). The intermediate level comprises 17 provincial health bureaux. Each provincial bureau coordinates all health activities within its allocated province. It also supports health districts functions and coordinates inter-sector collaboration (Government of Burundi, 2011). The peripheral level has 45 health districts, 63 hospitals and 735 primary healthcare centres (Government of Burundi, 2011). Health districts, hospitals and primary healthcare centres are spread across the 129 cities of the country (Government of Burundi, 2011). In Burundi, health districts are the cornerstone of the healthcare system (Government of Burundi, 2011). Each health district covers 100000 to 150000 residents (approximately 2 to 3 cities) (Government of Burundi, 2011). Each health district coordinates healthcare systems at the community, primary health centres and district hospital within its jurisdiction.

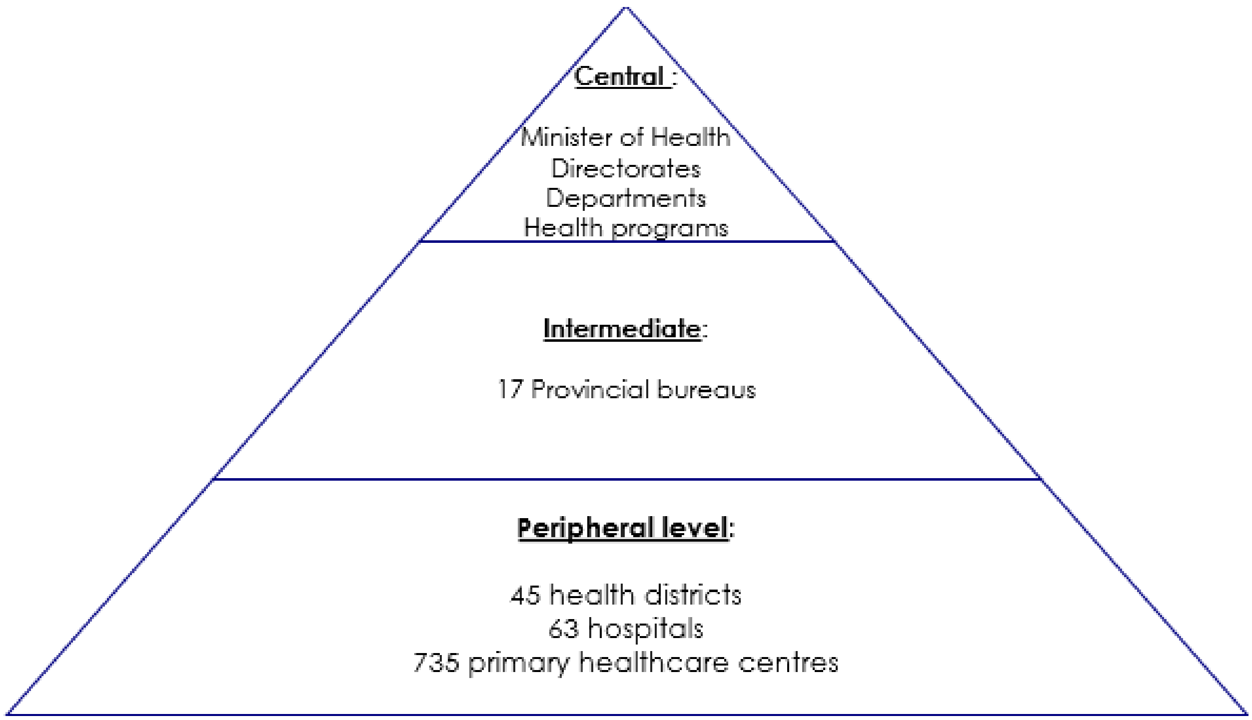

Figure 1: Burundi's hierarchical health system structure

Data collection and transmission within the Burundi's public healthcare sector follows the healthcare system hierarchical structure. However, such data structure and data collection methods present challenges as described in the next section.

HEALTH IT CHALLENGES IN BURUNDI

In Burundi, although most of the provincial and health districts use an Information Management System (GESIS system) to report health data to the central level, several hospitals and almost all the healthcare centres still rely on paper-based data collection methods (Nyssen, Kaze and Mugisho, 2015). Clerks and clinical staff manually record health/patients' data. Such data is then sent to the health district monthly although in some cases urgent diseases outbreak surveillance data is sent quicker through SMS technology (Nyssen *et al.*, 2015). Health districts then compile health facilities' reports and send them to the provincial health administration authority, who, in turn relay such information to the central health administration authority in the capital city Bujumbura. Healthcare centres keep at least 25 paper-based registers while approximately 75 registers are used in a single district hospital (ibid.). Lack of integrated reporting mechanisms often leads to repetitive reports from healthcare facilities and district level which poses an administrative burden (op. cit.).

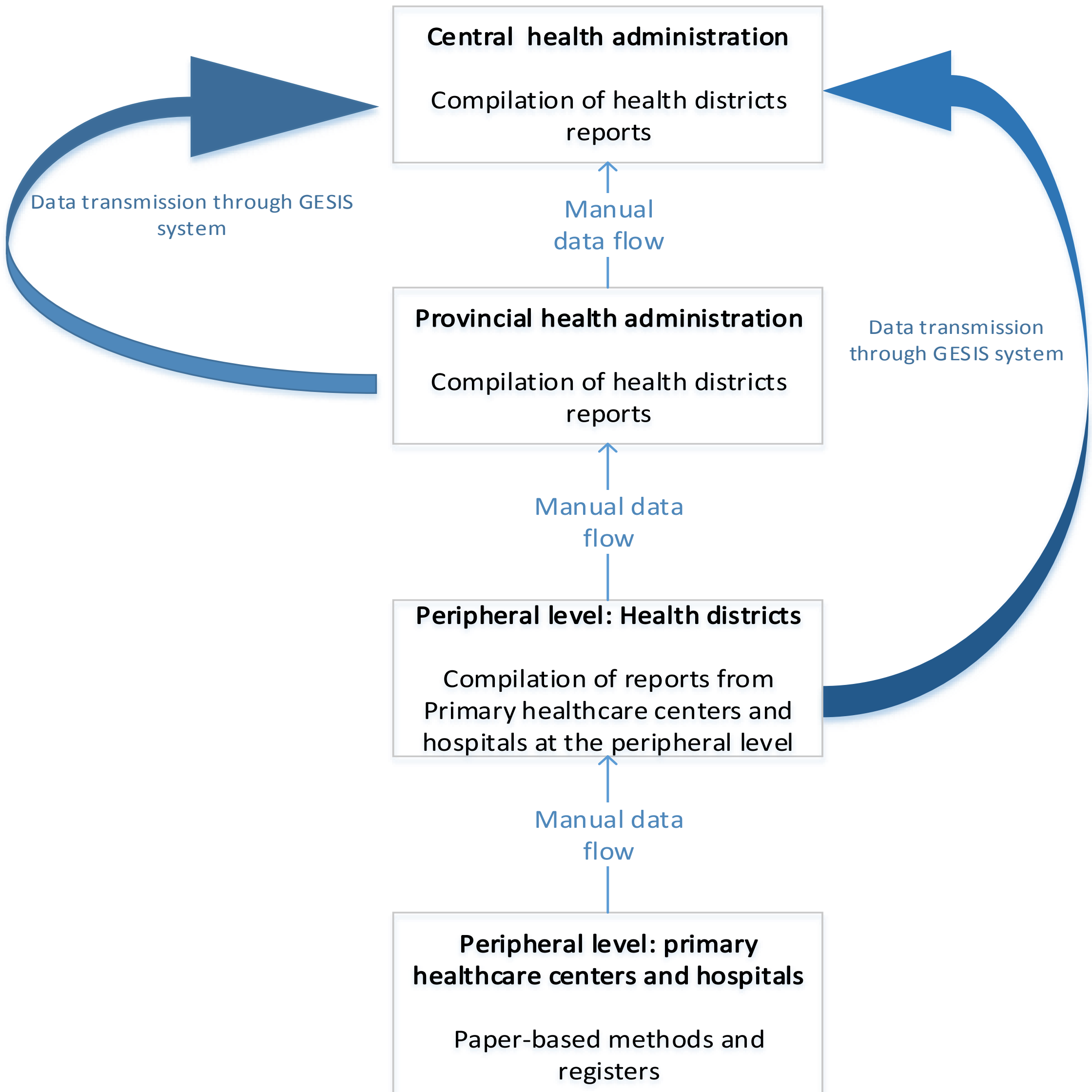

Figure 2: Data collection and transmission methods within the Burundi's healthcare system

Medical data collection through mobile healthcare applications reduces human errors that are manifest in paper-based systems (Thriemer *et al., 2012*; Zhang *et al., 2012*)). Thus, healthcare stakeholders can make timely decision based on reliable data (WHO, 2011). In the literature, there is evidence of the effectiveness of mobile applications as a tool for data collection. For instance, in Tanzania and Kenya, SMS messaging was used as a tool to provide real-time updates on drug stocks in health facilities, reducing instances of out-of-stock medicines and supporting drug stock management (Githinji *et al.*, 2013; Barrington *et al.*, 2010). The text messaging system led to timely data collection on drug stock levels, thus improving the availability and supply of drugs to clinics (Aranda-Jan, Mohutsiwa-Dibe and Louakanova, 2014). It is anticipated that in the context of Burundi, data collection through mHealth applications could minimize the flaws within the health ministry's data collection process. However, the adoption of mHealth should take into cognisance users' perceptions of factors associated with its adoption to maximise the prospects of adoption.

The following section discusses the DOI model. It describes how the model's persuasion factors have been used previously as potential determinants of mHealth adoption in other contexts.

THE DIFFUSION OF INNOVATION (DOI) THEORY

The diffusion of a technology is the process through which a technology is spread among members of a social system through certain media over time (Rogers, 1995). The theory postulates that some individual passes through 5 stages that forge his/her decision to adopt or not adopt a technology as summarised in figure 1. These are knowledge, persuasion, decision, implementation and confirmation stages. Rogers (1995) argues that there are 5 factors that influence the individual's persuasion (at the persuasion phase) to adopt or not adopt a technology: relative advantage, trialability, observability, complexity and compatibility. This paper specifically focuses on the persuasion phase and examines whether any of the persuasion factors significantly influence mHealth adoption by Burundi's healthcare professionals.

DOI constructs	Description
Knowledge	Entails an individual getting exposure and to an innovation and understanding how it functions
Persuasion	The individual adopts a favourable or unfavourable attitude towards an innovation based on information received or experience
Decision	The individual engages in activities that lead to the decision to adopt or reject a technology (for example partial trial of the technology)
Implementation	The individual decides to use a technology
Confirmation	The individual reinforces his decision to adopt a technology or reverses a previous decision to adopt or reject the technology

Table 2:Diffusion of Innovation process (Adapted from Cain and Mittman (2002))

Many researchers have investigated the influence of the persuasion factors on technology adoption. In prior research compatibility was found to be a critical factor that can predict consumers' technology adoption or resistance (Zhang *et al*., 2015). Holak and Lehmann (1990) argue that culture and previous experience with products can determine (to some extent) consumers' sense of comfortability with innovation. Moreover, they further claim that if an innovation is perceived as compatible with experience, principles, and lifestyle, it will be readily accepted. Dunphy and Herbig (1995) and Tan and Teo (2000) argue that compatibility is positively related to the diffusion rate and negatively related to consumers' resistance. Putzer and Park (2010) found that compatibility (work-related compatibility factors) was the most significant factor associated with the adoption of smartphones among nurses in community hospitals in South Eastern of the United States of America (USA).

Numerous researchers have found that an innovation with considerable complexity demand more skills and efforts to increase its adoption and decrease the possibility of consumers' resistance (Cooper and Zmud, 1990; Tan and Teo, 2000). It is generally believed that innovative products that are less complex are easily adopted by consumers (Holak and Lehmann, 1990). In their qualitative study, McAlearney, Schweikhart and Medow (2004) found that USA doctors' perception that mobile devices are not easy to use in clinical practice is a barrier to mHealth adoption. However, Hu, Chau, Sheng and Tam (1999) argue that health professionals are generally competent enough to learn and use a new technology. Thus, in most cases, they will use their own judgment when making decisions and the technology complexity will not inhibit their technology adoption.

Persuasion variables				
Relative advantage	***Complexity***	***Compatibility***	***Trialability***	***Observability***
Usefulness	Difficulty of use of mobile devices	Compatibility with duties	Testing mHealth before adoption	Need to see tangible results of mHealth adoption before adopting it
Making job easier	Difficulty to learn how to use mobile health applications	Compatibility with what is needed to execute daily tasks	mhealth adoption first and then evaluation of results	Need to be shown where mHealth worked before adopting it
Reduction of the amount of effort spent on executing some tasks	Not coping with using mHealth devices	Compatibility with experience with mobile devices	mhealth adoption because it has proven to work in other countries	No need to see tangible results
Ability to reach a larger portion of the country's population	Not coping using mHealth applications	Compatibility with organisational working style	Willingness to adopt mhealth without trying it	
Larger portion of the population will benefit from health care services	Ease of use of mHealth devices	Compatibility with work ethics		
Improvement in prevention and awareness of diseases				

Table 3: Persuasion variables

In general, perceived relative advantage of an innovation is positively related to its rate of adoption (Rogers, 1983; Tan and Teo, 2000), and negatively related to consumers' resistance (Dunphy and Herbig, 1995). Alsos, Dabelow and Faxvaag (2011) study on doctors' adoption of mHealth, found that doctors preferred using Personal Digital Assistants (PDAs) over paper-based methods due to the perceived relative advantage associated with the PDAs' user interface. The interface design reduced doctors' need to memorize medications' names and associated dosages. Kidd (2011) further identified increased contact with patients, work efficiency, teamwork, and life-work balance (i.e. flexibility that mobile technology offers) as determinants of mobile technology adoption and use by community nurses in England. Putzer and Park (2010) argue that observability has the potential to influence the adoption of mobile health professionals. They state that when a user has an opportunity to observe an innovation in practice, the innovation is more likely to be adopted (Putzer and Park, 2010). Specifically, observability has an influence on nurse adoption of smartphone for delivery of healthcare services in hospitals in the South Eastern United States.

The persuasion variables that are incorporated in this paper and depicted in table 3 are derived from an extensive literature review of factors that influence mHealth adoption.

METHODOLOGY

Data was collected through a questionnaire administered to 212 primary healthcare workers systematically sampled from 48 primary healthcare institutions. The identified DOI persuasion variables in table 3 were included in the questionnaire and tested as possible determinants of mHealth adoption within the specific context of Burundi. In this regard, Principal Components Analysis (PCA) was performed to generate a score that represent mHealth adoption (mHealth adoption index), and scores that represent each one of the DOI factors. The mHealth adoption index is based on the variables within the questionnaires that assessed healthcare professionals' inclination towards accepting mHealth (see table 5). Correlation analysis was performed to assess the relationship between mHealth adoption and DOI factors based on the PCA scores.

The survey instrument was subjected to content validity. In this regard, firstly, the researcher did a literature review to identify and understand how constructs pertaining to the Diffusion of Innovation theory were defined and used in various contexts. Such identification and understanding led to the researcher's classification of various variables identified in the literature into the DOI's persuasion constructs. Hence, in this way, the researcher ensured that the research instrument's content is representative of the constructs being examined. The research instrument was then translated from English to French. The process of translation was deemed necessary as the country (Burundi) is predominantly French speaking (in addition to the single indigenous language). The translation process followed the World Health Organisation (WHO, 2017) practical guidelines on translating and adapting instruments for health-related data collection. Following these steps ensured that the content validity of the instrument is not violated through the process of translation. Ethical clearance was obtained to conduct this study.

To validate the internal consistency of items within the grouped factors (mHealth adoption factors and DOI factors), the Cronbach's Alpha statistic was used (see table 4). The Cronbach's Alpha coefficient for the two sets of factors are 0.823 and 0.707 respectively, which depicts internal consistency of items within the grouped factors (coefficient > 0.7).

Variables	Number of items	Cronbach Alpha coefficient	Comment
mHealth adoption	8	0.823	Adequate: coefficient>=0.7
DOI factors	23	0.707	Adequate: coefficient>=0.7

Table 4: Questionnaire reliability statistics (per grouped factors)

DATA ANALYSIS AND DISCUSSION

Adoption of mobile health

In table 5, the most highly ranked mHealth option is communication between fellow healthcare professionals using mobile devices (% agree or strongly agree = 94.2%) while the monitoring and treatment of patients using mobile devices received the least adoption (51.2% agreed or strongly agreed).

mHealth adoption	Frequencies							Main Principal Component	
	Strongly disagree	Disagree	Not sure	Agree	Strongly Agree	**Agree+ strongly agree**	**Rank**	**Loading**	**Variation**
MHealth 1: I would accept to send SMS to make people aware of different methods of disease prevention	20 9.5%	13 6.2%	29 13.7%	101 47.9%	48 22.7%	**70.6%**	**3**	0.645	**Percentage of total variation = 45.19%**
MHealth 2: I would accept to collect medical/health data by means of mobile devices	10 4.7%	10 4.7%	15 7.1%	119 56.1%	58 27.4%	**83.5%**	**2**	0.623	
MHealth 3: I would accept to monitor and treat patients using mobile devices	40 19.5%	25 12.2%	35 17.1%	78 38.0%	27 13.2%	**51.2%**	**8**	0.734	
MHealth 4: I would accept to communicate with fellow health professionals using mobile devices	5 2.4%	4 1.9%	3 1.4%	103 49.5%	93 44.7%	**94.2%**	**1**	0.376	
MHealth 5: I would accept to train health workers using mobile devices	24 11.5%	33 15.8%	31 14.8%	75 35.9%	46 22.0%	**57.9%**	**7**	0.659	
MHealth 6: I would accept to track diseases and epidemic outbreak using mobile devices	13 6.3%	22 10.7%	31 15.0%	92 44.7%	48 23.3%	**68.0%**	**4**	0.700	
MHealth 7: I would accept to use mobile devices for diagnostic support	14 6.8%	25 12.1%	29 14.1%	93 45.1%	45 21.8%	**67.0%**	**5**	0.791	
MHealth 8: I would accept to use mobile devices for treatment support	17 8.3%	21 10.2%	30 14.6%	98 47.8%	39 19.0%	**66.8%**	**6**	0.762	

Table 5: mHealth adoption

Principal Components Analysis was used to generate the mHealth adoption index. The PCA scores for each variable are depicted in the 'loading' column of table 5. PCA scores or loading scores are the weight by which each variable (in this case mHealth adoption variables) should be multiplied to obtain the main (or overall) component score (or index) (Tashakkori and Teddlie, 2010). Thus, statistically, the overall mHealth adoption index is constructed as follows:

mHealth adoption index= 0.645× **mHealth 1** +0.623× **mHealth 2** + 0.734× **mHealth 3** + 0.376× **mHealth 4** + 0.659× **mHealth 5** + 0.700× **mHealth 6** + 0.791× **mHealth 7 +** 0.762× **mHealth 8**

Persuasion Variables for the Adoption of mHealth

mHealth complexity

Table 6 depicts that difficulty of usage of mHealth devices is the least concern for most respondents as only 26.3% agreed or strongly agreed that they would not adopt mHealth because of difficulty of device usage. In fact, 50.3% (21.5% strongly disagreeing and 28.8% disagreeing) showed that mobile device usage is not a problem.

DOI Factors: Complexity	**Frequencies**							**Main Principal Component**	
	Strongly disagree	Disagree	Not sure	Agree	Strongly Agree	**Agree+ strongly agree**	**Rank**	**Loading**	**Variation**
Complex1: I would not adopt mHealth because mobile devices are difficult to use	44 21.5%	59 28.8%	48 23.4%	39 19.0%	15 7.3%	**26.3%**	**5**	0.690	Percentage of total variation = 40.93%
Complex2: I would not adopt mHealth if mHealth applications are difficult to learn	37 18.0%	56 27.2%	53 25.7%	41 19.9%	19 9.2%	**29.1%**	**4**	0.679	
Complex3: I will not cope with using mHealth devices	43 20.8%	41 19.8%	44 21.3%	44 21.3%	35 16.9%	**38.2%**	**3**	0.726	
Complex4: I will not cope with using mHealth applications	36 17.1%	43 20.4%	48 22.7%	43 20.4%	41 19.4%	**39.8%**	**2**	0.762	
Complex5: I would adopt mHealth because mHealth devices are easier to use	10 4.8%	20 9.7%	43 20.8%	82 39.6%	52 25.1%	**64.7%**	**1**	-0.042	

Table 6:mHealth complexity

However, 24.4% were not sure about mHealth complexity. 64.7% of the respondents agree or strongly agree that they would adopt mHealth because mHealth devices are easy to use. In the overall calculation of complexity index, **complex5** has a negative and small coefficient (-0.042) because it is the opposite of the other negatively worded **complex1**.

The overall complexity index is constructed as follows based on the 5 items that represent the complexity factor:

DOI- complexity = 0.690× **complex1** +0.690× **complex2** + 0.726× **complex3** + 0.762× **complex4**×- 0.042× **complex5**

mHealth relative advantage

Table 7 shows that more than 70% of respondents strongly agree or agree with the relative advantages associated with mHealth. The fact that mHealth makes one's job easier (82.3%) and the usefulness of mHealth (81.3%) are the first two most agreed upon mHealth advantages.

The overall relative advantage index is constructed as follows based on the 6 relative advantage factors:

DOI- relativeAdvantage = 0.545× **RA1** ×0.679× **RA2** × 0.595 ×**RA3** × 0.809 × **RA4** × 0.816 ×**RA5** × 0.776 × **RA6**

DOI Factors: Relative Advantage	**Frequencies**							**Main Principal Component**	
	Strongly disagree	Disagree	Not sure	Agree	Strongly Agree	**Agree+ strongly agree**	**Rank**	**Loading**	**Variation**
RA1: mHealth is useful to me	6 2.9%	12 5.8%	21 10.1%	90 43.3%	79 38.0%	**81.3%**	**2**	0.545	**Percentage of total variation = 50.58%**
RA2: mHealth will make my job easier	6 2.9%	5 2.4%	26 12.4%	102 48.8%	70 33.5%	**82.3%**	**1**	0.679	
RA3: M-heath will reduce the amount of effort spent on executing some tasks	8 3.8%	13 6.2%	38 18.0%	91 43.1%	61 28.9%	**72.0%**	**6**	0.595	
RA4: mHealth would enable me to reach a larger portion of the country's population	8 3.8%	12 5.8%	27 13.0%	93 44.7%	68 32.7%	**77.4%**	**3**	0.809	
RA5: A larger portion of the population will benefit from healthcare services if mHealth is implemented	10 4.8%	10 4.8%	36 17.1%	91 43.3%	63 30.0%	**73.3%**	**5**	0.816	
RA6: There will be an increase in prevention and awareness of diseases should mHealth be adopted	6 2.9%	9 4.3%	33 15.9%	98 47.1%	62 29.8%	**76.9%**	**4**	0.776	

Table 7:mHealth relative advantage

mHealth compatibility

Although more than half of the respondents generally agree with the compatibility variables as depicted in table 8, compatibility with what is needed to execute daily tasks is the most agreed upon while compatibility with work ethics is the least agreed upon.

The overall compatibility index is constructed as follows based on the 5 compatibility factors:

0.812× **compat1**×0.779× **compat2**×0.640× **compat3**×0.796× **compat4**×0.579× **compat5**

DOI Factors: Compatibility	**Frequencies**							**Main Principal Component**	
	Strongly disagree	Disagree	Not sure	Agree	Strongly Agree	**Agree+ strongly agree**	**Rank**	**Loading**	**Variation**
Compat1: mHealth is compatible with my duties	8 3.8%	10 4.8%	34 16.2%	106 50.5%	52 24.8%	**75.2%**	**2**	0.812	**Percentage of total variation = 52.88%**
Compat2: mHealth is compatible with what I need to execute my daily tasks	6 2.9%	8 3.8%	27 12.9%	105 50.2%	63 30.1%	**80.4%**	**1**	0.779	
Compat3: mHealth is compatible with my experience with mobile devices	14 6.7%	29 13.9%	52 24.9%	83 39.7%	31 14.8%	**54.5%**	**4**	0.640	
Compat4: mHealth is compatible with my organisational working style	12 5.7%	23 11.0%	45 21.4%	96 45.7%	34 16.2%	**61.9%**	**3**	0.796	
Compat5: mHealth is compatible with my work ethics	16 7.6%	33 15.7%	51 24.3%	76 36.2%	34 16.2%	**52.4%**	**5**	0.579	

Table 8:mHealth compatibility

mHealth trialability

Table 9 indicates that most respondents agreed (84.7%) that they would first test mHealth before adopting it and only few (9.1%) would adopt mHealth immediately without trying it. The overall trialability index is constructed as follows based on the 4 trialability factors: 0.771×**trial1**×0.872× **trial2**×0.543× **trial3**×0.143× **trial4**

DOI Factors: Trialability	Frequencies							Main Principal Component	
	Strongly disagree	Disagree	Not sure	Agree	Strongly Agree	**Agree+ strongly agree**	**Rank**	**Loading**	**Reliability statistics**
Trial1: I would first test mHealth before adopting it	4 1.9%	11 5.3%	17 8.1%	104 49.8%	73 34.9%	**84.7%**	**1**	0.771	**Percentage of total variation = 41.75%**
Trial2: I would first adopt mHealth and then evaluate the results	14 6.7%	17 8.2%	16 7.7%	98 47.1%	63 30.3%	**77.4%**	**2**	0.872	
Trial3: I would adopt mHealth anyway because it has proven to work in other countries	6 2.9%	11 5.3%	71 34.1%	74 35.6%	46 22.1%	**57.7%**	**3**	0.543	
Trial4: I am willing to adopt mHealth immediately without trying it	84 40.2%	65 31.1%	41 19.6%	14 6.7%	5 2.4%	**9.1%**	**4**	0.143	

Table 9:mHealth trialability

mHealth observability

Table 10 indicate that most respondents (82.5%) would want to see where mHealth worked before adopting it. The overall observability index is constructed as follows based on the 3 observability factors:

0.558×**observ1**×0.714×**observ2**×-0.654×**observ3**

DOI Factors: Observability	Frequencies							Main Principal Component	
	Strongly disagree	Disagree	Not sure	Agree	Strongly Agree	**Agree+ strongly agree**	**Rank**	**Loading**	**Variation**
Observ1: I need to see tangible results of mHealth adoption before adopting it.	11 5.2%	19 9.0%	24 11.4%	98 46.7%	58 27.6%	**74.3%**	**2**	0.558	**Percentage of total variation = 41.62%**
Observ2: I need to be shown where mHealth worked before adopting it	2 0.9%	13 6.1%	22 10.4%	104 49.1%	71 33.5%	**82.5%**	**1**	0.714	
Observ3: I do not need to see tangible results of mHealth. I will adopt it because I know it will work for me	61 28.8%	53 25.0%	41 19.3%	43 20.3%	14 6.6%	**26.9%**	**3**	-0.654	

Table 10:mHealth observability

Correlation analysis between mHealth adoption and DOI factors

The correlation results between mHealth adoption and DOI factors are presented in table 11. The results show that mHealth adoption is significantly and positively correlated to DOI-relative advantage (correlation=0.502, p-value=0.000). This concurs with prior studies' findings discussed above such as Alsos, *et al*. (2011) and Tan and Teo (2000). In addition, mHealth adoption is significantly ($p<0.05$) and positively correlated with DOI-compatibility (correlation=0.370, p-value=0.000). mHealth adoption is also significantly and positively correlated with DOI-trialability (correlation=0.270, p-value=0.000) and DOI-observability (correlation=0.160, p-value=0.027).

Complexity has a negative but weak and non-significant ($p>0.05$) correlation with mHealth capabilities adoption (correlation= -0.052, p-value=0.451). This means that complexity does not influence the adoption of mHealth by primary healthcare professionals. This finding coincides with Hu, *et al.*'s (1999) who also found that complexity does not inhibit health professionals' technology adoption.

	Pearson Correlations		mHealth adoption	DOI Factors			
				DOI_ Complexity	DOI-Relative Advantage	DOI-Compatibility	DOI-Trialability
DOI Factors	DOI_Complexity	Correlation	-0.057				
		p-value	0.451				
		N	176				
	DOI-Relative Advantage	Correlation	0.502**	-0.127			
		p-value	0.000	0.090			
		N	179	180			
	DOI-Compatibility	Correlation	0.370**	-.233**	0.543**		
		p-value	0.000	0.002	0.000		
		N	182	183	194		
	DOI-Trialability	Correlation	0.270**	-0.008	0.304**	0.313**	
		p-value	0.000	0.919	0.000	0.000	
		N	181	182	193	195	
	DOI-Observability	Correlation	0.160*	0.058	0.089	0.065	0.259**
		p-value	0.027	0.429	0.213	0.355	0.000
		N	190	189	197	202	199

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Table 11: Correlation between mHealth adoption and DOI factors

Some of the DOI factors are also correlated among themselves. DOI-compatibility is negatively correlated with DOI-complexity (correlation= -0.233, p-value=0.002). In addition, DOI-compatibility and DOI-relative advantage are positively correlated (correlation=0.543, p-value=0.000). DOI trialability is positively correlated with DOI-relative advantage and DOI-compatibility. DOI-observability is positively correlated with DOI-trialability.

CONCLUSION AND RECOMMENDATIONS

Involving users in the development process of telehealth initiatives is critical for such initiatives to succeed (Wootton *et al*., 2009). The participatory design approach is particularly suitable for mHealth adoption as through this approach, people who are ultimately the beneficiary of mHealth interventions become participants in mHealth design and not just mere recipients of mHealth technology. Particularly user- centred design enhances the usability of mHealth devices (McCurdie, 2012). In the case of Burundi, as mHealth is relatively new concept within the public healthcare delivery system, the knowledge pertaining to the use of mobile technologies to provide public healthcare services might be limited. Users' consultation in the design phase of mHealth interventions will be an avenue to train stakeholders in the use of mHealth systems and increase the awareness (among healthcare professionals) of the options that mobile phones can offer to support healthcare interventions.

This research established that the increase in the perceptions of mHealth as being compatible with work related duties (1), work daily requirements (2), working style (3), work ethics (4) and one's experience with mobile devices (5) is a valued ingredient (by primary healthcare professionals) that would lead to an increase in mHealth adoption. Hence, mHealth interventions should be compatible with the five areas in order to increase the likelihood of successful adoption. In addition, there is a need for continued education and awareness programs that emphasize the relative advantage of mHealth-led interventions such as the ability to make one's job easier, reduction of the amount of effort spent on executing some tasks, ability to reach a larger portion of the country's population and improvement in prevention and awareness of diseases. Such education should be coupled with a showcase of evidence of successful mHealth-led interventions in other parts of the world as observability is significantly correlated with mHealth adoption. Particularly, the East African Community (of which Burundi is part) is a fertile ground for the country to leverage the other member states' expertise in the implementation of mHealth interventions. Thus, it is proposed that the country, through relevant stakeholders (such as the Ministry of Health), forge partnerships within the EAC to seek advice and learn about the best practices that could be followed and adapted to the Burundian context.

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