m-Health: A Critical Analysis of Awareness, Perception, and Attitude of Healthcare Among Providers in Himachal Pradesh, North India

Krishnan Ganapathy, MCh (Neurosurgery), FACS, FICS, FAMS, PhD,[1]
Vikrant Kanwar, MBBS, PGDHA, MHA,[2]
Tarun Bhatnagar, MD, PhD, PGDBE,[3]
and N. Uthayakumaran, MSc, PGDCM, PhD[3]

[1]*Apollo Telemedicine Networking Foundation, Chennai, India.*
[2]*RP Medical College, Tanda-Kangra, Himachal Pradesh, India.*
[3]*National Institute of Epidemiology, Indian Council of Medical Research, Chennai, India.*

Abstract

Introduction: *Providing healthcare in remote mountainous areas is challenging. The increasing availability of mobile connectivity needs to be exploited by offering healthcare through a mobile medium, popularly known as mobile health (m-health). It is essential to understand the awareness, perception, and attitude of healthcare providers (HCPs) in deploying m-health. Their outlook on new technologies influences patient adoption. Reports on attitudes regarding healthcare through mobile phones are now confined to views from the recipient.* ***Materials and Methods:*** *This study from August 1 to September 30, 2014 analyzed the views of 592 HCPs (12.3% of all HCPs) in Himachal Pradesh, India. They included faculty and students of the two medical colleges, as well as HCPs from all of the 12 districts.* ***Results:*** *Although Himachal Pradesh has the highest teledensity of all states in India (117.6%), only 58.8% of HCPs (of those surveyed, 72% lived in suburban areas and 24.8% in Shimla, the state capital) would easily recommend m-health. Self-perceived ability to use mobile services was 85%. Fifty-nine percent used mobile devices for social networking, and 52.4% used Wi-Fi. Sixty-one percent of those interviewed were females, and 39% were males.* ***Conclusions:*** *The transformative potential of m-health hinges on its acceptance and use by all stakeholders. The study suggests that as HCPs in Himachal Pradesh are already using mobile value added services and are highly information technology literate, addressing their specific concerns could lead to use of m-health in Himachal Pradesh. Healthcare delivery in Himachal Pradesh is still suboptimal. With increasing connectivity, awareness, and commencement of telemedicine services in Himachal Pradesh, m-health has the potential to be a reality.*

Key words: *mobile health, telemedicine, telehealth, telecommunications*

Introduction

That the World Health Organization has recognized mobile health (m-health) as a distinct entity[1] speaks for the importance of m-health in a global scenario. The potential of the mobile phone for healthcare delivery in India was documented as early as 2008.[2] With 973.35 million mobile phones in India (as April 30, 2015),[3] with a teledensity of 77.46 (urban, 143.64; rural, 47.79), the prospects for use of m-health is at an all-time high. Himachal Pradesh has the highest teledensity of 117.60 among all the states in India, whereas the lowest (53.6) is in the state of Bihar. The city of Delhi has a teledensity of 237. A pan-India survey in 2012–2013 across six states revealed that there was equal enthusiasm to use m-health in rural and urban India.[4] An earlier study in Chennai revealed very low awareness about m-health.[5] The transformative potential of m-health in India hinges on its acceptance and use.

The outlook of a healthcare provider (HCP) on new technologies can influence patient adoption as well. Doctors have to move into a whole new world, and the older ones, in particular, may be concerned that their life is getting complicated.[6] It was therefore felt that a prospective, well-designed study on the awareness, perception, and attitude of HCPs toward using mobile phones was equally important. Himachal Pradesh, a sparsely populated mountainous state in Northern India, illustrates the practical difficulties in making available quality healthcare. Subzero temperatures, inhospitable mountainous terrains, and scarcity of HCPs result in individuals often having to travel 10–15 km on foot to an inadequately equipped health outpost. High teledensity in Himachal Pradesh gives an opportunity to exploit the mobile phone to become a " doctor in your pocket." For mobile value added services to be introduced, it is imperative to understand the awareness, perception, and attitude of HCPs toward m-health.

Materials and Methods

STUDY AREA

This study was conducted in Himachal Pradesh, a small sub-Himalayan northern state of India (population, 6.8 million)

(*Fig. 1*). Seventy percent of the region is mountainous and difficult to access, with subzero temperatures most of the time. Ninety percent of healthcare is through the government. The only two medical colleges and the seven district-level hospitals were included in this study. Of HCPs, 2,000 doctors, 600 medical students, and 2,200 nurses were considered as representing government HCPs; an additional 250 were in the private sector.

STUDY DESIGN

This cross-sectional study was conducted from August 1 to September 30, 2014. The participants were doctors (faculty and medical officers), postgraduate and undergraduate medical students, and nurses working in the government sector. Assuming a 5% margin of error and a confidence level of 99% for a population of 4,800, with a response distribution of 50, the sample size was calculated to be 584, which we rounded to 600. The required sample size was distributed across the medical college and district hospitals in the state (*Table 1*).

DATA COLLECTION

A predesigned validated questionnaire (Supplementary *Fig. S1*; Supplementary Data are available online at www.liebertpub.com/tmj) was personally administered to all the participants by the Co-Investigator. The domains covered included general information, usage of mobile phones, health status, and knowledge of m-health. The questionnaire was a modified version of the one used in an earlier pan-India study.[4] Prior to this, through several sessions the Co-Investigator had been thoroughly trained in understanding each question and

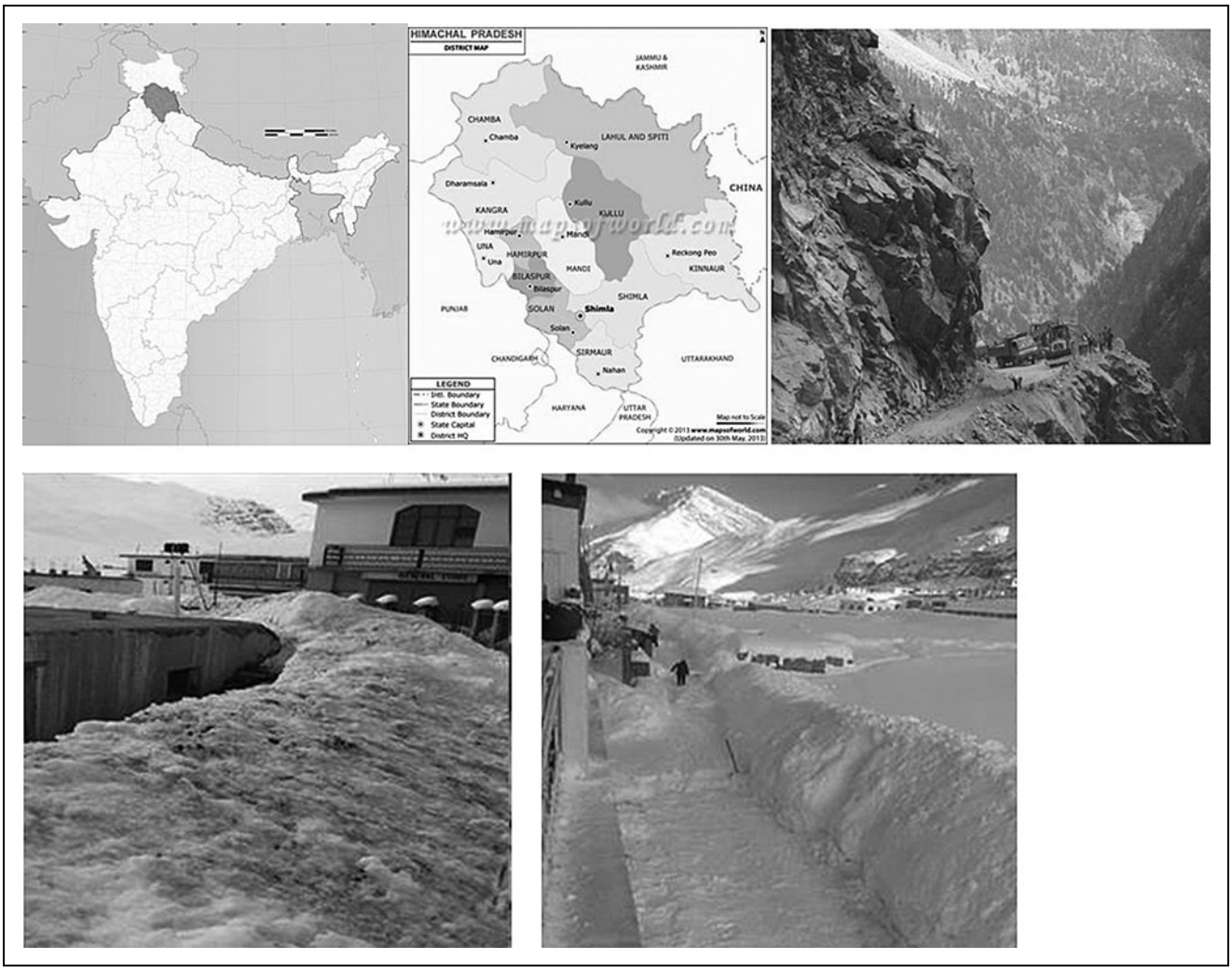

Fig. 1. Map showing Himachal Pradesh and its districts and examples of the physical conditions encountered in reaching some of the isolated and poorly equipped and staffed healthcare outposts between 9,000 and 16,000 feet in altitude.

Table 1. Distribution of Healthcare Providers Studied in Himachal Pradesh, India

SITE NUMBER	HOSPITAL (STUDY UNIT)	DOCTORS	NURSES	MEDICAL STUDENTS	TOTAL
1	Indira Gandhi Medical College, Shimla	40	40	100	180
2	Dr. Rajendra Prasad. Government Medical College, Tanda	40	40	100	180
3	District Hospital, Una	10	10	–	20
4	District Hospital, Hamirpur	10	10	–	20
5	District Hospital, Bilaspur	10	10	–	20
6	District Hospital, Dharamsala	10	10	–	20
7	District Hospital, Shimla	10	10	–	20
8	District Hospital, Chamba	10	10	–	20
9	District Hospital, Kullu	10	10	–	20
10	District Hospital, Mandi	10	10	–	20
11	District Hospital, Keylong	10	10	–	20
12	District Hospital, Rekongpeo	10	10	–	20
13	District Hospital, Solan	10	10	–	20
14	District Hospital, Kullu	10	10	–	20
	Total	200	200	200	600

possible responses, as well as how to document the answers. For faculty and medical officers, the questionnaire was distributed individually. The objective of the study was explained, and their response was recorded. Medical students and nurses were assembled in groups of 20–30 (*Fig. 2*). As can be seen from *Table 1* all districts in the state were covered. Each respondent answered each question without discussion with any one. Each question was explained and also translated in the local language, Hindi. Individuals took an average of 20 min to answer a questionnaire, and for groups it took 45 min.

DATA ANALYSIS

Proportions were calculated for sociodemographic characteristics, mobile use, channels of healthcare information, and attitude and acceptance items for m-health. A composite variable was created for "willingness to use m-health instead of in-person doctor visits" by combining willingness for any activity including clinical diagnosis, providing health advice, monitoring compliance for treatment, and exchanging clinical information with patients. Among a subset of participants with complete data on all relevant parameters, first simple logistic regression analysis was done to calculate the crude odds ratio (OR) with 95% confidence interval (CI). For each variable relevant covariates found to be significantly associated in univariate analysis ($p<0.05$) were selected for multiple logistic regression analysis to calculate the adjusted ORs with 95% CI in order to determine the participants' characteristics independently associated with willingness to use m-health instead of in-person doctor visits.

ETHICS STATEMENT

Clearance was obtained from the Ethics Committee and the Institutional Review Board of Apollo Hospitals Chennai. An informed consent was obtained from each participant.

Results

Of the 659 HCPs approached (the larger number approached, assuming that not all would be willing), 592 responded. Inability to spare the necessary time was the main reason for the nonresponders. Responses to various question items ranged from 463 to 592 participants.

Fig. 2. Administration of the questionnaire to doctors, nurses, and medical students across Himachal Pradesh, India.

Table 2. Sociodemographic and Mobile Use-Related Characteristics of Study Participants

PARTICIPANT CHARACTERISTICS	TOTAL *N*	*N* (%)
Sociodemographic		
Age (years)	586	
18–30		303 (51.7)
31–50		219 (37.4)
>50		64 (10.9)
Female gender	590	360 (61.0)
Individual income (INR)	463	
15,000 or below		144 (31.1)
15,001–30,000		52 (11.2)
30,001–50,000		96 (20.7)
50,001 or above		171 (37.0)
Main occupation	584	
Clinical practice		158 (27.1)
Nursing		189 (32.4)
Medical student		150 (25.7)
Others (administrator/manager/teacher)		87 (14.9)
Location of work	528	
State capital		131 (24.8)
Suburb		380 (72.0)
Tribal area		17 (3.2)
Computer/mobile use		
Use tablet at		
Home	526	140 (26.6)
Work	522	71 (13.6)
Use laptop at		
Home	551	389 (70.6)
Work	525	189 (36.0)
Use PC at		
Home	526	287 (54.6)
Work	526	151 (28.7)
Duration of using mobile phone (years)	591	
Less than 5 years		82 (13.9)
5–9 years		151 (25.5)
More than 9 years		358 (60.6)
Use Wi-Fi on mobile device	590	309 (52.4)
Aware of security problems on mobile networks	580	503 (86.7)
Frequency of using mobile phone for		
E-mails	560	
High		156 (27.9)
Low		166 (29.6)
Never		238 (42.5)
Internet	561	
High		346 (57.9)
Low		73 (12.2)
Never		142 (25.3)
Healthcare advice/information	580	
High		190 (31.8)
Low		157 (27.1)
Never		233 (40.2)
Social networking	576	
High		339 (58.9)
Low		72 (12.5)
Never		165 (28.6)
Banking/finance	577	
High		38 (6.6)
Low		101 (17.5)
Never		438 (75.9)
Games	574	
High		194 (33.8)
Low		144 (25.1)
Never		236 (41.1)
Review of diagnostic images	571	
High		156 (27.3)
Low		114 (20.0)
Never		301 (52.7)
Self-perceived ability to use mobile services	592	505 (85.3)
Self-perceived utility of mobile services	591	460 (77.8)
High self-perceived comfort in using mobile services	582	494 (84.9)

PC, personal computer.

SOCIODEMOGRAPHIC CHARACTERISTICS

Of those who responded, 61% were females, and 51.7% were below the age of 30 years. Of the 463 individuals who had given their monthly income, 37% had a monthly income of more than INR 50,000 (1 US$ = INR 64), whereas 31% had a monthly income that was less than INR 15,000. Of 584 respondents, 32.4% were nurses, 27.1% were clinicians, and 25.7% were medical students. Of 528 respondents, 72% lived in suburban areas (*Table 2*).

Of 591 respondents, 60.6% had been using mobile phones for more than 9 years, and 13.9% had done so for less than 5 years. Of respondents to the question, 52.4% had access to Wi-Fi on their mobile phones. Interestingly, 86.7% of 580 respondents were aware of the possibility of security issues on their mobile devices (perhaps this was inadvertently brought to their notice by the Co-Investigator while explaining the questions). Of the 560 respondents, 57.5% received and sent e-mails on their mobile phones, although with varying frequency. Of 580 respondents, 58.5% used their mobile phones for healthcare advice or information. Of 571 respondents, 47.3% reviewed diagnostic images using their mobile phones. In all, 84.9% of 582 respondents expressed a high self-perceived comfort in using mobile-based services (*Table 2*).

SEEKING AND GIVING HEALTH-RELATED INFORMATION

Internet search engines were reported to be most frequently used (65.3% of 590 respondents) for seeking health-related information, followed by books/information pamphlets (63.5% of 588 respondents). Although most common, the use of information pamphlets (40.3%) and Internet search engines (39.5%) was relatively low for giving clinical/health advice (*Table 3*).

Table 3. Channels for Seeking and Giving Healthcare-Related Information Among Study Participants

FREQUENCY OF USE OF VARIOUS CHANNELS	SEEKING HEALTHCARE INFORMATION		GIVING CLINICAL HEALTH-RELATED ADVICE	
	TOTAL *N*	*N* (%)	TOTAL *N*	*N* (%)
Internet search engines	590		588	
High		224 (38.0)		86 (14.6)
Low		161 (27.3)		146 (24.8)
Never		205 (34.7)		356 (60.5)
Books/information pamphlets	588		586	
High		228 (38.8)		96 (16.4)
Low		145 (24.7)		140 (23.9)
Never		215 (36.6)		350 (59.7)
Social networking sites	592		588	
High		129 (21.8)		82 (13.9)
Low		160 (27.0)		139 (23.6)
Never		303 (51.2)		367 (62.4)
Media/other sources	585		583	
High		119 (20.3)		63 (10.8)
Low		165 (28.2)		133 (22.8)
Never		301 (51.5)		387 (66.4)
Online medical forum	582		583	
High		106 (18.2)		51 (8.7)
Low		156 (26.8)		120 (20.6)
Never		320 (55.0)		412 (70.7)
Blogs	581		580	
High		34 (5.9)		22 (3.8)
Low		122 (21.0)		89 (15.3)
Never		425 (73.1)		469 (80.9)

ATTITUDE TOWARD USE OF M-HEALTH SERVICES

Nearly 60% or more of the respondents stated that m-health would be useful in taking care of health concerns, enhance the effectiveness of healthcare activities, and decrease the institutions' healthcare expenses. On the other hand, 38% of 589 respondents stated that m-health would threaten privacy of personal health information, and 19.2% stated that m-health can adversely impact patients' health. Of 583 respondents, 32.9% perceived that patients would prefer to use m-health (*Table 4*).

ACCEPTANCE OF M-HEALTH SERVICES

Willingness to use m-health services in place of in-person doctor visits ranged from 27% for clinical diagnosis to 47% for monitoring treatment compliance. More than 60% of the respondents were willing to use m-health services in addition to in-person visits for clinical diagnosis, monitoring treatment compliance, giving health advice, and exchanging clinical information with patients (*Table 4*).

FACTORS ASSOCIATED WITH WILLINGNESS TO USE M-HEALTH SERVICES

Study participants with income above INR 30,000 (OR = 2.1; 95% CI, 1.2–3.7), using mobile phones for more than 5 years (OR = 3.0; 95% CI, 1.1–8.5), seeking healthcare

Table 4. Attitude and Acceptance of Mobile Health Services Among Study Participants

OPINIONS	TOTAL *N*	*N* (%)
Attitude regarding mobile health services		
Easy to recommend	583	354 (60.7)
Decrease institution's healthcare expenses	592	353 (59.6)
Increase my professional income	588	212 (36.1)
Enhance my customer base	586	277 (47.3)
Competently handle personal health information	588	214 (36.4)
Threatens privacy of personal health information	589	224 (38.0)
Enhance the effectiveness of healthcare activities	589	358 (60.8)
Useful in taking care of health concerns	588	367 (62.4)
High potential for adverse impact on the patient's health	589	113 (19.2)
Self-perception of patients' preference	583	
Mobile health		192 (32.9)
In-person doctor visits		270 (46.3)
Neutral		121 (20.8)
Acceptance of mobile health services		
Clinical diagnosis		
Instead of in-person doctor visits	591	163 (27.6)
In addition to in-person doctor visits	584	351 (60.1)
Providing health advice		
Instead of in-person doctor visits	586	235 (40.1)
In addition to in-person doctor visits	585	389 (66.5)
Monitoring compliance for treatment		
Instead of in-person doctor visits	585	276 (47.2)
In addition to in-person doctor visits	584	381 (65.2)
Exchanging clinical information with patients		
Instead of in-person doctor visits	586	264 (45.1)
In addition to in-person doctor visits	584	380 (65.1)

information from search engines (adjusted OR = 5.3; 95% CI, 1.8–15.2) or blogs (adjusted OR = 3.4; 95% CI, 1.6–7.2), and having a positive attitude toward m-health in terms of decrease in healthcare expenses (OR = 2.8; 95% CI, 1.7–4.6), increase in professional income (OR = 2.2; 95% CI, 1.3–3.6), enhancement of customer base (OR = 1.6; 95% CI, 1.0–2.6), and competency to handle personal information (adjusted OR = 3.3; 95% CI, 1.8–6.0) were more likely to be willing to use m-health instead of in-person doctor visits (*Table 5*).

Study participants who were males (OR = 0.6; 95% CI, 0.4–1.0), used a personal computer at home (OR = 0.6, 95% CI 0.4–1.0) or work (adjusted OR = 0.5; 95% CI, 0.3–0.9), used mobile phones for Internet access (OR = 0.5; 95% CI, 0.3–0.8), healthcare information (OR = 0.6; 95% CI, 0.3–1.0) or social networking (OR = 0.5; 95% CI, 0.3–0.9), and sought healthcare information from books or pamphlets (OR = 0.6; 95% CI, 0.3–1.0) were less likely to be willing to use m-health instead of in-person doctor visits (*Table 5*).

Discussion

This study has revealed that in September 2014 the awareness and deployment of mobile phones for healthcare-related activities among HCPs in Himachal Pradesh were low, coupled with a perception of low acceptability among their patients. There was greater acceptability of m-health services as an additional tool for clinical work rather than a replacement for interaction with patients. The literature survey reveals that the mobile phone is increasingly being used in clinical practice. Attitudes of heart failure patients and their HCPs toward home monitoring and technology have been studied; patients were confident in using mobile phones to view health information, although visual acuity and manual dexterity were often issues; in this study[7] clinicians cited lack of remuneration, potential increased clinical workload, and possible medicolegal implications as concerns. Text messaging has been used in management of AIDS[8,9] and sexual health,[10] home follow-up of patients undergoing ambulatory surgery,[11] and obesity.[12,13] The attitude of families of patients with genetic diseases toward m-health technologies has been studied.[14]

A meta-analysis of 25 studies deploying short message service in 13 countries covering 38,060 individuals revealed significant improvements in medication compliance.[15] Asthma symptoms, hemoglobin A1c and stress levels, smoking quit rates, and self-efficacy improved. Process improvements were reported in the form of fewer failed appointments, quicker diagnosis and treatment, and improved teaching and training. The findings that enhancing standard care with reminders, disease monitoring and management, and education through cell phone voice and short message service can help improve health outcomes and care processes have implications for both patients and providers.[15]

Mobile phones are being used as tools for encouraging physical activity[16] and healthy diets, for symptom monitoring in asthma and heart disease, for sending patients reminders about upcoming appointments, for supporting smoking cessation, and for a range of other health problems.[17,18]

Table 5. Factors Associated with Willingness to Use Mobile Health "Instead of" In-Person Doctor Visits in Himachal Pradesh, India

PARTICIPANT CHARACTERISTIC	WILLING TO USE MOBILE HEALTH INSTEAD OF IN-PERSON DOCTOR VISITS		CRUDE OR (95% CI)	AOR (95% CI)
	YES (N=168)	NO (N=113)		
Sociodemographic characteristics				
Age (years)				
18–30	56 (33.3)	53 (46.9)	0.5 (0.2–1.1)	
31–50	86 (51.2)	48 (42.5)	0.8 (0.4–1.8)	
>50	26 (15.5)	12 (10.6)	Reference	
Gender				
Male	56 (33.3)	52 (46.0)	0.6 (0.4–1.0)	
Female	112 (66.7)	61 (54.0)	Reference	
Individual income (INR)				
50,001 or above	68 (40.5)	35 (31.0)	2.1 (1.2–3.7)	
30,001–50,000	36 (21.4)	19 (16.8)	2.0 (1.0–4.0)	
15,001–30,000	19 (11.3)	11 (9.7)	1.8 (0.8–4.3)	
15,000 or below	45 (26.8)	48 (42.5)	Reference	
Main occupation				
Clinical practice	44 (26.2)	38 (33.6)	0.7 (0.3–1.6)	
Nursing	82 (48.8)	36 (31.9)	1.5 (0.7–3.1)	
Medical student	17 (10.1)	23 (20.4)	0.5 (0.2–1.1)	
Others (administrator, manager, or teacher)	25 (14.9)	16 (14.2)	Reference	
Location of work				
State capital	51 (30.4)	17 (15.0)	1.5 (0.3–6.7)	
Suburb	111 (66.1)	93 (82.3)	0.6 (0.1–2.5)	
Tribal area	6 (3.6)	3 (2.7)	Reference	
Computer/mobile use				
Use tablet at home				
Yes	42 (25.0)	36 (31.9)	0.7 (0.4–1.2)	
No	126 (75.0)	77 (68.1)	Reference	
Use tablet at work				
Yes	23 (13.7)	20 (17.7)	0.7 (0.4–1.4)	
No	145 (86.3)	93 (82.3)	Reference	
Use laptop at				
Home				
Yes	113 (67.3)	79 (69.9)	0.9 (0.5–1.5)	
No	55 (32.7)	34 (30.1)	Reference	

continued →

Table 5. Factors Associated with Willingness to Use Mobile Health "Instead of" In-Person Doctor Visits in Himachal Pradesh, India *continued*

PARTICIPANT CHARACTERISTIC	WILLING TO USE MOBILE HEALTH INSTEAD OF IN-PERSON DOCTOR VISITS		CRUDE OR (95% CI)	AOR (95% CI)
	YES (*N*=168)	NO (*N*=113)		
Work				
Yes	57 (33.9)	42 (37.2)	0.9 (0.5–1.4)	
No	111 (66.1)	71 (62.8)	Reference	
Use PC at				
Home				
Yes	84 (50.0)	71 (62.8)	0.6 (0.4–1.0)	
No	84 (50.0)	42 (37.2)	Reference	
Work				
Yes	42 (25.0)	41 (36.3)	0.6 (0.3–1.0)	0.5 (0.3–0.9)[a]
No	126 (75.0)	72 (63.7)	Reference	
Duration of using mobile phone (years)				
>9	110 (65.5)	72 (63.7)	2.6 (1.0–7.0)	
5–9	51 (30.4)	29 (25.7)	3.0 (1.1–8.5)	
<5	7 (4.2)	12 (10.6)	Reference	
Use Wi-Fi on mobile device				
Yes	74 (44.0)	60 (53.1)	0.7 (0.4–1.1)	
No/don't know	94 (56.0)	53 (46.9)	Reference	
Aware of security problems on mobile networks				
Yes	141 (83.9)	98 (86.7)	0.8 (0.4–1.6)	
No	27 (16.1)	15 (13.3)	Reference	
Frequency of using mobile phone for				
E-mails				
High	53 (31.6)	31 (27.4)	1.0 (0.6–1.8)	
Low	35 (20.8)	33 (29.2)	0.7 (0.4–1.2)	
Never	80 (47.6)	49 (43.4)	Reference	
Internet				
High	90 (53.6)	74 (65.5)	0.5 (0.3–0.8)	
Low	19 (11.3)	17 (15.0)	0.4 (0.2–0.9)	
Never	59 (35.1)	22 (19.5)	Reference	
Healthcare advice/information				
High	45 (26.8)	42 (37.2)	0.6 (0.3–1.0)	
Low	40 (23.8)	28 (24.8)	0.7 (0.4–1.4)	
Never	83 (49.4)	43 (38.1)	Reference	

continued →

Table 5. Factors Associated with Willingness to Use Mobile Health "Instead of" In-Person Doctor Visits in Himachal Pradesh, India *continued*

PARTICIPANT CHARACTERISTIC	WILLING TO USE MOBILE HEALTH INSTEAD OF IN-PERSON DOCTOR VISITS		CRUDE OR (95% CI)	AOR (95% CI)
	YES ($N=168$)	NO ($N=113$)		
Social networking				
High	83 (49.4)	67 (59.3)	0.5 (0.3–0.9)	
Low	18 (10.7)	18 (15.9)	0.4 (0.2–0.9)	
Never	67 (39.9)	28 (24.8)	Reference	
Banking/finance				
High	15 (8.9)	8 (7.1)	1.3 (0.5–3.1)	
Low	28 (16.7)	20 (17.7)	1.0 (0.5–1.8)	
Never	125 (74.4)	85 (75.2)	Reference	
Games				
High	41 (24.4)	39 (34.5)	0.6 (0.3–1.0)	
Low	45 (26.8)	29 (25.7)	0.9 (0.5–1.5)	
Never	82 (48.8)	45 (39.8)	Reference	
Review of diagnostic images				
High	23 (13.7)	25 (22.1)	0.5 (0.3–1.0)	
Low	32 (19.1)	23 (20.4)	0.8 (0.4–1.5)	
Never	113 (67.3)	65 (57.5)	Reference	
Self-perceived ability to use mobile services				
Yes	149 (88.7)	101 (89.4)	0.9 (0.4–2.0)	
No/don't know	19 (11.3)	12 (10.6)	Reference	
Self-perceived utility of mobile services				
Yes	142 (84.5)	88 (77.9)	1.6 (0.8–2.9)	
No/don't know	26 (15.5)	25 (22.1)	Reference	
Self-perceived comfort in using mobile services				
High	151 (89.9)	96 (85.0)	1.6 (0.8–3.2)	
Low/neutral	17 (10.1)	17 (15.0)	Reference	
Frequency of use of various channels for seeking healthcare information				
Search engines				
High	52 (31.0)	48 (42.5)	0.6 (0.4–1.1)	2.4 (0.9–6.3)[b]
Low	42 (25.0)	21 (18.6)	1.2 (0.6–2.3)	5.3 (1.8–15.2)[b]
Never	74 (44.0)	44 (38.9)	Reference	

continued →

Table 5. Factors Associated with Willingness to Use Mobile Health "Instead of" In-Person Doctor Visits in Himachal Pradesh, India *continued*

PARTICIPANT CHARACTERISTIC	WILLING TO USE MOBILE HEALTH INSTEAD OF IN-PERSON DOCTOR VISITS		CRUDE OR (95% CI)	AOR (95% CI)
	YES (*N*=168)	NO (*N*=113)		
Social networking sites				
High	24 (14.3)	26 (23.0)	0.6 (0.3–1.2)	
Low	42 (25.0)	19 (16.8)	1.5 (0.8–2.7)	
Never	102 (60.7)	68 (60.2)	Reference	
Blogs				
High	4 (2.4)	11 (9.7)	0.3 (0.1–0.8)	0.4 (0.1–1.4)[c]
Low	41 (24.4)	15 (13.3)	1.9 (1.0–3.7)	3.4 (1.6–7.2)[c]
Never	123 (73.2)	87 (77.0)	Reference	
Online medical forum				
High	30 (17.9)	24 (21.2)	0.8 (0.4–1.4)	
Low	40 (23.8)	29 (25.7)	0.8 (0.5–1.5)	
Never	98 (58.3)	60 (53.1)	Reference	
Books/information pamphlets				
High	54 (32.1)	52 (46.0)	0.6 (0.3–1.0)	
Low	34 (20.2)	17 (15.0)	1.1 (0.6–2.2)	
Never	80 (47.6)	44 (38.9)	Reference	
Media/other sources				
High	34 (20.2)	22 (19.5)	1.0 (0.5–1.9)	
Low	36 (21.4)	28 (24.8)	0.8 (0.5–1.5)	
Never	98 (58.3)	63 (55.8)	Reference	
Frequency of use of various channels for giving health-related advice				
Search engines				
High	22 (13.1)	16 (14.2)	0.9 (0.4–1.7)	
Low	34 (20.2)	27 (23.9)	0.8 (0.4–1.4)	
Never	112 (66.7)	70 (61.9)	Reference	
Social networking sites				
High	19 (11.3)	16 (14.2)	0.7 (0.4–1.5)	
Low	32 (19.1)	25 (22.1)	0.8 (0.4–1.4)	
Never	117 (69.6)	72 (63.7)	Reference	
Blogs				
High	7 (4.2)	3 (2.7)	1.5 (0.4–6.0)	
Low	20 (11.9)	19 (16.8)	0.7 (0.3–1.3)	
Never	141 (83.9)	91 (80.5)	Reference	

continued →

Table 5. Factors Associated with Willingness to Use Mobile Health "Instead of" In-Person Doctor Visits in Himachal Pradesh, India *continued*

PARTICIPANT CHARACTERISTIC	WILLING TO USE MOBILE HEALTH INSTEAD OF IN-PERSON DOCTOR VISITS		CRUDE OR (95% CI)	AOR (95% CI)
	YES ($N=168$)	NO ($N=113$)		
Online medical forum				
High	14 (8.3)	10 (8.9)	1.0 (0.4–2.3)	
Low	35 (20.8)	20 (17.7)	1.2 (0.7–2.3)	
Never	119 (70.8)	83 (73.4)	Reference	
Books/information pamphlets				
High	22 (13.1)	17 (15.0)	0.8 (0.4–1.7)	
Low	34 (20.2)	25 (22.1)	0.9 (0.5–1.6)	
Never	112 (66.7)	71 (62.8)	Reference	
Media/other channels				
High	18 (10.7)	12 (10.6)	1.0 (0.4–2.1)	
Low	33 (19.6)	26 (23.0)	0.8 (0.5–1.5)	
Never	117 (69.6)	75 (66.4)	Reference	
Attitude regarding mobile health				
Decrease institution's healthcare expenses				
Yes	121 (72.0)	54 (47.8)	2.8 (1.7–4.6)	
No/don't know	47 (28.0)	59 (52.2)	Reference	
Increase my professional income				
Yes	81 (48.2)	34 (30.1)	2.2 (1.3–3.6)	
No/don't know	87 (51.8)	79 (69.9)	Reference	
Enhance my customer base				
Yes	96 (57.1)	51 (45.1)	1.6 (1.0–2.6)	
No/don't know	72 (42.9)	62 (54.9)	Reference	
Competently handle personal health information				
Yes	63 (37.5)	24 (21.2)	2.2 (1.3–3.9)	3.3 (1.8–6.0)[c]
No/don't know	105 (62.5)	89 (78.8)	Reference	
Threatens privacy of personal health information				
Yes	59 (35.1)	35 (31.0)	1.2 (0.7–2.0)	
No/don't know	109 (64.9)	78 (69.0)	Reference	
Enhance the effectiveness of healthcare activities				
Yes	99 (58.9)	60 (53.1)	1.3 (0.8–2.0)	
No/don't know	69 (41.1)	53 (46.9)	Reference	

continued →

Table 5. Factors Associated with Willingness to Use Mobile Health "Instead of" In-Person Doctor Visits in Himachal Pradesh, India *continued*

PARTICIPANT CHARACTERISTIC	WILLING TO USE MOBILE HEALTH INSTEAD OF IN-PERSON DOCTOR VISITS		CRUDE OR (95% CI)	AOR (95% CI)
	YES (N=168)	NO (N=113)		
Useful in taking care of health concerns				
Yes	102 (60.7)	63 (55.8)	1.2 (0.8–2.0)	
No/don't know	66 (39.3)	50 (44.2)	Reference	
High potential for an adverse impact on the patient's health				
Yes	27 (16.1)	25 (22.1)	0.7 (0.4–1.2)	
No/don't know	141 (83.9)	88 (77.9)	Reference	

Data are number (%).

[a]Adjusted for age.

[b]Adjusted for main occupation.

[c]Adjusted for gender and main occupation.

AOR, adjusted odds ratio; CI, confidence interval; OR, odds ratio.

Multimedia messaging as a healthcare application has been discussed by Bäck and Mäkelä.[19]

Mao et al.[20] have demonstrated that mobile phone services' adoption and acceptance issues have a significant impact on business and personal communication practices at regional and global levels.

Using an extended Technology Acceptance Model in the United States and Turkey, perceptions and acceptance of remote video visits in a urological patient population have been studied.[21] Key factors influencing usefulness, ease of use, and intentions to use advanced mobile phone services, such as mobile Internet access, e-mail, and payments, have been studied. Potential factors that affect adoption of smartphones by healthcare professionals were studied using the Technology Acceptance Model, Self-Efficacy, and the Innovation Diffusion Theory. One hundred fifty-three surveys—88 from the United States and 65 from Taiwan—were analyzed. The results showed that attitude toward using a smartphone had a direct positive influence on the intention to use a smartphone.

Healthcare professionals who feel that they can master the functions of a smartphone, particularly to complete clinical tasks, are more apt to use them.[22]

A study of 400 physicians in public tertiary hospitals in Hong Kong suggested that the Technology Acceptance Model involving end users and business managers in ordinary business settings may not be equally valid for an HCP.[23]

A study in 2013 revealed that patients preferred to use the Internet rather than mobile applications and preferred their attending doctors to do likewise—possibly because mobile applications were less common then.[24]

HCPs are more likely to use a mobile phone professionally if there is a high-speed cellular network with increasing coverage.[25]

A study of 120 primary care physicians in Israel revealed that they preferred giving their cell phone numbers rather than e-mail addresss.[26]

Seventy-two percent of 201 patients thought that their surgeon was more caring if they had cell phone access. They would communicate directly as a last resort for mostly urgent issues.[27]

A study in 2003 revealed that 72% of 283 physicians used e-mail to communicate with patients and were highly satisfied, although concerned about confidentiality.[28]

Some authors are of the opinion that telephone consultations may be more suited to follow-up and management of long-term conditions.[29]

A national public opinion survey conducted in 2007 and published in 2009 of 1,404 Americans studied their attitudes toward mobile healthcare technology. The survey revealed high levels of interest in emergency intervention services, but much less so in health information and monitoring services. A minority was negatively disposed toward such applications, particularly if it was a wearable technology.[30]

As early as 2003, Car and Sheikh[31] published an article discussing telephone-linked healthcare in the management of acute and chronic disorders and how quality and safety of telephone consultations need to be ensured.

Human motivation underlying individual behavioral intention to use mobile Internet has been studied in Korea. Attitude toward mobile Internet was the most significant factor in predicting the behavioral intention to use mobile Internet.[32]

End-user perceptions regarding m-health interventions was studied in a village in rural Bangalore in early 2014; 484 (99%), were willing to receive health-related information on their mobile phones. Although receiving reminders for drug adherence was acceptable to 98%, 89% preferred voice calls. Nearly all were willing to consult by telephone a doctor for an emergency, and 75% were willing for an acute illness.[33]

In a 7-month study, carried out in 2007 in rural Haryana, 78% of 660 calls analyzed stated that they had followed the advice provided. Of these, 91% found the advice helpful, and 96% of users wished to continue to use the service in future.[34]

The Mother & Child Tracking System, deployed by the Indian Ministry of Health and Family Welfare, uses user-friendly mobile-based short message service technology to communicate with grass roots–level healthcare services providers, managers, and administrators. In the first 3 years alone, 25.2 million pregnant women and 18.3 million children were registered in the Mother & Child Tracking System since its inception in 2010.[35]

Use of mobile phones by Accredited Social Health Activists, under India's National Rural Health Mission scheme, has been evaluated. The study revealed benefits and obstacles. Policy recommendations for supporting organic diffusion of mobile phones has been discussed.[36]

In response to a provocative query whether the mobile telephone can be an effective healthcare intervention in developing countries, Kaplan[37] pointed out that the developed world model of personal ownership of a phone may not be appropriate to the developing world in which shared mobile telephone use is important. To the Westerner sharing may be a drawback in terms of privacy. In rural India, however, one's health problems are often discussed with the community, bringing in much need succor.

LIMITATIONS OF THE STUDY

The questionnaire method, used in this study for eliciting views, has some limitations. Although most of these were anticipated and addressed, language and difficulties in comprehension may not have been totally eliminated. Interestingly, 86.7% of 580 respondents were aware of the possibility of security issues on their mobile devices (perhaps this was inadvertently brought to their notice by the Co-Investigator while explaining the questions).

Conclusions

The HCPs in Himachal Pradesh did not frequently use their mobile phones for Internet access. The awareness and current use of mobile phones for healthcare-related activities were low. There was a moderate level of positive attitude toward m-health among the HCPs, coupled with their perception of low acceptability among the patients. There was greater acceptability of m-health services as an addditional tool for clinical work rather than a substitute for personal interaction with the patients.

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REFERENCES

1. World Health Organization. m-Health: New horizons for health through mobile technologies: Second global survey on eHealth. Global Observatory for eHealth Series. **2014.** Available at www.who.int/goe/publications/goe_m-Health_web.pdf (last accessed December 14, 2015).
2. Ganapathy K, Aditi R. m-Health: A potential tool for healthcare delivery in India. Making the e-health connection, m-health and mobile telemedicine—An overview. The Rockefeller Foundation, Bellagio, Italy. **2008.** Available at http://www.ehealth-connection.org/files/conf-materials/mHealth_A%20potential%20tool%20in%20India_0.pdf (last accessed December 15, 2015).
3. Telecom Regulatory Authority of India. Highlights of telecom subscription data as on 30th April. **2015.** Available at www.trai.gov.in (last accessed December 16, 2015).
4. Ganapathy K, Rai A. Will m-health be accepted in India? Results of a pan-India survey. Available at www.slideshare.net/thitconference/session-6-01-arun-rai-26405121?related=1 (last accessed December 14, 2015).
5. Lourdusamy JB, Ganapathy K. Attitudes towards acceptance of m-health in an institute of technology in Chennai, India. Available at http://transformhealthit.moozup.com/Mobile/magenda?Ids=336 (last accessed December 14, 2015).
6. Bresnick J. How attitudes towards m-health can drive patient engagement. February 5, **2015.** Available at http://mhealthintelligence.com/news/how-attitudes-towards-mhealth-can-drive-patient-engagement (last accessed December 15, 2015).

7. Seto E, Leonard KJ, Masino C, Cafazzo JA, Barnsley J, Ross HJ. Attitudes of heart failure patients and healthcare providers towards mobile phone-based remote monitoring. *J Med Internet Res* **2010;**12:e55.
8. Pop-Eleches C, Thirumurthy H, Habyarimana JP, Zivin JG, Goldstein MP, de Walque D, et al. Mobile phone technologies improve adherence to antiretroviral treatment in a resource-limited setting: A randomized controlled trial of text message reminders. *AIDS* **2011;**25:825–834.
9. Harris LT, Lehavot K, Huh D, Yard S, Andrasik MP, et al. Two-way text messaging for health behavior change among human immunodeficiency virus-positive individuals. *Telemed J E Health* **2010;**16:1024–1029.
10. Lim MS, Hocking JS, Hellard ME, Aitken CK. SMS STI: A review of the uses of mobile phone text messaging in sexual health. *Int J STD AIDS* **2008;**19:287–290.
11. Martínez-Ramos C, Cerdán MT, López RS. Mobile phone-based telemedicine system for the home follow-up of patients undergoing ambulatory surgery. *Telemed J E Health* **2009;**15:531–537.
12. Burke LE, Styn MA, Sereika SM, Conroy MB, Ye L, et al. Using m-health technology to enhance self-monitoring for weight loss: A randomized trial. *Am J Prev Med* **2012;**43:20–26.
13. Gerber BS, Stolley MR, Thompson AL, Sharp LK, Fitzgibbon ML. Mobile phone text messaging to promote healthy behaviors and weight loss maintenance: A feasibility study. *Health Inform J* **2009;**15:17–25.
14. Tozzi AE, Carloni E, Gesualdo F, Russo L, Raponi M. Attitude of families of patients with genetic diseases to use m-health technologies. *Telemed J E Health* **2015;**21:86–89.
15. Krishna S, Boren SA, Balas EA. Healthcare via cell phones: A systematic review. *Telemed J E Health* **2009;**15:231–240.
16. Hurling R, Catt M, Boni MD, Fairley BW, Hurst T, Murray P, Richardson A, Sodhi JS. Using Internet and mobile phone technology to deliver an automated physical activity program. *J Med Internet Res* **2007;**9:e7.
17. Klasnja P, Pratt W. Healthcare in the pocket: Mapping the space of mobile-phone health interventions. *J Biomed Inform* **2012;**45:184–198.
18. Cole-Lewis H, Kershaw T. Text messaging as a tool for behavior change in disease prevention and management. *Epidemiol Rev* **2011;**32:56–69.
19. Bäck I, Mäkelä K. Mobile phone messaging in healthcare—Where are we now? *J Inf Technol Software Eng* **2012;**2:106.
20. Mao E, Srite M, Thatcher JB, Yaprak O. A research model for mobile phone service behaviors: Empirical validation in the U.S. and Turkey. *Global IT J* **2005;**8(4):7–27.
21. Viers BR, Pruthi S, Rivera ME, O'Neil DA, Gardner MR, Jenkins SM, Lightner DJ, Gettman MT. Are patients willing to engage in telemedicine for their care: A survey of preuse perceptions and acceptance of remote video visits in a urological patient population. *Urology* **2015;**85:1233–1239.
22. Chen J, Park Y, Putzer GJ. An examination of the components that increase acceptance of smartphones among healthcare professionals. *E J Health Inform* **2010;**5:e16.
23. Chau P, Hu PJ. Information technology acceptance by individual professionals: A model comparison approach. *Decision Sci* **2001;**32:4:699–720.
24. Koehler N, Vujovic O, McMenamin C. Are individuals more accepting of the internet than mobile phone apps being used in clinical practice? *Mobile Technol Med J* **2013;**2:14.
25. Baumgart DC. Smartphones in clinical practice, medical education, and research. *Arch Intern Med* **2011;**171:1294–1296.
26. Peleg R, Avdalimov A, Freud T. Providing cell phone numbers and email addresses to patients: The physician's perspective. *BMC Res Notes* **2011;** 4:76.
27. Chin KR, Adams SB Jr, Khoury L, Zurakowski D. Patient behavior if given their surgeon's cellular telephone number. *Clin Orthop Relat Res* **2005;**439: 260–268.
28. Gaster B, Knight CL, DeWitt DE, Sheffield JV, Assefi NP, Buchwald D. Physicians' use of and attitudes toward electronic mail for patient communication. *J Gen Intern Med* **2003;**18:385–389.
29. McKinstry B, Hammersley V, Burton C, Pinnock H, Elton R, Dowell J, Sawdon N, Heaney D, Elwyn G, Sheikh A. The quality, safety and content of telephone and face-to-face consultations: A comparative study. *Qual Saf Health Care* **2010;**19:298–303.
30. Katz J, Rice R. Public views of mobile medical devices and services: A US national survey of consumer sentiments towards RFID healthcare technology. *Int J Med Inform* **2009;**78:104–114.
31. Car J, Sheikh A. Telephone consultations. *BMJ* **2003;**326:966–969.
32. Cheong JH, Park M. Mobile Internet acceptance in Korea. *Internet Res* **2005;**15: 125–140.
33. DeSouza SI, Rashmi MR, Vasanthi AP, Joseph SM, Rodrigues R. Mobile phones: The next step towards healthcare delivery in rural India? *PLoS One* **2014;**9:e104895.
34. Bali S, Singh AJ. Mobile phone consultation for community health care in rural north India. *J Telemed Telecare* **2007;**13:421–424.
35. Ministry of Health and Family Welfare, Government of India. India is the second-largest mobile phone user in world. **2013.** Available at http://pib.nic.in/newsite/erelease.aspx?relid=%2085669 (last accessed December 16, 2015).
36. Chib A, Cheong YJ, Lee Lin Chieh L, Ng Chiah Hwee C, Tan CK, Kameswari VLV. The hope of mobile phones in Indian rural healthcare. *J Health Inform Dev Countries* **2012;**6:406–421.
37. Kaplan WA. Can the ubiquitous power of mobile phones be used to improve health outcomes in developing countries? *Global Health* **2006;**2:9.

Address correspondence to:
Krishnan Ganapathy, MCh (Neurosurgery), FACS, FICS, FAMS, PhD
Apollo Telemedicine Networking Foundation
21 Greams Lane
Chennai 600006
India

E-mail: drganapathy@apollohospitals.com

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