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RESEARCH PAPER

Smart phone accessibility and mHealth use in a limited resource setting

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Abstract

Aim: To determine smartphone access and use including future opportunities for mHealth and potential ethical implications among health care professionals practicing at a health care facility in Bengaluru, India.

Background: The evolution of smart phones can provide convenient, portable, and rapid access to resources for health care professionals. While mobile phone accessibility has improved in recent years in many low and middle-income countries, the use of smart phones to address health priorities remains limited in some limited resource settings.

Design: A quantitative descriptive design was used.

Methods: A survey was administered in November of 2016 to nurses and physicians at a tertiary care hospital in India.

Results/Findings: All respondents had a mobile phone, and the majority owned a smart phone that was used for text messaging, email, accessing internet, and downloading apps. Participants recommended smart phone use to improve health care provider access to continuing education and to improve patient knowledge about health. Physicians had better access to mHealth resources compared with nurses.

Conclusion: Credible, evidence-based, affordable mobile applications are needed to provide a platform for continuing health education to health professionals and patients in India and limited resource settings. Nurses need equitable access to mHealth resources to build successful mHealth initiatives.

KEYWORDS

accessibility, low and middle-income countries, mHealth, mobile technology, nursing, physicians, smart phones

SUMMARY STATEMENT

What is already known about this topic?

- The World Health Organization recommends mHealth, the use of wireless and mobile technologies to address health priorities.

- Mobile phone accessibility has increased globally in recent years including in many low and middle-income countries.

- The use of smart phones to address health priorities remains limited in some low and middle income countries, including India.

What this paper adds?

- Smart phone use is prevalent among nurses and physicians in Bengaluru, India.

- Nurses and physicians in a low and middle income country recommend smart phone use to improve health care provider access to

continuing education and to improve patient knowledge about health and treatment.

- The social media platform *WhatsApp* was predominantly used among health care professional participants in this study.

The implications of this paper:

- Credible, evidence-based, affordable mobile applications are needed to provide a platform for health education to improve health outcomes in India and other low and middle-income countries.
- Physicians had better access to mHealth resources when compared with nurses in India, and advocacy is needed to ensure equitable technological resources for successful mHealth initiatives.
- Innovative use of *WhatsApp*, a social media platform, could include communication of mobile continuing education platform links between health care providers in India.

1 | INTRODUCTION

The World Health Organization (WHO, 2011) described mHealth as the innovative use of wireless and mobile technologies to address health priorities. The evolution of 2-way analog phones into smart phones provides convenient, portable, and rapid access to resources for health care professionals (Wyatt & Krauskopf, 2012; Sondaal et al., 2016). Mobile phone accessibility has increased globally in recent years including in many low and middle-income countries (LMICs) where mobile infrastructure has surpassed roadway and electrical infrastructure (Sondaal et al., 2016; WHO, 2011). However, the use of smart phones to address health priorities remains limited in some LMICs, including India (Sondaal et al., 2016; WHO, 2011) an emerging technological powerhouse in today's global society (Johnson, Green, & Maben, 2014) and the setting for this study.

The WHO postulated mHealth has the potential to change the delivery of health care around the world (2011). Factors driving this change include rapid advances in mobile or smart phone technologies and applications, increased opportunities for integrating smart phone and other electronic health services, and vast growth in smart phone coverage. Approximately 70% of wireless subscribers reside in LMICs. The WHO (2011) is calling for strategies and best practices that integrate mHealth with other electronic health services to improve health outcomes globally.

The Pew Research Center conducted a study on cell phone activities in 2013 through its Internet & American Life Project Spring Tracking Survey (Duggan, 2013). Mobile phone activities surveyed with results included use of text messaging (81%), access to internet (60%), email (52%), downloading of apps (50%), location-based services (49%), listen to music (48%), participate in video calls (21%), and share location (8%). Overall, most activities increased in usage from 2011 to 2013; however, the study was limited to American participants and therefore did not reflect activity in LMICs (Duggan, 2013).

A recent systematic review of 27 studies conducted to assess the effects of mHealth interventions in improving maternal and neonatal care in low and middle-income countries only included 2 studies from India. Both of the studies conducted in India included the use of

unidirectional text messaging to improve consumer knowledge of health services (Sondaal et al., 2016). One, a pilot study, used this method of texting to remind mothers to take their infants for vaccinations. Results showed successful results with 95% compliance with first dose, 98% with second dose and 100% with the third dose (Pathak, 2012; Sondaal et al., 2016). The other study conducted in India used text messaging to provide education on a healthy pregnancy and found significant increase in respondents' knowledge on medication compliance, number of clinic visits during pregnancy, signs of danger during pregnancy, identification of low birth weight infant, length of time for exclusive breastfeeding, and age to start supplemental feedings (Datta, Ranganathan, & Sivakumar, 2014; Sondaal et al., 2016) While these studies show optimistic results, more research is needed in India. According to World Health Statistics (2016) India ranked second country from the last among 11 countries in the South East Asia Region, for life expectancy, had the poorest inequities score for reproductive, maternal, newborn and child health intervention coverage, and was third country from the bottom on under-five mortality and neonatal mortality rates (WHO, 2016).

Bengaluru is known as the technical and medical hub of India, the home of a wide variety of health research and medical centres (Johnson et al., 2014) and thus serves as an optimal setting to explore the use of mHealth to address health priorities in India and other LMICs. The aim of this quantitative descriptive study was to determine smartphone access and use including future opportunities for mHealth and potential ethical implications among health care professionals practicing at a health care facility in Bengaluru, India.

2 | METHODS

2.1 | Sample population and setting

A convenience sample of nurses and physicians practicing at a 340+ bed tertiary care facility in Bengaluru, India was used. In addition to serving as a metropolitan teaching hospital, this facility's community health division serves over 1700 rural villages and 12 slum regions in Bengaluru. Inclusion criteria for study participants were (1) age 18 or older, (2) health professional practicing at the setting site, and (3) ability to read and write English proficiently (the primary language spoken at this health care facility). Those not meeting all inclusion criteria were excluded from participation.

2.2 | Data collection

Data were collected in November 2016 using an adapted form of the Pew Research Center's Internet & American Life Project Spring Tracking Survey (Duggan, 2013). The Pew Survey was originally administered to 2076 American adults, with results reported with a 95% confidence interval and error attributed to sampling at plus or minus 2.3 percentage points (Duggan, 2013). The adapted survey was administered in English. Questions were added to the survey to assess smartphone and Wi-Fi accessibility and use to communicate with both colleagues and patients at the setting site. Additionally, open-ended questions were added to explore current health applications used by the sample population and explore ideas for

future use at this health care facility including their potential ethical implications. These questions were chosen to assess infrastructure to inform a future interventional study to improve communication between health care providers in India. Questions were chosen because of their alignment with mHealth research reported in the WHO (2011). Global Observatory for eHealth report. The WHO (2011) reported mHealth initiatives require careful assessment and evaluation in order to be considered among competing health system priorities. The adapted survey was reviewed by a health care professional and experienced researcher at the facility prior to administration to establish face validity and cultural appropriateness.

Nursing House Supervisors distributed the paper pencil survey to physicians and nurses on each unit of the hospital and collected them each day for a period of 1 week.

2.3 | Ethical considerations

This study received exempt status by an Institutional Review Board (IRB) in the United States and was approved by a hospital IRB in Bengaluru, India. The surveys were completed anonymously, and identifying data was not obtained.

2.4 | Data analysis

Data were entered into IBM SPSS version 24 software. Univariate analysis of the descriptive data included measures of distribution, central tendency, and dispersion. Data from the open-ended items were categorized by responses.

3 | RESULTS

3.1 | Sample demographics

Four hundred surveys were distributed, and 97 were completed yielding a response rate of 24.3%. This was comparable to response rates for The Pew Research Center for the People and Press standard surveys of 27% from 1997 to 2003 (Hardigan, Popovici, & Carvajal, 2016). Of respondents, 82.5% (N = 80) were nurses; N = 17 were physicians. While 100% of respondents had a mobile phone, 75.3% (N = 73) reported their cell phone was a smart phone and completed the remainder of the survey. Among respondents who had a mobile phone but did not have a smart phone (N = 24), 100% were nurses. Among participants with a smart phone, 76.7% (N = 56) were nurses and 23.3% (N = 17) were physicians. Mean age was 30.5 (SD 6.9) years, and 83.6% (N = 83.6) were female, while 16.4% (N = 12) were male. Mean duration of health professional experience was 7.3 (SD 6.3) years and of practicing at the research site, 4.9 (SD 4.6) years.

3.2 | Smart phone accessibility and use

Quantitative affirmative responses to questions in the accessibility and use survey are displayed in Table 1. Additionally, an open-ended question assessed types of smart phone applications the sample used to aid in their positions as health professionals. Most frequent responses included *Google* (N = 13), *Medscape* (N = 4), *WhatsApp* (N = 3), and *PubMed* (N = 2). Other responses (N = 1 for each)

TABLE 1 mHealth survey responses among health professional participants with smart phones

Survey Question	# Responded "Yes" N = 73	% Responded "Yes"
Do you have Wi-Fi access for your smart phone at work?	30	41.1
Do you use your smart phone to:		
[a]send and receive text messages?	55	75.3
[a]send or receive email?	51	69.9
[a]access the internet?	55	75.3
[a]download apps?	52	71.2
[a]listen to music?	48	65.8
[a]participate in a video call or video chat?	35	47.9
[a]"check in" or share your location?	29	39.7
[a]get directions, recommendations, or other location-based information?	36	49.3
Do you use a smart phone to communicate with patients?	11	15.1
Do you use a smart phone to communicate with others at your facility? If yes, which method?	61	83.6
Voice call	35	47.9
Text message	46	63
Email	17	23.3
Do your patients use smart phones to access health information? If yes, what type?	36	49.3
To look up or update their own medical records	12	16.4
To search information about disease process/treatment etc.	23	31.5
Do you use your smart phone to access social media outside of work? If yes, which ones?	58	79.5
Facebook	41	56.2
Instagram	5	6.8
WhatsApp	54	74
Snap Chat	2	2.7
Twitter	3	4.1

[a]These questions originated in the Pew Research Center's Internet & American Life Project Spring Tracking Survey.(Duggan, 2013)

included *YouTube, Medical in Nursing and Oncology App, Google Scholar, WebMD, Q Calc, Doc Plus, Practo, Radiopedia, Drug Index and Dosage,* and *Wikipedia*.

3.3 | Future use for mHealth initiatives

Two open-ended questions assessed perceived ideas for future use for mHealth initiatives. Question 1 asked: "*Do you have any ideas on how a smart phone could help you better care for patients? If yes, please explain*". Responses were categorized and included health care provider continuing education/ to gain knowledge (N = 16), improve communication between health care providers (N = 15), give health care providers access to check medical records (N = 13), install Wi-Fi at health care facility (N = 2), advertise health services provided by facility (N = 1), and improve safety/ SOS for travelling health care providers (N = 1).

Question 2 asked: "*Do you have any ideas on how patients could use smart phones to improve health outcomes? If yes, please explain*". The response categories for the second question were to gain knowledge about health and treatment (N = 16), improve communication between provider and patient (N = 8), give patients access to check medical records/reports (N = 6), use new smart phone technology for point of care testing (N = 5), patients living in remote areas can take pictures to send to providers (N = 2), and 24 hours 7 days/week helpline (N = 1).

3.4 | Comparison between physician and nurse access and use

Among physician respondents, 52.9% (N = 9) had access to WiFi at work compared with nurses at 37.5% (N = 21). Additionally, 35.3% (N = 6) physicians reported using their smart phones to communicate with patients while only 8.9% (N = 5) nurses reported doing so. Nurses were also less likely (at 82.1%: N = 46) to use their smart phones to communicate with others health professionals at their facilities when compared with physicians (at 88.2%: N = 15).

3.5 | Ethical concerns

The last open-ended question asked "*Do you have any ethical concerns about smart phone use in health care? If yes, please explain*". Responses included: potential confidentiality breach (N = 11), misuse/ misconstruing of health information (N = 5), cybercrime (N = 2), increase patient anxiety (N = 1), and reduces paper (N = 1).

4 | DISCUSSION

Baseline data obtained in this study provided valuable information on a sample population of health care providers' smartphone access, use, and perceptions about future mHealth use and ethical implications. All respondents had a cell phone, and a vast majority in this study owned a smart phone. This underscores the WHO's (2011) finding that mobile phone usage in LMICs is prevalent therefore a feasible option for innovative initiatives to improve health outcomes.

While a direct comparison to the Internet & American Life Project Spring Tracking Survey Results (Duggan, 2013) was not possible due to an imbalance in sample sizes and dates of data collection, results of this study suggested mobile phone usage rates among the Indian sample were similar to rates among Americans. Highest usage activities in both studies were text messaging, email, accessing internet, and downloading of apps. These results support text messaging between providers and patients as a viable mHealth option for improving health consumer compliance and knowledge as reported in previous research conducted in India (Datta et al., 2014; Pathak, 2012).

To our knowledge, this was the first study to assess health care provider perceptions of mHealth use for future initiatives in India and associated ethical implications. Stakeholder buy-in is imperative to the success of a new service or project (University of Kansas, 2016). Front line health care providers such as nurses and physicians are well positioned to offer insights to patient care services. The most frequent suggestion for mHealth activities that would help improve patient care was health care provider use for continuing education/ to gain knowledge. This coincides with "Google" cited as the most frequent response to the question "*What types of apps do you use to aid in your position as a health professional*?" The high access to mobile technology by health care providers in this study supports the need to develop a reputable mobile platform to deliver credible evidence based continuing education. This education could also serve as a conduit for providing patients with credible and informative internet sites. To gain knowledge about health and treatment was the most frequent response to *Do you have any ideas on how patients could use smart phones to improve health outcomes?* The ability to direct patients to trustworthy sites to obtain information about their disease process and treatment plan also revealed an ethical concern listed by a few respondents (7%) that patients may misuse or misconstrue health information.

While a relatively small number of participants (27%) indicated having any ethical concerns regarding the use of smart phone use in health care, those expressing concern identified the following potential issues, the highest number of responses focused on the potential for confidentiality breach, and misuse/misconstruing of health information. While further exploration of the reasons and actual incidence of these occurrences is warranted, it is postulated that the potential health benefit will outweigh this ethical consideration for targeted patient populations with very limited access to any health care resources. Study respondents did not provide narrative explanation for their listed ethical concerns, thus limiting data extrapolation. It is interesting to note, however, that 1 participant provided a response that smart phone use in health care "reduces paper". Rather than being an ethical concern for utilization, this provides an avenue for further exploring unanticipated environmental and cost-savings benefits of smart phone use in health care.

Another new finding suggested the social media platform *WhatsApp* was popular among health care professional participants in this study with 74% reporting use, and 3 participants even reported using it to aid in their position as a health professional. One article was found that reported a case on the use of *WhatsApp* in telemedicine in India (Thota & Divatta, 2015). The app was used to communicate electrocardiogram results between providers. The use of social

media to communicate patient information heightens the risk for confidentiality breach, the most frequent response in the current study in answer to the question _Do you have any ethical concerns about smart phone use in health care?_ However, another innovative use of _WhatsApp_ could include communication of mobile continuing education platform links between health care providers.

Only 41% of participants reported having access to Wi-Fi at work, and physicians had better access than nurses. While organizational infrastructure will need to be improved to provide better access for mHealth initiatives to be successful at this facility, baseline results suggest this study setting as optimal for future mHealth innovations. More research is needed in India and other LMICs to trail mHealth interventions to address the disparities reported by the World Health Organization (WHO, 2016) For example, respondents in this study suggested smart phones could be used to improve communication between provider and patient. Translational research is needed to assess the efficacy of virtual telehealth and video conferencing between patients and providers in India.

4.1 | Study limitations

The convenience sample used in this study limits the generalizability of the study results. Additionally, the study initially aimed to target health care professionals which may have included pharmacists, physical therapists, occupational therapists, and others, but the procedure for distributing the survey within the health care facility resulted in all respondents being either nurses or physicians.

5 | CONCLUSION

Health professionals in India and other LMICs need convenient and portable access to health resources. While mobile infrastructure is rapidly advancing in LMICs, many health professionals do not own personal computers. There is a need for convenient and affordable platforms to deliver credible and evidence-based health education to both health professionals and health consumers in India and elsewhere to improve health outcomes. Additionally, research is needed to test the effectiveness of mHealth initiatives, as well as ethical implications for usage, in India and other limited resource settings.

Findings in this study also suggested physicians were better positioned to use mHealth resources than nurses due to accessibility. Physicians had better access to Wi-Fi in the workplace which may have influenced their increased use of smart phones when communicating with patients and other health care professionals when compared with nurses. This underscores the need for a thorough assessment of technological infrastructure for successful mHealth initiatives to ensure provision of technological resources is equitable for nurses. WHO (2011) Global Observatory for eHealth report acknowledges the essential role hospital nurses play in health service delivery and emphasizes the need for quick access to effective mHealth technology to support their practice. More research and advocacy are needed to assess health care mHealth infrastructure and equitability for nurses in India.

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