ADOPTION BEHAVIOR TOWARDS MHEALTH BY PRIMARY CARE PHYSICIANS (PCP) IN HEALTH CENTRE AT THE DISTRICT LEVEL IN INDONESIA

Julius JILLBERT- INDONEZIA

Researcher, Information System Management, Lecturer and Consultant in Developing Countries, Indonesia

An effort to identify needs from Primary Care Physicians (PCP), which has the greatest impact on their receptivity to use mHealth in making a clinical decision, becomes a focus of this paper, as the smartphone, PDA, and cell phones generally are cheaper and easy to handle than other devices aside from their limited features. Findings from the empirical studies suggest that several factors can be categorized as catalysts and inhibitor in the adoption of mHealth in the health centre. One of the major barriers to mHealth adoption that addresses throughout this paper from the results of this survey is the lack of needed infrastructure.

Keywords — mHealth, adoption, physician, health centre (Puskesmas)

1. INTRODUCTION

The commercialization of the mobile Internet technology has driven wireless driven applications to become one of the important media for simplifying the sharing of information between an organization and its consumer. To the consumer and service provider; the technology can play a very active and important role in the commercial applications and services due to the speed and convenience with which a mobile user can perform all wireless activities [1]. In the health sector, this new type of application is conducted through mobile devices using a wireless telecommunications network and known as mobile health or abbreviated as mHealth. mHealth could be considered as a sustainable system that makes use of appropriate Information and Communication Technology (ICT) to reduce 'urban bias' [2] and reinforcing disparities in access to health services and in health outcomes [3].

Broadly, mHealth can be defined as a term used for the practice of medicine and public health by mobile devices to allow an exchange of ideas and services between mobile users, service providers and technology providers. Also, mHealth could be considered as part of electronic health (eHealth) and mobile commerce (mCommerce). The main difference between mHealth and eHealth is that eHealth is usually connected via wireline while mHealth and mCommerce are connected through a wireless network. Current review on mHealth does found the fact that the mHealth experiences are still passing through their developmental phases and specifically, they are in need of reliable and inter-operable infrastructures to set the stage for higher-level research projects [4].

Issues that are affecting the adoption of mHealth thus include deficiencies in infrastructure (wireless and business), rival standards, poor input and display ability in cell phones, and consumer unresponsiveness. Another problem for wireless application is privacy concerns from the use of location services that combine GPS and wireless devices [5]. Moreover at present, mHealth have several limitations such as uniform standards, ease of operation, security of transactions, screen size, display type and bandwidth, billing services, and the relative penury of websites.

This has led several researchers to focus on user centered design [6,7]. Previous study proposed that requirement and design for smart healthcare application should come from (1) the conventional way of delivering the health care service, (2) the domains of the technologies that have been used to create the smart healthcare application, and (3) the interplay of the actual clinical situation and the novelty of the smart healthcare application [8]. It is believed only through the consideration of this human factor, mHealth could promise the availability of health information that in turn could provide confidence in clinical decision-making, improves practical skills and attitudes to care. Recent findings appear to substantiate that healthcare professionals will increasingly embrace smartphone when they perceive them as a useful accompanying tool to further help with the completion of clinical tasks [9].

2. LITERATURE REVIEWS

Like most new technology, earlier research on mobile application tends to dwell on the technology side. With the ubiquitous nature of the wireless technology, ongoing studies were trusted toward modeling this wireless environment and integrating them with existing services [10]. Previous literature reviews from a study that reviewed the articles published in PubMed, Web of Science, Scopus, and Ovid found that the effect of mobile devices and applications for mHealth in biomedical databases was few and many of the published evidence were about mobile systems and infrastructures [4].

Other related studies on eHealth suggest an adoption model which relied on the content or 'clicks', existing infrastructure or 'bricks' and techniques used for roll out or 'tricks' [11]. Some even highlight a deficient understanding of the clicks, which may be the result of poor design and, limited engagement or poor marketing and suggest intermittent access to the bricks and, therefore, the simplicity of access being important [12].

This has led us to define clearly mHealth with several concrete examples as the meaning of mHealth may be different in different countries. In Indonesia, several

endeavors to apply mHealth have been done and still ongoing to help physicians in making their clinical decision. Two of them is Nokia Life Healthcare Services, initiated and run by the Nokia Corporation, and JATIS/LAFAI's "SMS Info Obat Murah" (SMS Affordable Drug Information), which is collaboratively run by JATIS, an application platform provider, and Lembaga Anti-Fraud Asuransi Indonesia (LAFAI), an Indonesian NGO designed to fight fraud in the health system [13]. Other initiatives include the physician blogs such http://dokter-umum.blogspot.com that contained all the post in Yahoo Groups! Dokter-Umum. The blogs such as this could be considered as a medium for knowledge sharing and knowledge repository for physicians that represent an online community of practice (CoP). This online CoP provides a means of gathering and sharing information [14].

The future of mHealth has already arrived at a different place at different points in time. User experience or expectations with/to mHealth, therefore, differ to a great extent and thus the acceptance depends as much on individual differences as on the technology itself. Without a doubt, as the environment becomes more diverse, dynamic and complex, the information intensive feature will vary from one physician to another, e.g. specialists compared to Primary Care Physicians (PCP). This is because specialists could be generalized as performance-based and relatively want the latest technology even though it means extra cost out of their pocket, whereas primary care physicians are price-sensitive and demand a service that will give the best value for their money.

Figure 1 depicted the device that conducts wireless related activities and its related trade-off between cost and inherent features [15]. As shown, most mobile users will choose to have a cell phone instead of PDA or even smartphone. Cell phones generally are cheaper and easy to handle than other devices aside from their limited features. And this has pushed user adopted it even though within large areas in South East Asia there is no or only very limited Web access, this region do have many cell phone users and cell phone services [16]. Moreover, the previous study conceives that more physicians soon will use medical applications on a smartphone to submit electronic prescriptions, monitor disease management, and view radiological images [17].

Study have shown that developing healthcare solutions around the world is a set of unique contextual challenges due to gain access to infrastructure which is limited, costly, and cumbersome [18]. Healthcare workers particularly in developing countries have difficulties to gain access to basic and practical information to enable them to deliver safe, effective care [19], even though previous research on healthcare professionals on the use of wireless handheld devices in Pakistan found that to continuously use this ubiquitous technology, training and technical supports were essential as it will result in the attraction of more practitioners, save time, save effort and provide high-quality information [20].

Figure 1 – Trade-offs in choosing portable devices
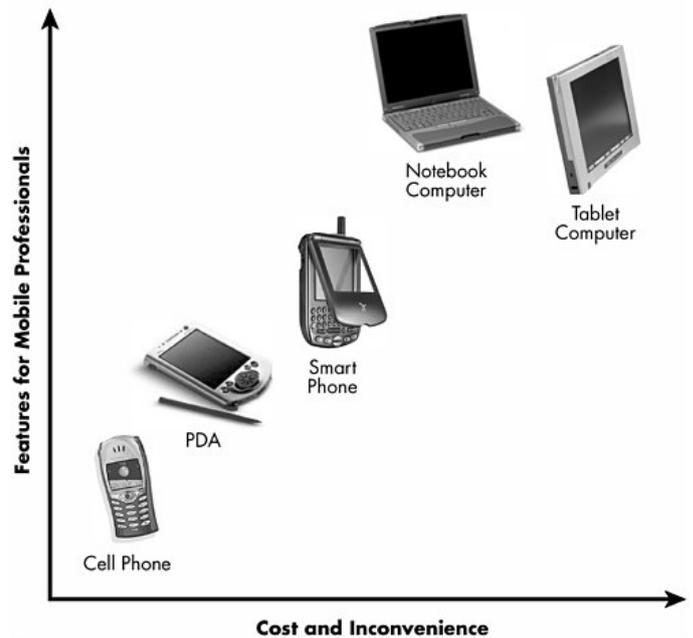
The researcher had explained that healthcare organizations are complex social systems comprising individuals with varying backgrounds, experiences, and values [21]. As one of the healthcare organizations, the health centre that could be categorized as primary health care is fundamental for medical care and for the improvement of beneficiaries' health [22]. In the context of developing countries, the significance of this type of health facilities is even more important as it provides health service for those who live in rural areas. Thus, it is important to understand how social factors influence adoption attitudes of physicians in health centre settings to identify their need that has the greatest impact on their receptivity to adopting mHealth. Further, current study might proof an answer to findings that only a few studies have examined innovation factors that affecting mHealth adoption based on clinicians' perceptions [9,23].

This is in line with the current review as the growth of mobile computing offers enormous opportunities for affordable solutions to increase access to medical care, it attracts actors from both developing and developed countries, especially with the current demographic trends (large growth of dependent populations such as young and elderly) [24]. At a time, mobile computing technologies revolutionize the field of health care, the current study provides a deeper understanding of the catalyst and inhibitors toward adoption and use of mHealth by physicians in health centre settings at the district level in Indonesia to give a snapshot on mHealth adoption in one of a developing country in the world, Indonesia.

3. SURVEY METHODOLOGY

Health centre is known as Pusat Kesehatan Masyarakat or abbreviated in Indonesian as Puskesmas. Although a

more common word for health centre is Community Health Centre in Indonesia, but during the publication of our research, we choose to use standard definitions of health facilities from the previous study at the district level [25], that also use Health Centre to name this type of health facilities in Indonesia.

Moreover, as this research is aimed at investigating adoption phenomena that occurring at the district level, we choose to unearth the nature of mHealth acceptance by dealing with the diffusion and use of mHealth by physicians in the rural region and only includes the districts (Kabupaten or abbreviated as Kab in Indonesian). And finally, as our contact person at the moment is located in the provinces of South Sulawesi, we focus our data collection within the health centre in the said region.

Preliminary invitation by snail mail with a return stamp and short questionnaire were sent to respondents in early June 2017 to identify physicians who have wireless devices (i.e. smart phone, PDA or WAP-enabled cell phones) to several districts in South Sulawesi. This was the first phase of this survey to identify those who could be a potential sample to unearth the nature of mHealth adoption within these rural districts.

It is realized that mHealth may still be hype for some physicians and thus we ask them to open a video in YouTube such as those could be found in http://youtu.be/5EOq80kV39k or http://youtu.be/NF9eSX0KcyA depicting mHealth-related activities before answering the questionnaire. As addressed by the previous research, common meaning would have been difficult to achieve and merely describing the technology and its intended uses and applications would have been insufficient [26].

Others also acknowledged that this type of technology presented special problems in research design [27]. How, for example, could people understand and discuss technology that is still in its developmental stage? How could people be expected to gauge their need and possible use of this new technology if they could not conceptualize it?

From the first phase of the survey, there are 116 physicians who gave their consent by the end of July 2017. This allows us to proceed to the second phase of the survey in which another snail-mail or e-mail along with questionnaire attachment was sent in Early September 2017 to the selected respondents to ask them about the nature of their behavior toward mHealth adoption issues, i.e. diffusion and use in making the clinical decision. Finally, by the end of November 2017, there were 97 valid responses, resulting in a favorable response rate of 84%.

Current study applies general survey research design, which is considered to be appropriate for acquiring self-reported data on each of the model constructs. Available evidence suggests that despite the possible inaccuracy involved with self-reported data in an absolute sense, it is usually the best and most appropriate approach for investigating decisions among individuals [28,29].

The questionnaires composed mostly of rather simple questions that consist of factors around the scope of this research. The factors identified in the previous survey and previous researches on technology diffusion were used in the questionnaire [30,31,32]. Findings from the previous survey then considered and the questionnaire was replicated and modified to accommodate the purpose of this study by asking physicians on whether they use mHealth to support their clinical decision.

3. RESULTS AND DISCUSSION

Before discussing the important issues raised by the data, the limitations of the study should be emphasized. The research was carried out in the context of specific product and environment; therefore, the findings may be context-specific. This shows that while the current research at the moment has provided better knowledge specifically relevant to mHealth adoption from physicians in the contexts of health centre within the rural districts in developing countries, we need to put further research in other product-specific and mHealth adoption contexts. By extending the research to other provinces, we can prepare to build a model for mHealth that is appropriate to many contexts.

The sample is also quite small; the results may not be applicable to medium or a large number of healthcare workers. Last but not the least, this study is only part of the ongoing research on mHealth adoption phenomenon, the next step in this research is to incorporate qualitative research technique, i.e. grounded theory, conversational analysis and ethnography in the future. Furthermore, as we choose not to incorporate cultural context, discussion of any issue related to the adoption and use of mHealth across culture is not yet presented.

3.1 Diffusion of mHealth use

To unearth mHealth diffusion it was necessary to classify respondents into three groups of individuals. We follow Rogers' Theory of Diffusion [33,34] on classifying the respondent. Thus, they were selected on the basis of the likelihood that they would feature in the "early adopters" or "innovators" of uptake and represent the groups that are most likely to adopt the new technology.

Table 1 – Respondents size and mHealth diffusion

	Number of PCP	Percentage (N=97)
Physician who adopted mHealth	32	33%
Physician who did not use mHealth	28	29%
Physician who intent to adopt mHealth	37	38%

Table 1 shows that even though the number of non-user (physicians who did not use mHealth and those who intent to adopt mHealth) is bigger than adopters, the significant percentage of PCP (29%) do have an intention of adopting mHealth in the future. This has important implication as empirical evidence from previous studies

revealed a strong correlation between the intention of using and actual behavior in Information Technology and Information Systems [35,36].

Physicians who adopt mHealth were then asked when they use mHealth for the first time. We use time range as it would make them easier to remember. Almost a half of them (Table 2) admit that they have done it on 2009 or earlier. This suggests that these users among all other mobile users ignited the proliferation of mHealth.

Table 2 – When you adopt mHealth with your mobile devices?

Year	Percentage of adopters (*n=32*)
2015-2017	-
2013-2015	22%
2010-2012	29%
2009 or earlier	49%

Important issues concerning diffusion within district-level are raised and shown that mHealth is still in the early days of its diffusion. Most of the adopters (79%) in Table 3 are using their wireless devices for mHealth for less than five times. It seems these adopters are sitting back and waiting for at least some of the problem that surrounding mHealth to be corrected before becoming frequent users.

Table 3 – How many times have you used your mobile devices for mHealth?

Number of use	Percentage of adopters (*n=32*)
Less than 5	79%
6 - 10	11%
11 - 15	6%
16 – 20	2%
21 - 25	1%
More than 26	-

It is acknowledged also that to be accepted, an individual within a certain community must champion new technology. As the context of this research was within surrounding rural community in the districts located in South Sulawesi, respondents were asked about the role that they played in the community ground, e.g. what are their affiliation in the community instead of practicing in the health centre.

Referring to Table 4, the majority (73%) of mHealth adopters do not involve themselves actively besides serving the community as physicians. Almost, the same situation occurs for physicians who have an intention of adopting mHealth. At a glance, those physicians who prefer to do not use mHealth seem to lead an active balanced life between their clinical jobs and mingle within their community.

3.2 mHealth non-user

Another interest is to know the reasons behind a majority of physicians to not using mHealth in making their clinical decision at health centre even though they already have the smartphone, PDA or cell phones with wireless capa-

Table 4 – Influential role of physicians within district-level

Physician's role in rural community (N=97)	Adopt mHealth (*n=32*)	Intention of adopting mHealth (*n=37*)	Not using mHealth (*N=28*)
Member of the clubs or association, e.g. NGO or religious community	10%	13%	23%
Board position in the clubs or association	6,5%	7,8%	21%
F/T or P/T worker at the university	5%	3%	6,6%
Member of the professional organization, e.g. IDI	1,8%	4%	7,3%
Teaching position, e.g. Tutor and Lecturer	3,7%	7%	17,1%
Research affiliate in the research centers & institutes	-	6%	14%
None	73%	59,2%	11%

bility, i.e. WAP. The phenomenon shows that it is a must to know the reasons they did not adopt mHealth even though they have the right devices to do so. This has important implication in the future as we could give a recommendation on how to diffuse mHealth in the future. Thus, we collect responses from two group of PCP (non-user and those who have an intention of adopting mHealth).

Table 5 – Why not using mHealth?

Reasons for not using mHealth	Percentage of physicians (multiple responses) (*n=65*)
I will waste my time using it	89%
Slow connection	81%
Security & privacy reasons	80%
Not tangible	75%
It will degrade me from social life	53%
Patients with which I give my health advise do not use it	43%
No improvement expected in ease and speed of services	42%
Too expensive to install or maintain	23%
Peer and social influences	18%
Too technical for me, e.g. do not know how	15%
Other	8%
Unspecified	6.5%

Findings in Table 5 are in line with commercial research determining that the greatest barriers to mobile applications were, in order of priority: security, tangibility, and physical experience [37]. Furthermore, according to a survey conducted by the Boston Consulting Group, nearly 75% of US consumers are concerned about security and privacy in the wireless environment [38].

Limited access to infrastructure, slow Internet and wireless connection in developing countries is one of the reasons that can lead to the introduction of another inhibitor to mHealth adoption. Why should a physician be interested in enter Nokia Life Healthcare Services, if the pages that he/she opens are very slow to be downloaded? He or she would rather choose to find the item he looking for physically. While it is too early to state that this problem can be originated from the user or the mHealth pages itself.

However, our observation on this condition shows that most mHealth sites that could be reached display a lot of pictures and use advanced web programming for example Flash to make it look more attractive. And unfortunately, most physicians only have an average Modem speed of 38 kbps and Internet connection of 25 kbps in the districts in South Sulawesi. This will result in a lack of speed when they make a connection to mHealth sites and explain the bias related to the uneven distribution of respondents with respect to the user (physicians who adopted mHealth) and non-user (physicians who did not use mHealth and those who have an intention to adopting mHealth).

3.3 Reasons for mHealth adoption

Table 6 has identified adopters as more information seeking than the non-adopter respondents. Information-seeking activities play a key part in determining adoption behavior and time to adopt. The longer an individual exhibits this characteristic, the longer the actual decision to adopt being actualized.

Table 6. **Why adopting mHealth?**

Reasons for adopting mHealth	Percentage of physicians (multiple response) (n=32)
Previous means of communication was inadequate (more communication with mHealth)	89%
Better throughout information	78%
Time-efficient	62%
Peer and social influences	54%
More choices of information	33%
More comparisons of information	31%
Faster information	16%
Patients with which I give my health advise use it	13%
Ease of access	10%
Participate in specific professional networks	7%
Other	2%
Unspecified	2%

The results show the adopters most likely are price-conscious. When asking why they adopt mHealth, adopter group mostly say that time is becoming more efficient for them. They also explain that they have an ability to have more information, and compare each information. This reinforces the findings of this study that adopter can be categorized as information-seeker.

The survey shows peer influences play an important role to adopting mHealth. Descriptive statistics from the adopters shown that they are under 45. Previous study from developed countries shown that in most technology-led markets, adopters that are more technology-literate found to be in the age between 15 and 34 years old [39,40]. It is usual to see that these adopters are driven by their peers and social pressure in making technology-based decision.

Reasons such as faster and ease of access seem to be not the most important factor which is only accounted for 14% of their answers. A small number of respondents also add participation in certain kind of professional physician net-

works to their answers, that might proof to be beneficial as this portal serve physician needs in the rural areas toward important information as they become a member of Ikatan Dokter Indonesia (Indonesian Physicians Association). As for http://www.hellodoctor4drs.co.id and http://www.udoctor.co.id, a limited respondent state that the needs for more engagement within the rural community are a reason behind their involvement in these patient-physicians online consultation sites, even though these sites is relatively new and not widely known within the district they live.

4. CONCLUSION

This survey on PCP has tried to capture the snapshot of mHealth adoption within rural districts of Indonesia as one of the developing countries in the world. For this purpose, we have conducted two-phase survey by employing questionnaires to bring to light important aspect from June to September 2017. Current study tries to unearth the use of mHealth in the clinical field, i.e. as a supporting tool to make a definitive diagnosis, to make a clinical decision, and to support patient's treatment regarding to therapy equipment in the contexts of health centre. Additional issues might be elaborated in the future for example use of mHealth in non-clinical field such as in managerial purpose, i.e. in administration and billing system and within different healthcare facilities such as hospitals or healthcare clinics.

We could also reinforce the findings (or contradict it) by extending the survey to nurses and midwives, then replicate it in other healthcare facilities context. The extension of the survey not just on the individual level, but also on the workgroup or organizational level should be conducted. Time also plays an important aspect in mHealth diffusion, so longitudinal survey will help in finding trends over time. The impact of new mHealth systems such as Portable Personal Health Record (PPHR) [16] is interesting as PPHR capabilities to integrate with the needs and wants of physicians and other healthcare worker needs to be investigated in the future.

It is recommended that the government in each districts in South Sulawesi keep close watch on it and even take an active role by embracing the latest wireless technology available. One of the major barrier to mHealth adoption that addresses throughout this paper from the results of this survey is the lack of needed infrastructures. By building Wi-Fi hotspots in rural areas and the surrounding health centre, speed can be enhanced. District head (Bupati in Indonesian) as government representative, health centre and Non-Governmental Organization (NGO) should work in tandem with related telecommunication industry.

The needed infrastructure need to be built along with donors, NGOs, and consultants as they have become key components of networks of development [41]. Their cooperation in providing management and IT consulting services in the private and public

sectors in developed countries over the preceding decades is another important considerations. Sooner or later this ubiquitous technology will come in anyway and eventually it might become a disruptive technology that will trans-

form health services. Incoming physicians will likely have wireless-enabled devices and more technology-literate that would help them in their clinician and non-clinician duties.

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