

Knowledge, Attitude and Practice of M-Health Towards Hospital Settings in Bengaluru

By

Ipshita Deb

*Dissertation submitted for the partial fulfillment of the
MBA Hospital and Health Management*

Academic year, 2015-2017



The IIHMR University, Jaipur

1, Prabhu Dayal Marg, Sanganer, Airport
Jaipur 302029, Rajasthan
Ph: 0141 3924700, Fax: 3924738
Website: www.iihmr.edu.in

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Website: www.iihmr.edu.in

TO WHOMSOEVER MAY CONCERN

This is to certify that **Ipshita Deb** student of MBA Hospital and Health Management from The IIHMR University, Jaipur has undergone internship training at **NTT Data Services, Bengaluru** from 6th February 2017 to 5th May 2017.

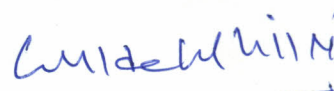
The Candidate has successfully carried out the study designated to her during internship training and her approach to the study has been sincere, scientific and analytical.

The Internship is in fulfillment of the course requirements.

I wish her all success in all her future endeavors.



Col (Dr.) Ashok Kaushik
Dean, Academics and Student Affairs
The IIHMR University, Jaipur



Dr. D. K. Mangal
Dean Research
The IIHMR University, Jaipur

NTT DATA Information Processing Services Private Limited

(Formerly known as Dell Business Process Solutions India Private Limited)

Plot 123, EPIP Phase II, Whitefield Industrial Area
Bengaluru, Karnataka 560 066, India

To whomsoever it may concern

This is to certify that **Ipshita Deb** of **The IIHMR University, Jaipur** has been working with NTT DATA Services for her summer project.

Project Details:

Project Name : Knowledge, Attitude and practice of mHealth towards hospital settings in Bengaluru
Duration : 90 days
Location : Bangalore
Guide Name : Dr. Anushree Pandit & Gabreena Lewis
Sponsor Name : Ajay Aiyar

She has successfully completed her project and her performance during the tenure of the internship has been found to be satisfactory.

Her findings in course of the project has been found to be practical and relevant and some of the recommendations will be incorporated on the floor on approval from the business.

Thanking You,

Regards,



Dilipkumar Santhanam
Business Partner Director, Services HRBP Team
NTT DATA Services

THE IIHMR UNIVERSITY, JAIPUR

CERTIFICATE BY SCHOLAR

This is to certify that the dissertation titled **“Knowledge, Attitude and Practices of mHealth towards hospital settings in Bengaluru”** is submitted by **Ipshita Deb** Enrollment No. **IIHMR-U/01/2015-17/0290** under the supervision of **Dr. D. K. Mangal** for award of MBA in Hospital and Health of the University carried out during the period 6st February to 5th May embodies my original work and has not formed the basis for the award of any degree, diploma associate ship, fellowship, titles in this or any other institute or other similar institution of higher learning.

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This is to certify that all ethical issues have been considered while collecting data for my dissertation titled **“Knowledge, Attitude and Practice of mHealth towards hospital settings in Bengaluru”**

Ipskita Deb

Signature of student

ABSTRACT

Introduction: Mobile health, also known as mHealth is considered as one of the biggest breakthrough in the field of new emerging technologies. The ubiquity of mobile technology offers encouraging solutions to the era of digitally empowered patients and doctors. Physicians and the nurses can easily communicate with their patients and colleagues without getting tethered to their offices. This ease of convenience allows them to be more fruitful while providing better care to their patients.

Objective: To understand the mHealth applications and medical mobile devices used in an Indian and Global scenario. To identify the awareness and attitude of healthcare professionals on the use of healthcare applications and mobile medical devices. Also, to determine the market and challenges of implementing mHealth.

Methodology: The study design was a descriptive cross sectional study where non-probability purposive sampling method was used. The whole duration of the study was three months where in total of 139 respondents which included 52 doctors and 87 nurses who were interviewed by conducting face-to-face interviews as well as through emails by using a semi-structured questionnaire consisting of 16 questions.

Results: The results were analysed and it was found that the knowledge amongst doctors and nurses about mHealth applications and mobile medical devices for quality improvement was found to be average but the understanding of the various mobile medical devices and health applications along with its safety and privacy amongst doctors and Nurses was found to be moderate. The awareness of the healthcare applications amongst the doctors was to be more than the medical mobile devices but the need felt by them is partially high as well as moderate. 61 % (76) of the study group were using some kind of mobile medical devices or healthcare applications in their work setting while 51% (63) of the study group were not using the same.

Recommendations: Since only about 40% of both the doctors and nurses received the training for the mHealth usage, so there was a need for strong education and training among them so as to develop skills for using mHealth technology more effectively. And, also developing hospital specific branded applications which can be used by both physicians and nurses and also evaluation of the same by developing a certification system for these medical applications.

Conclusion: Although the healthcare applications and medical devices provides the healthcare professionals with so many benefits, they are currently used without having a proper understanding of the associated benefits and risks. Certain barriers and gaps if are addressed then with period, the mHealth will be used by all individuals regardless of their qualification level or social classes.

Keywords: mHealth, mobile health, healthcare applications, mobile medical devices, healthcare professionals.

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LIST OF ABBREVIATIONS

1	eHealth	Electronic health
2	3G	Third generation
3	4G	Fourth generation
4	AIDS	Acquired immune deficiency syndrome
5	APPS	Applications
6	BP	Blood pressure
7	CAGR	Compound annual growth rate.
8	CDAC	Centre for development of advanced computing
9	CME	Continuing medical education
10	E-BOOK	Electronic book
11	E-MAIL	Electronic mail
12	EHR	Electronic health record
13	E-LEARNING	Electronic learning
14	GDP	Gross domestic product
15	GOE	Global observatory for electronic health
16	GPRS	General pack radio service
17	GPS	Global positioning system
18	GSMA	Global System for mobile communication Association
19	HCP	Health care professionals
20	HIV	Human immune deficiency virus
21	ICT	Information communication technologies
22	ICU	Intensive care unit

23	IT	Information technology
24	KAP	Knowledge, attitude and practice.
25	LVAD	Left ventricular assist device.
26	mHealth	Mobile health
27	MMS	Multimedia messaging service
28	PDA	Personal digital assistants
29	PWC	Price water house coopers
30	RHM	Remote health monitoring
31	SMS	Short messaging service
32	UAE	United Arab Emirates
33	UK	United kingdom
34	USA	United States of America
35	WHO	World health organization

1. INTRODUCTION

In the Indian healthcare system, there is an ever increasing demand and need of both urban and rural population. Almost 75% of the healthcare expenditure is paid out of pocket which actually creates a consumer induced market and definitely is capable of a change at a faster pace.¹

So, providing technology at an affordable price to the people facilitating wider access to care is a crucial step.¹

1.1. eHealth

Electronic health (also known as eHealth) is basically the use of different communication and information technologies for the purpose of data exchange and various other works thereby strengthening the communication possibilities between a healthcare provider and a patient, through patient involvement in the whole process.

1.2. Defining mHealth

Mobile healthcare (also known as mHealth) is one of the biggest breakthrough of our time. It is basically a component of eHealth. To date, no standardized definition of mHealth has been established. The Global Observatory for eHealth (GOe) has defined mHealth or mobile health as: *“medical and public health practice which is supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants or personal assisted devices (PDAs), and other wireless devices. mHealth involves the usage and capitalization on a mobile phone’s fundamental utility of voice and short messaging service (SMS) as well as more complicated functionalities and applications including general packet radio Service (GPRS), third and fourth generation mobile telecommunications (3G and 4G systems), global positioning system (GPS), and Bluetooth technology.”*²

1.3. What Are “Apps”?

Apps or applications are basically software programs that have been developed to run on a computer or mobile device to accomplish a definite purpose.⁵ Processors which are highly efficient, which has improved memory, and highly effective open-source operating systems that perform complex functions have actually bricked the way for the development of medical mobile device apps for both professional and personal use.⁵

Availability of different healthcare medical apps on the mobile devices of HCPs has made the life's way easier. There are different apps available for the medical purposes, including ones used for electronically prescribing purpose, diagnosis and treatment purpose, different types of practice management, billing, and CME or e-learning.^{14,15} A broad array of apps that helps in answering clinical practice and other parameters at the point of care exist, such as: reference guides for drugs, calculators for the medical purpose, clinical guidelines and other decision support aids, books, and literature search portals.^{12,18,19} Even for the purpose of hearing or vision tests, there are certain apps that can conduct simple medical exams.^{11,12} The health related applications are not intended to replace the desktop work but for the accompaniment to improve outcomes at the point of care.¹²

1.4. Mobile Health Technological Framework:

The wealth of the community can surely affect its health. Developed countries has a huge healthcare system where almost everyone receive good care. But in case of developing countries, both low and middle income countries, there is often a lack of transparency of information, access of healthcare issues as well as treatment quality concern persists. These problems not only exists in developing countries but also in case of few poor developed countries.

Maximum of these disparities comes from the gaps in resources, mainly because of financing, physical capital, also trained health workers. Even though when few of these resources are provided through foreign help, workable developments in health can be subtle if a country's ability and infrastructure do not progress, then countries need to find out ideas and technologies that govern the resources that are readily available and affordable.

The mobile technology intensification has an enormous potential in the developing countries. Mobile devices such as cellular phones and wireless devices have penetrated rapidly and deeply into developing countries, far overtaking the traditional system of grids and landline telephones. All over the world, such type of devices has more than 5 billion points of contact for health systems and people. In such a way, even the remote population can be reached, as because these devices are getting smarter day by day, and also the bandwidth that transmits their information is getting wider (and thus faster). In addition, the advent of cloud computing is making the process easier. Around the globe, as per an estimate by the McKinsey & Company and PWC, the use of mobile devices for health may soon make as much as \$60 billion a year in goods and services.

So, the need of the hour is to go for innovative, homegrown solutions by using technology in order to achieve better health in a more cost-effective and sustainable manner.³⁸

1.5. Mobile Health Network

The models for m-health network and its impact on health is shown in figure 1 and 2. The following are the main areas of mHealth which are actually making a difference:

1.1.5. Improving access and quality of healthcare

- A. **Treatment support:** The Mobile health services basically deals with the health problems of the patient rather than focusing on the diagnosis and prevention part. An example of one such common application is the compliance reminder when patients are reminded to take their medications using phone calls or SMS messages.

Medic Mobile (San Francisco) is one such application which is used to keep a stock of the essential medicines, used extensively in more than 20 countries; also used to track disease surveillance and outbreaks.

- B. **Patient tracking:** With the use of digital medical records, through the applications; the chances of the errors in medical diagnosis, treatment and prevention has reduced to a great extent. When a patient is visited by any community health worker, they can feed the data which is collected using a

centralized system. The health workers, in turn can get the updates or alerts about their patients which helps them to plan their rounds.

- C. **Supply-chain management:** Applications that gather information on sales and inventories aid inform procurement and ordering by suppliers, vendors, and health organisations. The similar people can use other applications to roadway consignments and monitor circulation of healthcare supplies. Applications that protect against copying helps the consumers, health staffs, and retailers avoid fraudulent products that can be ineffectual and even hazardous. An important advantage for remote area people is that, they can use the mobile devices for checking the price of medical services and products.
- D. **Health financing:** In order to optimize the operational efficiency, various products for health saving and Micro-insurance are being used extensively. This includes insurance, vouchers, smartcards etc. For example- M-PESA used in Kenya linked with technology is used mobile money transfer. Similarly, micro-insurance is used to deliver micro-insurance products to the consumers.
- E. **Emergency services:** The ambulance model such as Ziqita Healthcare/ 1298 in India has to the intensification in health emergency services and responses in combination with technology.

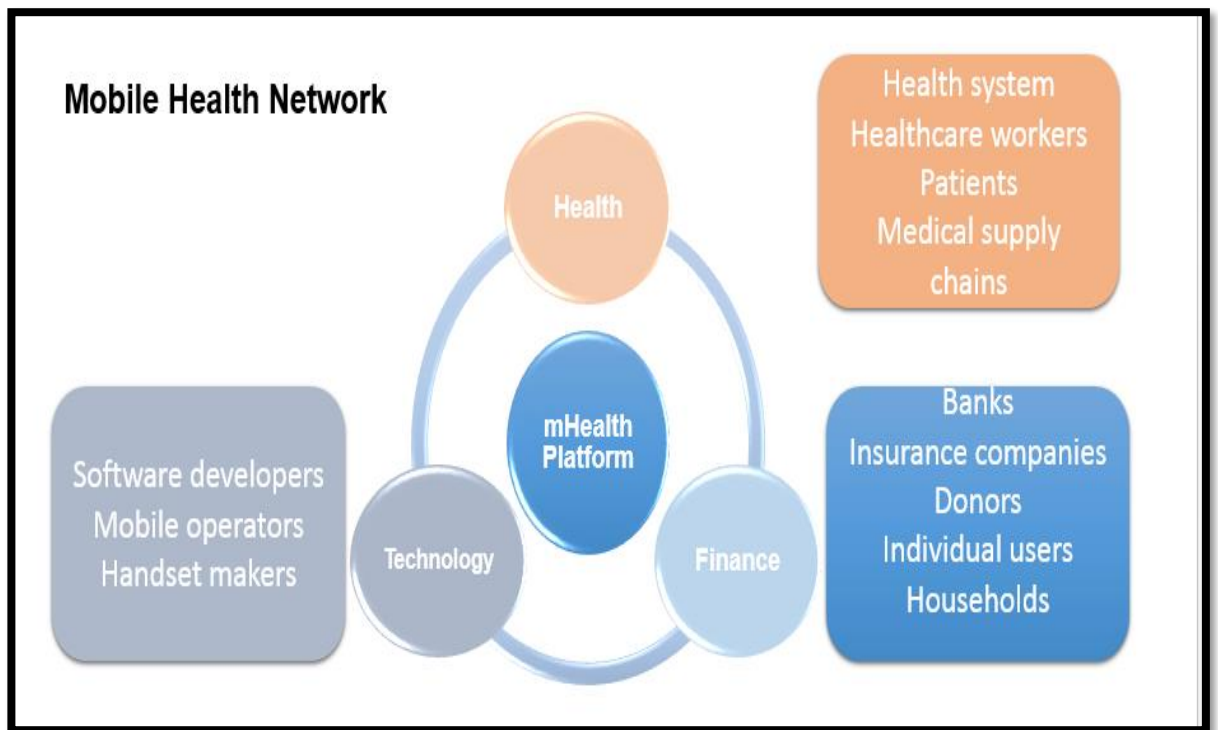


Figure 1.1: mHealth eco-system representing dynamic spheres i.e. health, technology & finance

(Source: Redrawn from Dalberg research and analysis)

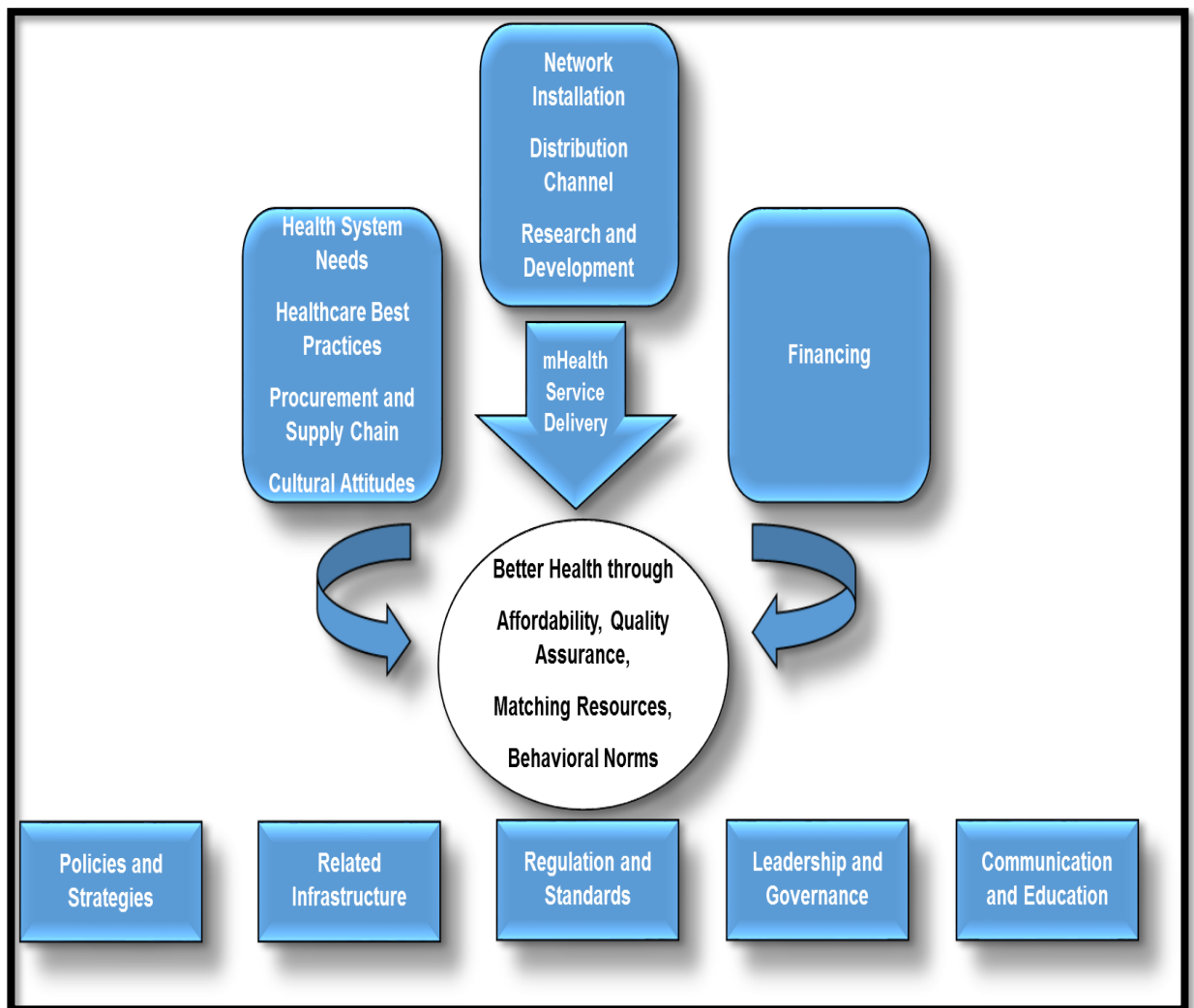


Figure 1.2: Different stakeholders in M-health. (Redrawn from Dalberg research and analysis)

1.6. Indian Healthcare scenario

According to a report by World Bank, India spends only 1% of its overall Gross domestic product (GDP) on public health. (See table)

Table 1.1: Country wise population and economic data (2012)

Country	Public healthcare expenditure (as % of GDP)	GDP)in trillions of USD)	Population size)in Millions)
Bangladesh	1.2	0.13	155
Indonesia	1.2	0.88	247
India	1.3	1.86	1,237
Singapore	1.7	0.29	5
Malaysia	2.2	0.30	29
Vietnam	2.8	0.14	89
Thailand	3	0.36	67
china	3	8.23	1,351
Japan	8.3	5.95	128
United States	8.3	16.16	314

(Source: Data redrawn from P. Dinesh “Indian medical device industry- current state and opportunities of growth”, 2015.)

Countries like Thailand and Vietnam has a much lower GDP than that of India, but comparatively spends more on the healthcare expenditure. China which has the largest population also spends more on their respective people’s healthcare as compared to India. Since in India, the healthcare expenditure is very low; the responsibility on the private sector to expand and capitalize the market is huge.³⁰

There is a mismatch of technology and existing economy which leads to unmet clinical needs of the population. In India, through the import; almost 75% of the medical devices demand is currently met where 30% support is provided by US alone.³¹

A leading edge technological device or application may not do well in the market due to affordability issues or inadequacy of training options available to the physicians. For example-LVAD implant i.e. left ventricular assist device costs around \$ 1,00,000.^{32,33}. In India, where most of the people are affected by cardiovascular disorders, has a huge market for the cardiac assisted devices. It is very important to identify the correct target patient population, determine the price strategically and intensify their collusion with the healthcare providers so as to maximize their revenue.

1.7. The Rise of Mobile Health Globally

The mobile health activities have grown prominently around the world. A global survey conducted by World Health Organization of 114 Nations found that many countries have established mHealth initiatives. The most frequent activity was the creation of health call centres (38 percent), responding to the patient inquiries (see Figure 1). This was followed by the use of SMS for appointment reminders (25 percent), followed by Telemedicine (18 percent), having an access to patient records (18 percent), measuring treatment compliance (17 percent), boosting awareness of health (10 percent), patient monitoring (8 percent), and physician decision support (6 percent). It was found that, the differences between developed and developing nations were huge. Africa had the minimum rate of mobile health adoption although North America, South America, and Southeast Asia showed the maximum adoption levels.³

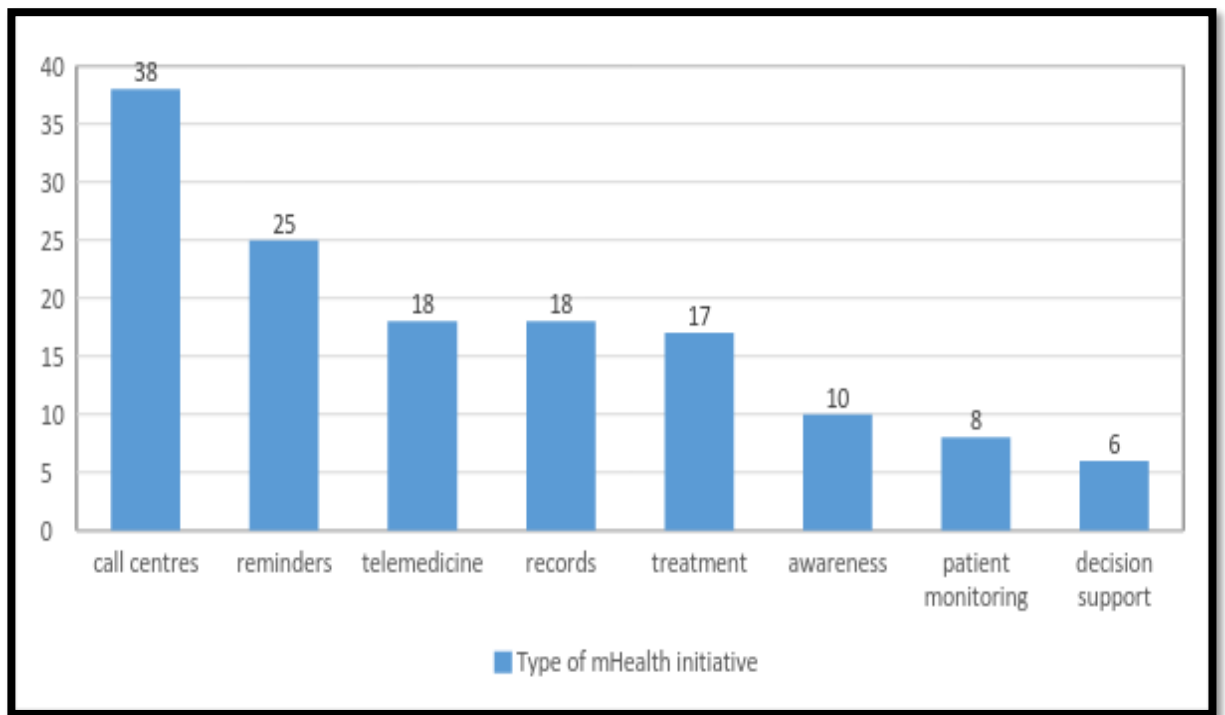


Figure 1.3: Type of mHealth initiative Worldwide

(Source: Figure redrawn from World Health Organization, volume 3, 2011)

The mobile healthcare application market has the possibility for high growth. In China, there are about 2,000 mobile applications. A Cube Labs study shows that by 2015 almost 30 percent of smartphone users are expected to use healthcare application. Mobile applications allow medical services for users through mobile devices, and will reduce the gap between the health care provider and the patient. It will help the users save time and allow doctors to treat their patients in a more effective manner. A Study conducted by the Cube lab says that the use of mobile apps can save medical workers time by 39 minutes every day.²⁶

There are certain expeditious advancements in the mobile technologies and applications, creating new opportunities of mobile health into existing eHealth services and maintaining growth of cellular networks. There are more than 5 billion wireless subscribers, and over 70% of them stay in low and middle income countries; according to the report of International telecommunication Industry. Also, Global System for mobile communication Association (GSMA) reports commercial wireless signals cover over 85% of the world's population, extending far beyond the reach of the electrical grid.²

The use of mobile technology and healthcare applications helps not only the patients, but also the physicians and other health providers, and policymakers in several different aspects. It supports patients by giving them tools to have a check on their own health conditions and communicate those results to physicians. It enables health providers such as doctors, nurses, and technicians etc. to associate with colleagues and offers alternative sources of information for patients. It is also an imperative tool to inform policymakers on health delivery and medical outcomes.

One of the major reasons for a high growth in the advancement of medical software applications (apps) is the usage of mobile devices in the healthcare settings. The use of mobile devices by health care professionals (HCPs) has revolutionized several aspects of healthcare industry including the clinical practice.⁵⁻⁶

1.8. Different uses of mobile devices and healthcare applications:

- Information management
 1. Used for writing and dictating notes.
 2. Record audio and take photographs.
 3. Organize information and images.
 4. Use e-book reader.
 5. Access the cloud service
- Time management
 1. Used for scheduling appointments and meetings.
 2. Recording call schedule.
- Communication and Consulting
 1. Used for Voice calling and video calling.
 2. Texting, MMS, email.
 3. Video conferencing

- Reference and information gathering.
 1. Medical textbooks and medical journals.
 2. Used for Literature search portals.
 3. Medical news
 4. For the purpose of drug reference guides
- Patient monitoring
 1. Monitoring health of the patient.
 2. Monitoring patient location.
 3. Collection of clinical data.²⁵

There are certain important applications of m-Health such as:

- Education and awareness
- Remote collection of data.
- Remote monitoring
- Communication and training for healthcare workers
- Disease and epidemic outbreak tracking
- Diagnostic and treatment support

Different Hospitals and various healthcare professionals incorporates mobile medical devices and applications into health diagnosis and treatment. So, Changes in operations and policy practices are important in order to make better decisions.

1.9. Why conduct a Knowledge, attitude and practice (KAP) survey:

The purpose of quantitative methods of data collection is to measure a phenomenon through the practice of questionnaires and statistical handling of the information collected. Questionnaire studies are the primary method of accumulating quantitative data. They comprises of interviewing, using a questionnaire, a sample of people as representative as possible of the entire study population. One benefit of a KAP survey is to permit, in a single

survey, the collecting of a huge amount of data that will be focused to statistical analysis (which qualitative methods of data collection do not allow).

2. LITERATURE REVIEW

2.1. Systematic Review Details

Here the systematic review follows the protocols mentioned by *Kitchenham*³⁴

In the upcoming sections, it will be assumed that the reader is thorough with such research procedures. The details of which are mentioned as follows:

2.2. Question Formulation This relates to the objectives of this research and is essentially done to understand the Knowledge, attitude as well as practice better for mobile health, characterizing the concepts within the literature, the results and research methods which were used.

2.3. Search String A grand total of 110 research papers in various libraries using the strings: (“awareness for mHealth” OR” mHealth knowledge” OR” mHealth practice” as well as “mobile health”)

2.4. Population: The searches were executed between the months of February and March 2017 in libraries that enclosed articles from journals and symposiums related to mobile devices in health care.

2.5. Libraries: The libraries were preferred considering access, conception and full paper movement availability. (Four libraries were selected: Springer Link, Science Direct, IEE Explore and ACM Digital Library.)

2.6. Selection of studies: The standards for inclusion and exclusion of papers in this research were:

- a) Key areas: information and attitude about area of usage;
- b) Only papers that focused on the attitude and practice were considered;
- c) Publication years ranging from 2010 to 2015;
- d) Papers that did not have application on m health were discarded;

- e) Also includes examination of papers published in journals and conferences;
- f) The paper is in an introductory study on the topic of KAP on the mobile health.

In the initial search, 110 papers were reverted. After reading the titles and summaries, 70 papers were nominated for full reading. After full reading, 47 articles were selected (approximately 43 % of the overall search engines results), which signifies an adequate trial conferring to the discussions.

The bulk of the articles (47) were judgement or locus papers; or review articles that suggested mHealth practice procedures identified gaps for its knowledge, or shortened mHealth results based on the authors' own literature reviews.

Mobile health KAP assessment is relatively new, it was tough to find literature that was directly related to the use of mHealth. In the review, therefore different themes for mHealth in developing as well as in developed countries were listed and identified that underwrote evidence, lessons cultured, or suggested plans that might be helpful to groups incorporating mHealth practice.

A study conducted in the year 2012 (June) by Manhattan Research which was a physician adoption model says that the physicians ownership and usage of medical mobile devices is ubiquitous, with more than 87% of the doctors uses a tablet or smartphone at their workplace, if compared to 99% of them who actually uses computer.¹⁷ It was also found that around 80% of the doctors use iPhone, while others go for the android devices.^{5,18} About 66% of the doctors uses a tablet, from which 54% use them in their practices.¹⁷ The acceptance of the mobile devices does not resemble with the age more than 80% of the doctors who is above 55 years of age uses a smartphone.¹⁷ The study says that use of medical devices is very common in a hospital or a clinic setting.

The use of healthcare applications and devices not only improves the affordability and quality of healthcare but also allows the patients to connect with their doctors in a hassle free manner. According to a study by Schulke in the year 2013; the free and paid healthcare apps in the

market must be designed involving the healthcare professionals which otherwise may impose health risks to the patients.²⁷

In another research done by McKinsey and Company' 2010 it shows the modern day use of mobile health in India, where now patient can call the caregiver at any time of the day/week instead of taking time out of the schedule for treatment of serious symptoms. The physician also relies on the biometric sensors (m- stethoscope, smart phone based ultra sound and other bio-sensors) instead of typical hands on examination. Also SMS reminders are ensured to timely delivery of the medicine and regulation of side effects. Here the patient can be monitored from a distant location and his/her condition can be brought into notice if the condition worsens or negative lifestyle events affects the treatment. Most importantly any patient can connect to any medical expertise rather than facing delay or shortage of it. Few areas which still needs improvement and standardisation of Indian market with that of the global includes: Develop a global scale to reduce RHM Service cost and develop a clear vibrant, competitive market, tailor the business model of m- health to local situations and regulations and to enable large usability of m-health services. Also development of a secure and trusted services for patients is needed which will comply with their infrastructural needs.

According to Ascari.A etal, fields where the global m-health standards needs improvement involves increasing the efficiency for the process of patient authentication as the errors in this area has serious consequences. Also proper encryption is needed to preserve the confidentiality of patient data with its backend storage at a larger rate and as real time feature to prevent system collapse when large volumes of data are used. Overall it has to be made sure that optimal benefits of patient monitoring with right interventions are made out of the feature²⁸

According to a study done by the United Nations, different countries use different mHealth applications. Some of the key applications are:

1. Remote data collection
2. Education and Awareness
3. Remote Monitoring
4. Communication and training for healthcare workers

5. Diagnostic and treatment support
6. Disease and outbreak control ³⁰

The below graph shows the mHealth programs which are either slated for implementation or operating in the different countries worldwide. Particularly India, Peru, Uganda, Rwanda stand out for their mHealth activity.

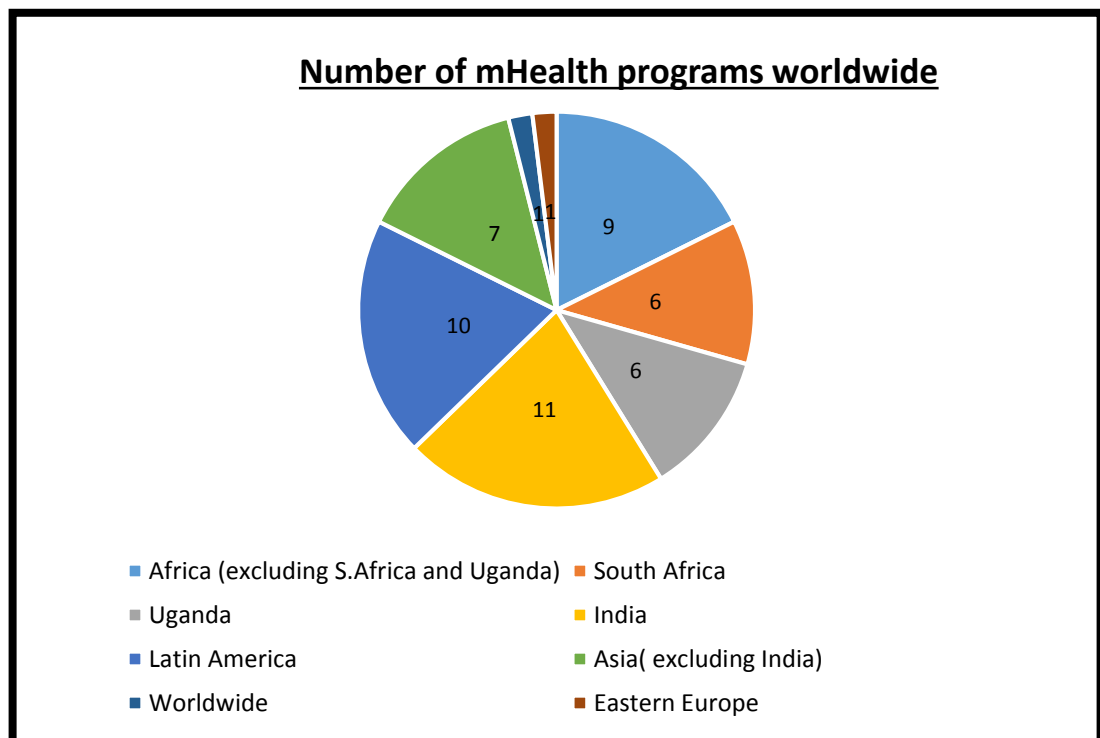


Figure 2.1: Number of mHealth Programs Worldwide

(Source: United Nations Foundation: mHealth for development)

The distribution of the various mHealth programs by application area are as follows:

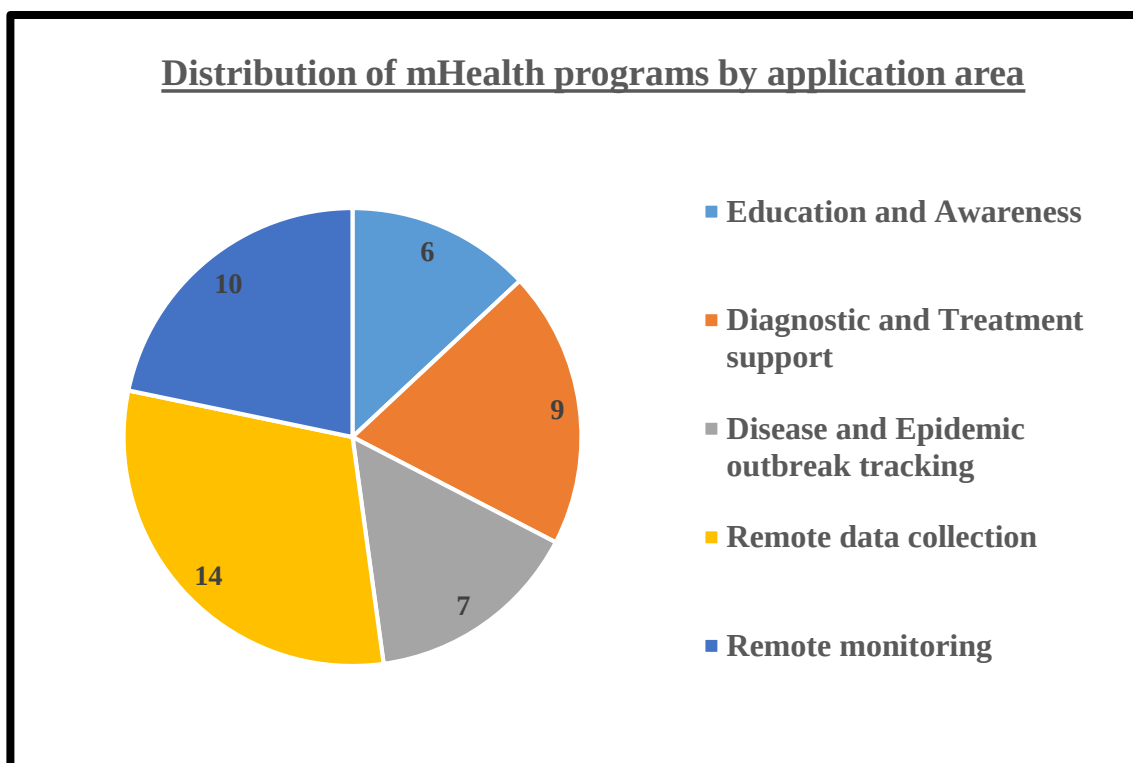


Figure 2.2: Distribution of mHealth program by application area

(Source: United Nations Foundation: mHealth for development)

2.7. mHealth Revenue worldwide

A study by Price water house coopers said that across the world, the mHealth revenue is expected to reach **US\$ 23** billion across various healthcare providers, mobile operators, device vendors etc. by 2017. It is also estimated that by 2017, Europe and Asia pacific with 30% share of the market will be the largest mHealth markets which is followed by the 27% share market of North America (USA and Canada). Correspondingly Latin America with 7% and Africa with 5% of the market share.

Among the mHealth services, the largest share which is approximately 65% accounts for monitoring services worldwide, which corresponds to about US\$ 15 billion (2017)

The monitoring services mainly comprises of independent ageing (30%) with revenues of US\$ 4.3 billion. Also, the post-acute care and the chronic disease management comprises of about 70% market share.^{29,30}

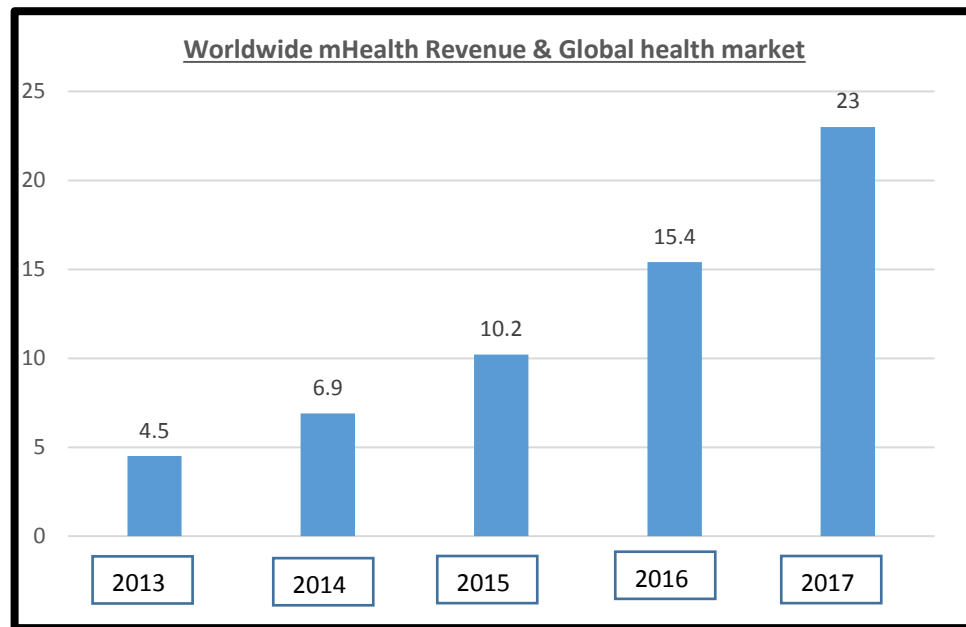


Figure 6- Source: PWC Analysis: V. Siddharth, V. Kaushal, N. Ravi “Touching lives through mobile health”, 2012

P. Dinesh in his article states that the Diagnostic services market accounts for around 15% of the mHealth market which corresponds to almost US\$ 3.4 billion where the revenues are mostly coming from the developing countries. Diagnostic services consists of call-center and mobile telemedicine consisting of US\$ 1.7 billion and US\$ 1.6 billion market respectively (2017). Figure 6 shows the global mHealth market and revenue market opportunity and the percentage of the overall market.

The key beneficiaries of the mHealth market are considered as mobile operators which consists of 50% of the overall share of the market, which equals to approximately US\$ 11.5 billion.

About US\$ 1 billion and US\$ 0.9 billion of the diagnostic and treatment solutions will contribute to operator revenues respectively.³⁰

Figure 7 shows the country wise mHealth market and its percentage share of the overall market.

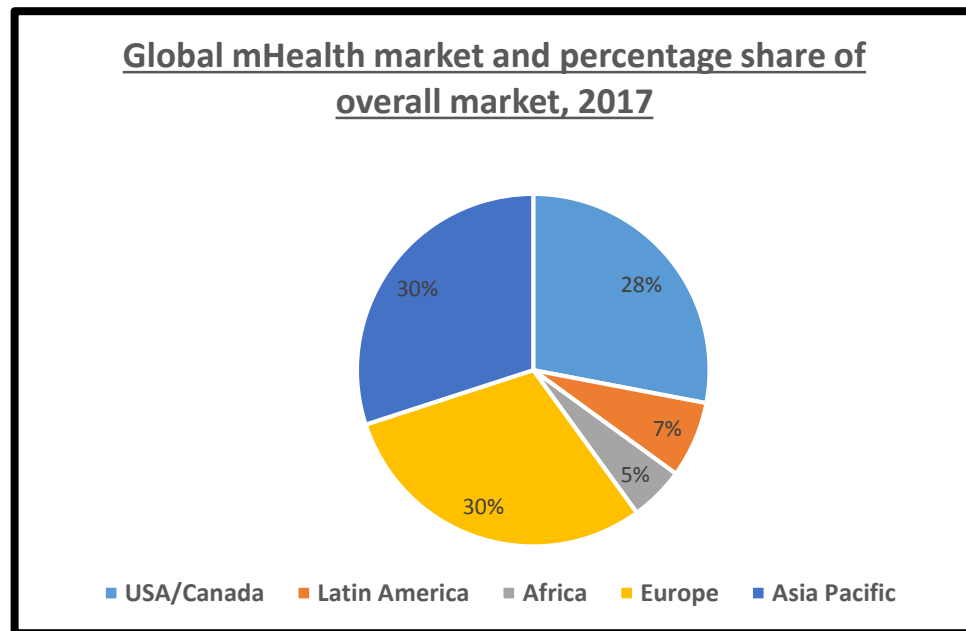


Figure 7- Source: PWC Analysis: V. Siddharth, V. Kaushal, N. Ravi “Touching lives through mobile health”, 2012

Healthcare expenditure in Developed markets:

According to a study by P. Dinesh, the organization for economic and co-operation and development (OECD) average of the total healthcare expenditure in the developed markets per capita has augmented 75% from US\$ ~2,280 in 2000 to US\$ ~3,970 in 2009.

Although in the developed countries, people are paying more for the healthcare but still there has not been much changes in the way services are delivered to them. For example- patients has to wait for an appointment with the specialist in countries such as Sweden, France, Canada for more than four weeks. In Australia, the average waiting time for a hip replacement or knee replacement from 95 and 114 in 2000 to 100 and 147 in 2009. Also, the healthcare spending per capita In Australia has increased from US\$ 1,730 in the year2000 to US\$ 3,870 in the year2009.³⁰

Burden of Disease:

The communicable diseases prevalence is maximum in the Africa, which is followed by the countries Asia and Latin America. In countries such as Indonesia, India and Vietnam; the burden of diseases is aggregating where there is an increase in the communicable diseases.

This will pose additional challenges to countries in Asia, Latin America and ultimately Africa as the healthcare delivery systems in these continents are primarily geared towards treating infectious diseases and will require significant advancement to help battle non-communicable diseases.³⁰

According to another study in the year 2012, the various opportunities of m-health in Indian as well as global scenario includes in monitoring of services, where the rising number of chronic diseases patients and ageing population is expected to rise which will need independent ageing based monitoring, diagnostic and treatment services. For example monitoring of cardiovascular diseases alone will rise by 65% to 85%. The low penetration of physicians within large rural population with a large population of it, affected by the communicable diseases will shape mobile health diagnostic services market up to a large extent. The treatment services will transit gradually from simple SMS based services to mobile application based as the people gets more comfortable with applications. The revenues will increase as people starts using more services with these features and the same gets improved in due time.

V. Siddharth et al in his study mentioned that although various challenges may creep which includes the confidentiality of data which should be the primary concern of the entire healthcare industry, additional issue may occur when the brand image goes down due to the buggy issues in poorly developed mobile applications which leads for the people to lose interest. Also there can be high market volatility where the consumer habits change too fast and latest trend influences the demand. As the mobile devices enable a customer to interact with the providers thus there is a deceased scope of innovations as it becomes difficult for the organisations to proceed further without the me-too approach, which has to be done for timely innovations. Finally there should be proper integration with the existing health IT systems with the various applications of m-health which should comply with the existing IT standards. The latest technologies need to be properly researched with their loop holes keeping in mind during the integration which should be addressed frequently.²⁹

Another study by P. Dinesh showed that the recommendations to capitalize the consideration of the Indian market which includes developing partnerships with indigenous technology firms, adopting this technology and climbing the curve in marketing which will again add value to the stakeholders. But in a country like India there should be a continuous push for

regulatory and tax code changes which is growing now with the make in India move and is in favour of indigenous manufacturing.³⁰

3. RATIONALE

In order to intensify the importance of online patient experience as a future path, ahead for healthcare providers in India, there is a persistent need to comprehend the global standards for m-health to apply and match the notion in Indian healthcare structure of traditional clinical protocols. For enacting every segment of this new feature current structure of m health, its market opportunities, feasibility and upcoming challenges has to be considered which can be obtained by studying the views and conviction of various clinical staffs and other available sources.

4. RESEARCH QUESTIONS

- i. What are the different mobile health scenario in an Indian and Global perspective?
- ii. What is the knowledge, attitude and practice of healthcare professionals regarding the Digital mobile platform?
- iii. What is the potential market for mHealth and current challenges faced by healthcare industry?

5. OBJECTIVES

- i. To understand the mHealth applications and medical mobile devices used in an Indian and Global scenario.
- ii. To identify the awareness and attitude of healthcare professionals on the use of healthcare applications and mobile medical devices.
- iii. To determine the Market and challenges of implementing mobile health

6. RESEARCH METHODOLOGY

6.1. STUDY DESIGN - The study design was a descriptive cross-sectional study design. This was done by collecting data from the study population.

6.2. SETTING - Different Hospitals and clinics in Bengaluru.

6.3. STUDY DURATION -Three months (February 6th to May 5th, 2017)

6.4. STUDY AREA - Mobile Healthcare Applications and Devices.\

6.5. STUDY POPULATION - The respondents for the study were the healthcare providers such as Physicians and Nurses in various hospital and clinic setting in Bengaluru.

6.6. SAMPLING - The sampling technique used was Non-Probability purposive sampling where Homogeneous sampling was done.

6.7. SAMPLE SIZE

Number of Doctors = 52

Number of Nurses = 87

Total number of respondents = 139

6.7.1. For Primary Data

Inclusion Criteria: This will include all the Physicians and Nurses working in various hospital and clinics as respondents who are directly dealing with the patients.

Exclusion Criteria: The study will exclude the administrative staffs.

6.7.2. For secondary Data

Inclusion criteria: This will include the literature which are related to mobile health platform which involves Mobile Medical devices and Healthcare applications used worldwide for improving the patient care.

Exclusion criteria: This will exclude those studies which will be Non English publications.

6.8. SOURCES OF DATA

6.8.1. Primary Data

The data was collected through a semi-structured questionnaire from the study population.

6.8.2. Secondary Data

The various journals representing the Indian and global scenario of mHealth were extensively searched.

6.9. DATA COLLECTION TOOL

Semi structured questionnaires was designed. It included few structured questions regarding the knowledge about the mobile health applications and few unstructured questions related to the future strategies for improving the process. This process also involved the pre-test, simulating the formal data collection process on a small scale to identify the practical problems with regard to data collection instruments, sessions, and methodology which was applied based upon the following factors:

- Evaluating language proficiency of data collection materials.
- Estimating the average rate of time required in conducting one interview.

6.10. Data Collection Technique - The technique which was involved in the data collection process were the face to face interviews and also through emails.

6.11. Data Analysis and Presentation -The corresponding codes (in numeric or in word) of every valid response will be matched relevant to their themes within the template and the survey. Analysis was done using Microsoft excel keeping the key variables i.e. knowledge, attitude and practice and results were presented in the form of pie-diagrams, bar and column graphs.

7. RESULTS

7.1. Objective 1: From the secondary analysis of the various articles and journals on mHealth, it was found that different countries use different mobile medical devices and healthcare applications.

7.1.1. AFRICA

Market share- 1.2 billion (US\$)

Percentage (%) share of overall market- 5 %

- A lot of existing mobile health deployments in Africa are meant at supporting remote healthcare workers in collection and then transmitting the data on disease and patients.
- In fact, almost 75% of current mobile health deployments in Africa focus on the road to recovery to the efficiency of healthcare staff and systems.
- Services that dispense prevention and awareness programs aimed at reducing the spread of infectious diseases and helping patients comprise around 20% of total deployments.
- South Africa and Kenya lead African countries presently in mobile health deployments.
- The majority of the applications in South Africa focus on improving the efficiency of healthcare workers, whereas Kenya has witnessed a great number of awareness/prevention solutions, especially around HIV/AIDS. Uganda, Malawi, Mozambique and Nigeria have also witnessed a number of mobile health deployments till date.²⁹

The following are the healthcare applications employed in Africa:

Table 7.1: Healthcare applications employed in Africa

Focus Area	Application	About application
Healthcare workers and health systems	Medic Mobile,Frontline SMS	It is basically a SMS platform that is employed for patient management. The service contains accessing of Electronic Health Records (EHR) via mobile phones, low price diagnostics and then mapping of wellbeing services
HIV/AIDS	Weltel, Kenya: (Dimagi)	SMS service to maintain antiretroviral medication adherence. It provides support to the health worker for assisting HIV patients and provides health information to the community. In addition it includes support for isolated data collection and logistics of moving healthcare linked products
Mobile doctors network	MDNet, Ghana: Vodafone, Ghana Medical Association	A free voice and SMS services which promotes transfer of information among the doctors. In case of emergency, this service helps in sending bulk messages and immediately contacting doctors of different specialities.
Maternal care	WE CARE Solar, Nigeria:	It basically promotes the secure motherhood and decrease maternal mortality in developing region, the health workers are provided with the dependable lighting, mobile communication, plus blood bank refrigeration where solar electricity will be used. The stipulation of mobile phones allow labour and delivery nurses to swiftly notify on-call doctors of emergency department, and ask for advice.

7.1.2. ASIA-PACIFIC

Market share- 6.8 Billion (US\$)

Percentage of overall market- 30%

- In Africa, mainly the current mobile health stationing in the Asia-Pacific region (APAC) target on improving the competence of healthcare workforce and systems.
- Solution that help extend prevention and awareness messages have also been extensively deployed and encompass about 20% of the mobile health formation in the region.
- India has witnessed noteworthy activity in the mobile health gap with the launch of different types of solutions, even though a majority of initiatives are focused on spreading prevention with awareness messages.
- In the Philippines, a lot of mobile health deployments focus on getting better the efficiency of community healthcare workforce.
- The Middle East too has a humble amount of mHealth service deployments. Kuwait along with Qatar lead here with the most of the formations followed by the United Arab Emirates and Saudi Arabia. The services mostly provide health information to the patients with a group of applications aimed at HIV/AIDS counselling and care. There are also Personal assisted devices/mobile-phone based services that help the remote healthcare workers in Indonesia and Bangladesh.

The following are the healthcare applications employed in Asia-Pacific

Table 7.2: Healthcare applications employed in Asia-Pacific

Focus area	Application	About Application
Tele-health, tele-education, tele-consultation	Apollo Telemedicine Networking Foundation, (India)	The health workers with the help of mobile phones connect with specialists of the hospital. This also includes the EHRs (electronic health records), ICU monitoring and telemedicine (mobile)
Chronic-disease management	Ideal Life Kiosks, (China)	Novatech Remote monitoring kiosks are used for the high-volume setting such as living centres, schools, doctor's offices and health clinics. These kiosk instrument the vitals such as blood pressure, weight, blood glucose levels and various other biometric reading.
Health line providers	Health Line, Telenor (Bangladesh)	Backend by 24/7 medical call centre staffed by doctors, intended for the people in remote areas. It also helps in providing information on connection with the doctors and medical facilities, pharmacies, lab results, medical advice along with emergency advice.
Breast mammography screening	Breast Screening Rural Broadband Digital Mammography Project, (Australia)	The project is supported by Ericsson which has shown that broadband can give women in rural areas access to the latest digital mammography technology and talk about some of the risk and inefficiencies connected with predictable analog x-ray film based screening system
Preventive Health	Health Text, (UAE)	Du offered various subscriptions for everyday health text messages with the program. Some of the programs are Live Well, Lose Weight, Her Health, Pregnancy Tips and Quit Smoke. The service is provided in Arabic and English and offers advice, counsel and facts.

7.1.3. EUROPE

Market share- 6.9

Percentage (%) of the overall market- 30%

- The mobile health in Europe have determined on monitoring patients with chronic diseases and actions of the elderly with a vision to aid independent ageing.
- Patient treatment along with remote monitoring solution constitute approximately 60% of the total mobile health deployments in Europe.
- There is also momentous push on solutions that add to the efficiency of the healthcare workforce and systems, which constitute almost 15% of overall mHealth programs. mHealth is driven by the rising adoption of smart phones, health oriented mobile applications have also been launched.
- The UK actually leads in mHealth deployments in Europe, with various kinds of solutions being offered plus services being delivered via different means, from simple SMS to complex applications.
- Norway, Spain, Germany and Greece have also seen significant mobile health deployments, with the prime focus on remote monitoring of patients who suffered from chronic diseases.³⁰

The following are the healthcare applications employed in Europe:

Table 7.3: Healthcare applications employed in Europe

Focus area	Application	About application
Alzheimer's disease	SIMAP, (Spain)	Spanish Red Cross, Vodafone Tele-monitoring - It is an alerting system for the family members and caregivers of Alzheimer's disease.
Remote tele-health for kidney diseases	ORANGE, Calydial (France)	It is a remote monitoring of kidney failure. It involves transferring patient data to the doctors touch screen.
Wireless pagers for emergency services	Amcom (Commotech), (UK):	It is a middleware that sends the alert notifications from patient remote monitoring to the accountable staff members for quick response in case of occurrence of emergency situation
Skin self-assessments	SkinScan, (Romania):	It is an iPhone application that helps the user examine skin for melanoma. It uses proprietary algorithm to determine melanoma and recommend the doctors in the nearby locality

7.1.4. USA AND CANADA

Market share- 6.5

Percentage (%) of overall market- 28%

- The US has been ahead in case of mobile health deployments in the world. Almost 40% of the solution deployed work in the direction of strengthening the healthcare systems.
- Solutions that helps in monitoring and treatment of patients comprise of about 25% of the deployments. About 13% of the total mobile health constitute of the applications related to fitness and wellness.
- The US has seen numerous significant activity in mHealth with solutions ranging from applications that help in achieving fitness goals to complicated patient monitoring systems.
- Canada has very few application in place with majority of them providing health information through text messages.³⁰

The following are the healthcare applications employed in USA/ Canada:

Table 7.4: Healthcare applications employed in USA/ Canada

Focus area	Application	About application
Health and fitness	MyFitnessPal, (USA)	It is a weight loss tool for smart phone user. It helps in Monitoring the calories consumed by the users and use personal information and exercise system to recommend the user on weight loss.
Practice management and billing solution	Dr Chrono, (USA)	It is an Electronic health record (EHR) for iPad. In spite of being an EHR, it also provides appointment reminders and image capturing facilities.
Adherence problem for pharmaceutical brands	Vitality GlowCaps, (USA)	A pharmacy connected pill bottle which reminds the patient to take medication, give adherence description (report) to caregivers and automatically replenish prescription.

7.1.5. INDIA

mHealth revenue- 0.6 billion (US\$)

Percentage (%) share in overall market- 7.6%

Table 7.5: Healthcare applications employed in India

<u>Focus area</u>	<u>Applications</u>	<u>About Applications</u>
Online pharmacy	1 mg	It is an online pharmacy where a wide range of prescription drugs and over the counter medicines can be purchased online
Doctors app	Curofy	It is a medical engaging networking application for communication between doctors
Emergency support system	Lybrate	It is a search tool for nearby ambulance services, booking appointments. Information like lab reports, past prescriptions can be easily accessed by doctors.
Clinical decision support system	UpToDate	It basically answers all the clinical questions saving time of the doctors, enhances the medical knowledge and reduces the medical complications.
Health, wellness and fitness	mSwasthya-CDAC	Used for diabetes monitoring, vaccination alerts, hospital search, monitoring of the patients.
Doctor appointments booking	Practo	Used for appointment booking for the doctors, consult with doctor, ordering medicines online, reading articles or booking a test.

7.2. Objective 2:

Data Analysis:

Number of Nurses	87
Number of Doctors	52
Total number of respondents	139

- 1.) Familiarity amongst study group (i.e. Doctors and nurses) with healthcare applications and Mobile medical devices was found to be high. About 71 % (37 out of 52) Doctors and 63.2 % (55 out of 87) of nurses said they were familiar the different healthcare applications and mobile health devices in the market as opposed to about 29% (15 out of 52) doctors and 36.8% (32 out of 87) who were not familiar with them.

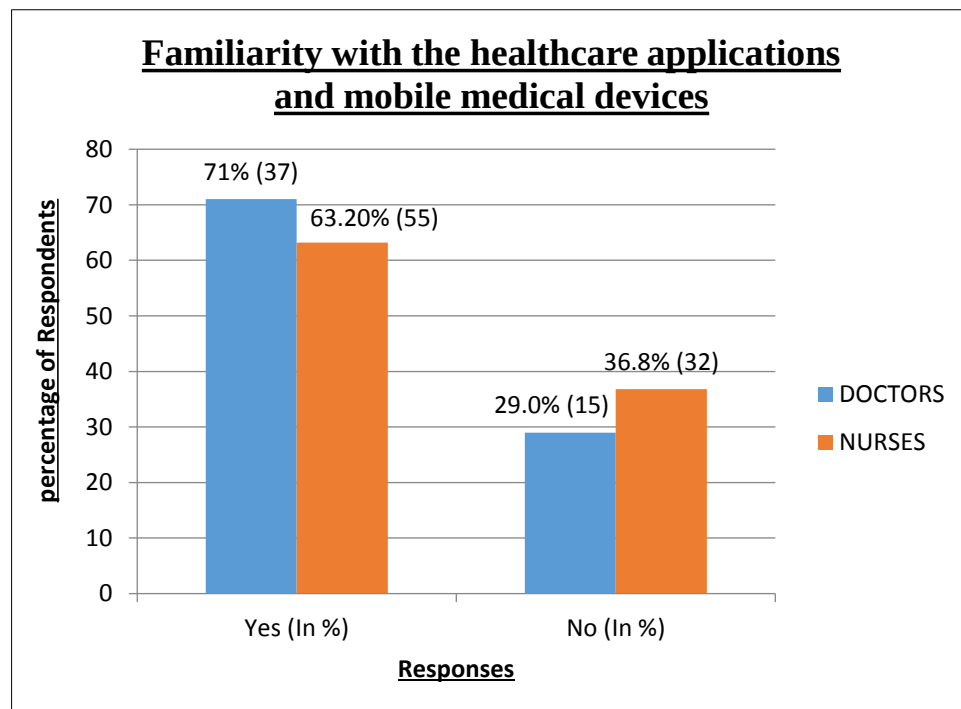
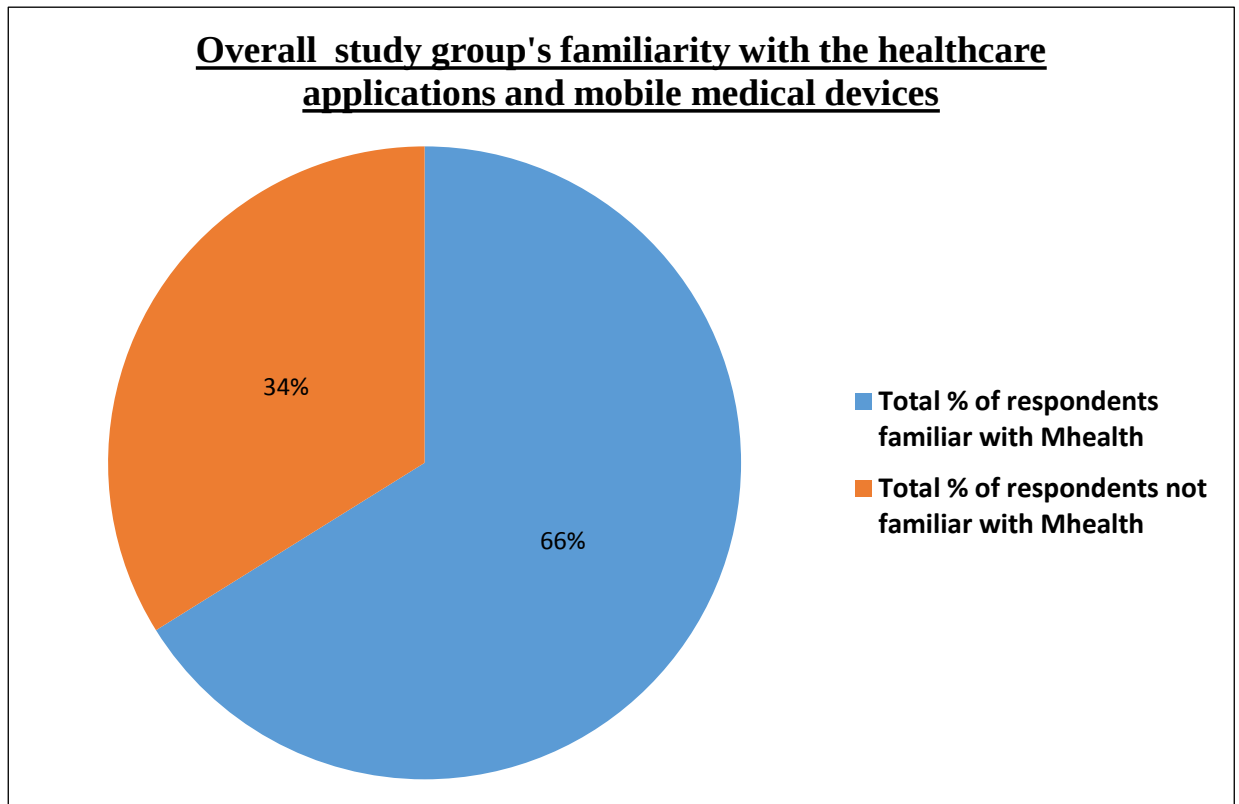


Figure 7.1: Familiarity with the healthcare applications and mobile medical devices

In total about 66 % of the study group were familiar the different healthcare applications and mobile health devices whereas in contrast 34% of the study whole were not familiar with the



same.

Figure 7.2: Overall study group's familiarity with the healthcare applications and mobile medical devices

2.) Knowledge amongst doctors and nurses about mHealth applications for quality improvement was found to be average. About 48 % of both doctors (25 out of 52) and about 48% nurses (42 out of 87) said that the use of Mobile health platform can improve the quality of healthcare whereas about 37% of Nurses (33 out of 87) and 35% of doctors (18 out of 52) said that mHealth can improve the quality of healthcare, only up to a certain extent.

About 17% of the doctors (9 out of 52) and about 14 % of the nurses (12 out of 87) said that the use of mHealth has no role in the improvement of quality of healthcare

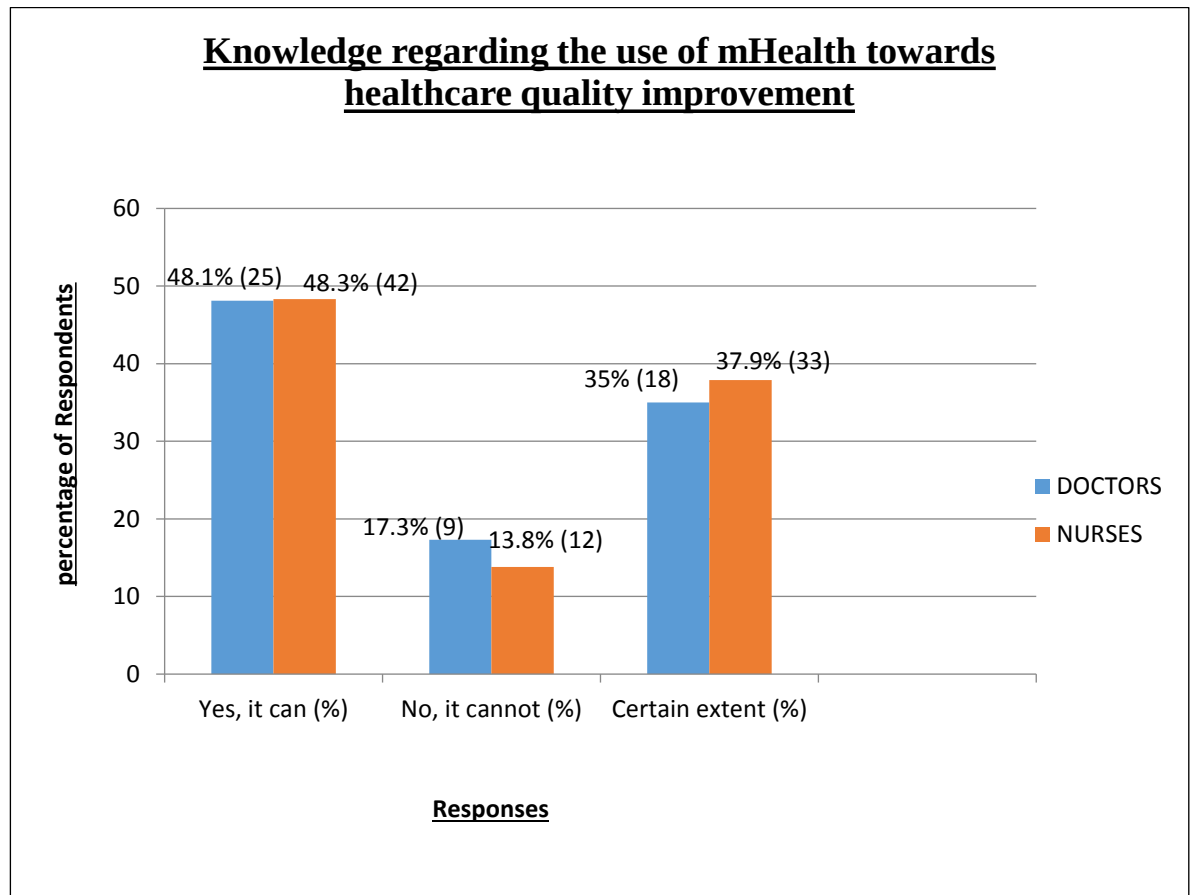


Figure 7.3: Knowledge regarding the use of mHealth towards healthcare quality improvement

3.) The understanding of the various mobile medical devices and health applications amongst Physicians and Nurses was found to be moderate. About 25 % doctors and (13 out of 52) and 23 % of nurses (20 out of 87) have a high understanding of the various health apps and mobile medical devices.

44.2% of doctors (23 out of 52) and 39% of nurses (34 out of 87) have a moderate understanding of such applications. 27% of doctors (14 out of 52) and 16 % of nurses (14 out of 87) said that they have a low understanding of such applications and mobile medical devices. Very few i.e. 1.9% of the doctors (1 out of 52) and 9.2% of the nurses (8 out of 87) said they have no understanding of such healthcare applications and mobile medical devices.

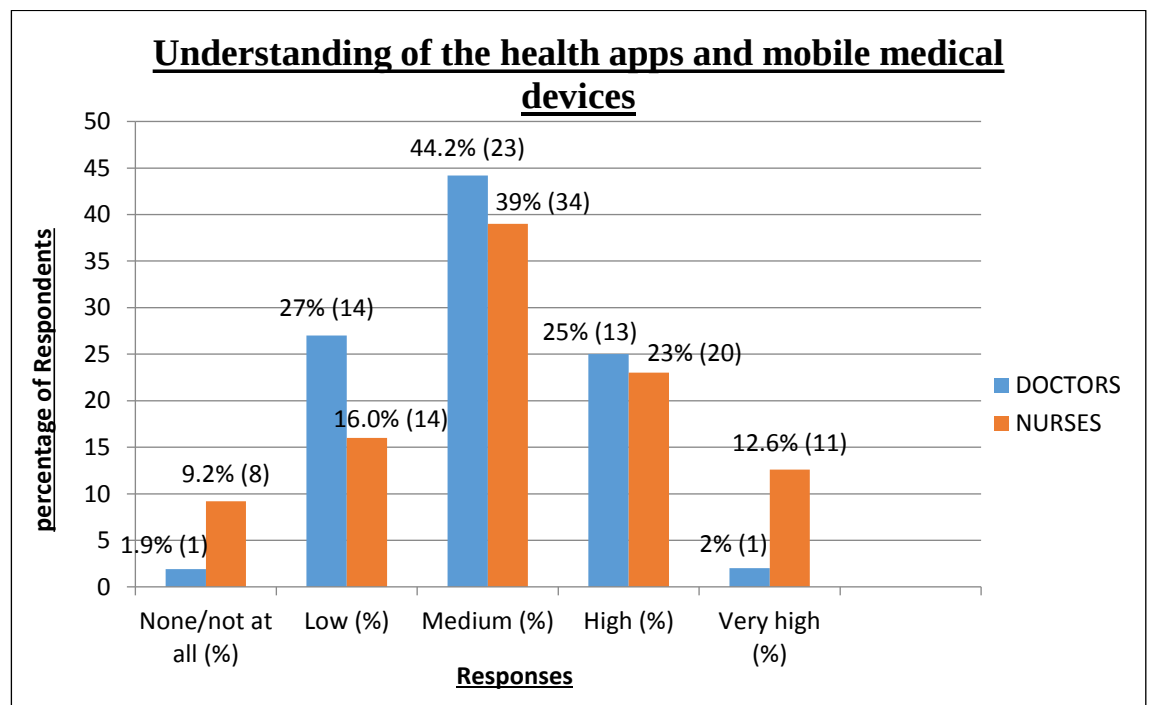


Figure 7.4: Understanding of the health apps and mobile medical devices

- 4.) About 40% (21 out of 52)) doctors and 46% (21 out of 87) Nurses felt that use of mobile medical devices and healthcare applications would make the process of healthcare delivery hassle free, while 38.5% (20 out of 52) doctors and about 39% (34 out of 87) Nurses said that it may help up to a certain extent. However, about 21.2% (11 out of 52) doctors and 14.9% (13 out of 87) of the nurses said that these healthcare applications and mobile medical devices cannot make the process of healthcare delivery hassle-free.

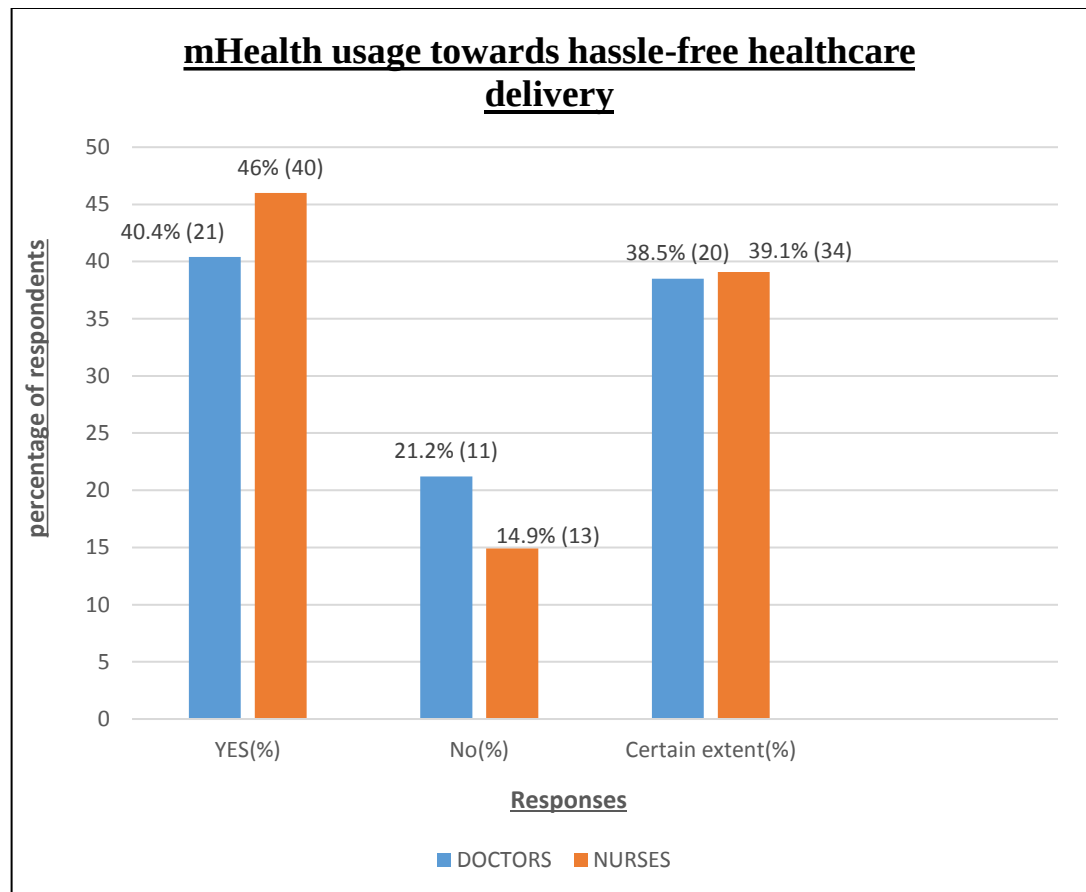


Figure 7.5: mHealth usage towards hassle-free healthcare delivery

- 5.) The safety and privacy of using mHealth for the healthcare purpose was mostly found to be moderate. About 27% (14 out of 52) of the doctors and 25% (22 out of 87) nurses

felt that the mHealth safety and privacy level was high. Then about 46% (24 out of 52) of the doctors and 52% (45 out of 87) of nurses said that the privacy level was medium. About 25% (13 out of 52) doctors and 14.9% (13 out of 87) nurses said that the level of safety and privacy in using mHealth was low.

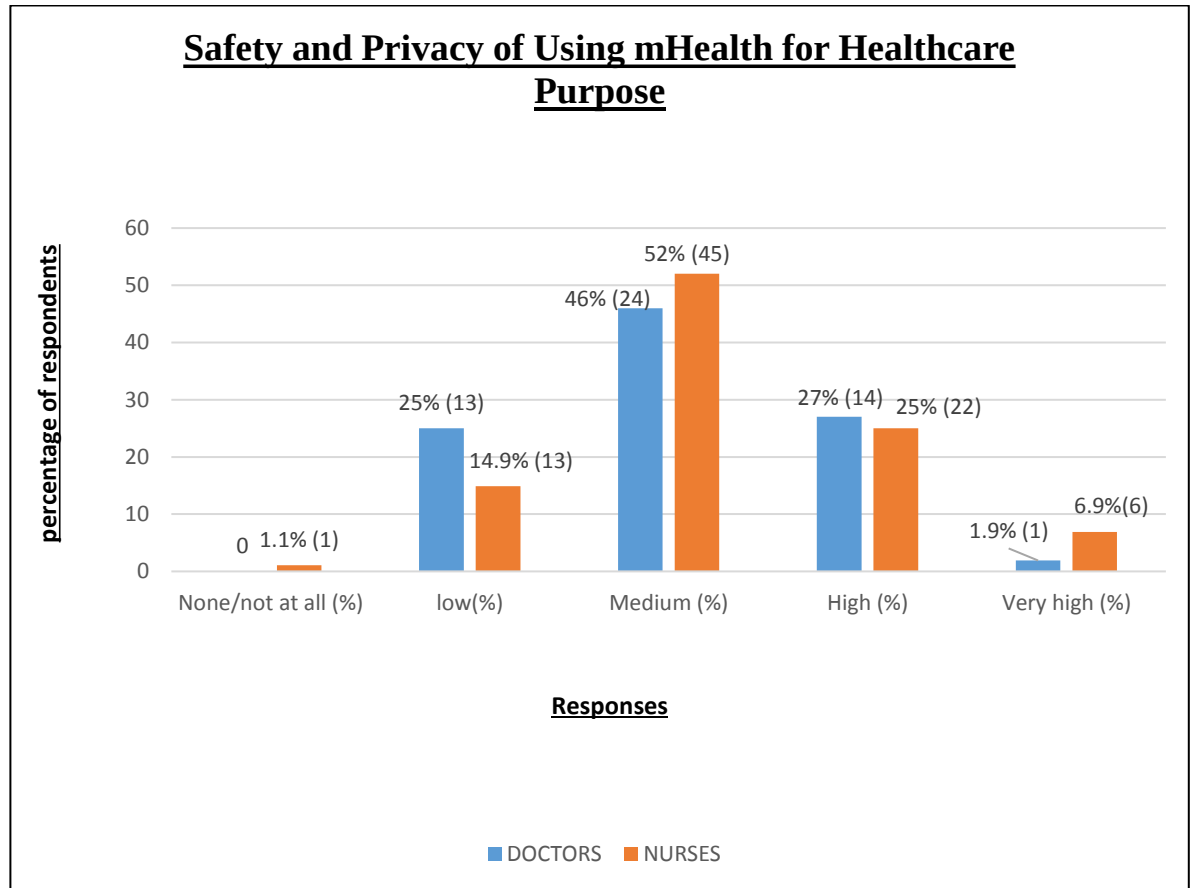


Figure 7.6: Safety and privacy of using mHealth for healthcare purpose

6.) The awareness of the healthcare applications among the doctors was found to be more than the medical mobile devices.

About 79% (41 out of 52) doctors and 45 % (39 out of 87) nurses were aware about the different healthcare applications available in the market.

Similarly, 21% (11 out of 52) of the doctors and 55% (47 out of 87) of the nurses were aware about the various medical mobile devices used in the healthcare industry.

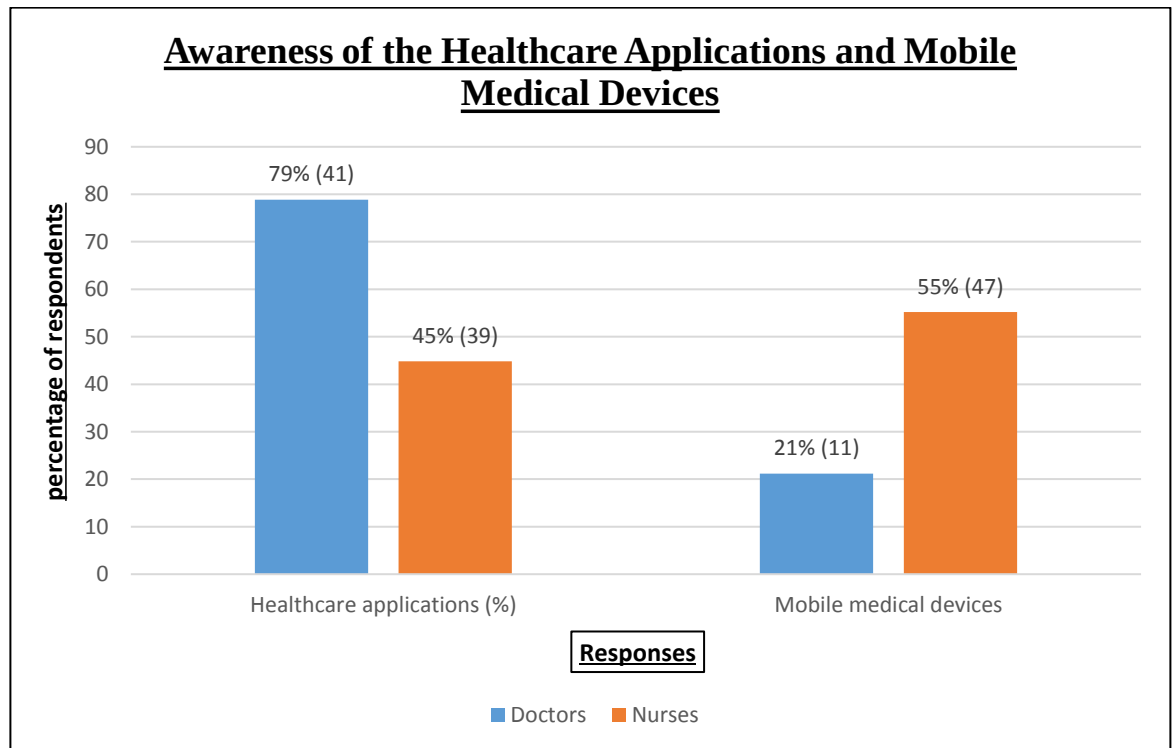


Figure 7.7: Awareness of the healthcare applications and mobile medical devices

7.) The importance of mHealth in the workplace was mostly found to be moderate. About 32.7% (17 out of 52) doctors and 20.7% (18 out of 87) nurses considered that the mHealth usage in the workplace was important. About 36.5% (19 out of 52) doctors and 51.7% (45 out of 87) nurses said that importance level was medium. Whereas 17.3% (9 out of 52) doctors and 14.9% (13) nurses said that the importance of mHealth in workplace was low. Very few i.e. .2.3% (2) nurses said that there is no importance of mHealth in the workplace.

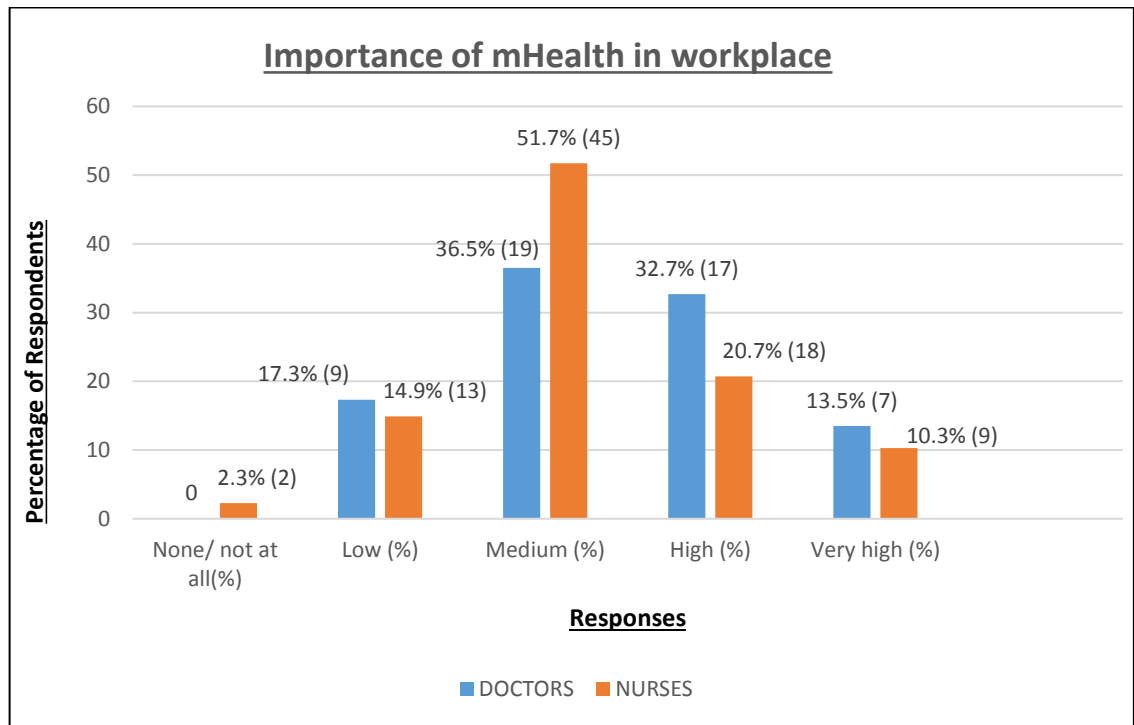


Figure 7.8: Importance of mHealth in workplace

8.) Regarding the opinion about the need of healthcare applications and mobile medical devices in our daily life, it was found that about 40% (21 out of 52) of the doctors said that it was highly needed in our daily life, while about 44% (23 out of 52) said that the need was medium. Very few i.e. 11.5% (6 out of 52) said that the importance of M-health was low in our daily life.

Similarly, among the Nurses, it was found that around 32% (28 out of 87) said it was highly needed in our daily life, about 7% (6 out of 87) said the importance was very high; while about 41% (36 out of 87) said that the need of M-health in daily life was medium, 18.4% (16 out of 87) of the nurses said that it holds low importance in our daily life.

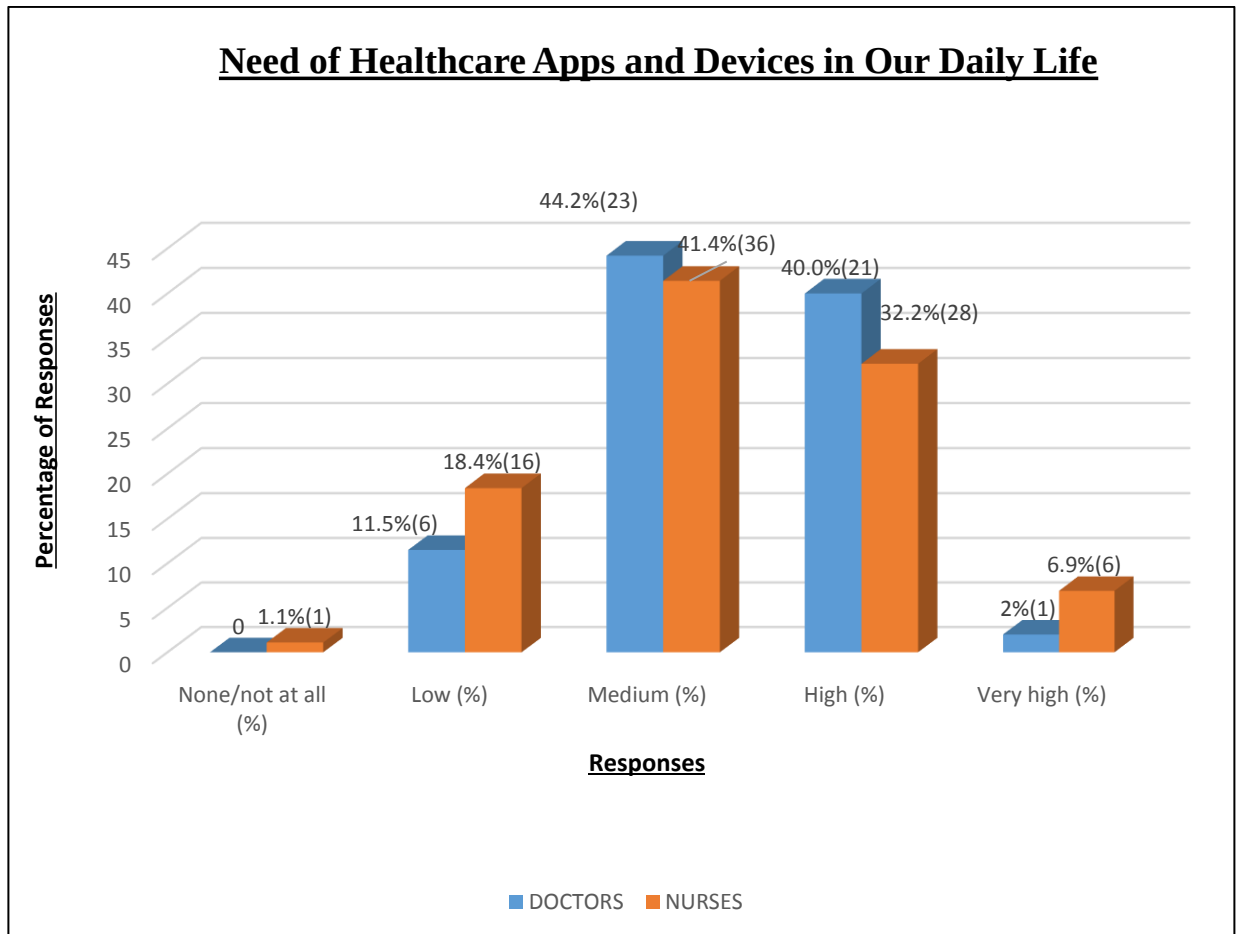


Figure 7.9: Need of Healthcare Apps and Devices in Our Daily Life

9.) 61.5% (32 out of 52) doctors and 36.5% (19) nurses said that the use of mHealth has proved beneficial for the purpose of healthcare delivery. While, 11.5% (10 out of 52) doctors and 88.5% (77 out of 97) nurses said that mHealth has no benefit for the healthcare professionals.

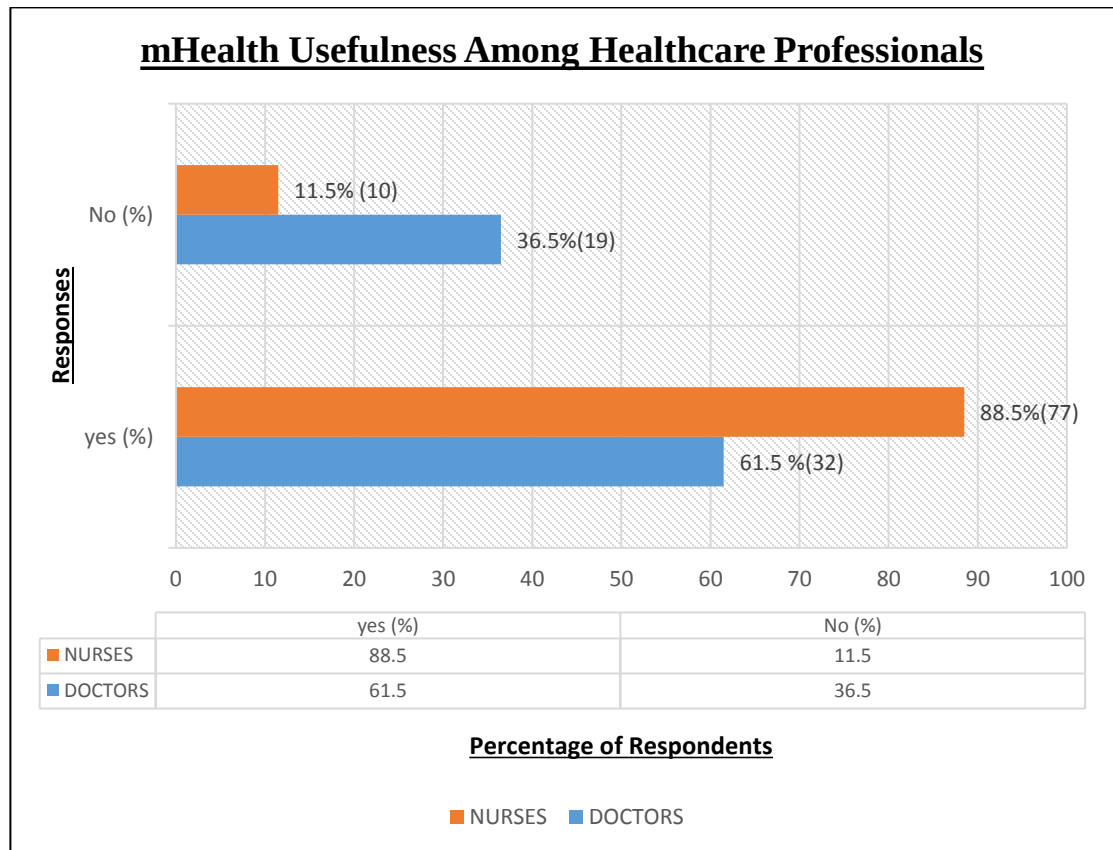


Figure 7.10: mHealth usefulness among healthcare professionals

So, finally it was found that about 87% (109) of the study group (including Doctors and Nurses) said that the use of mHealth was found to be beneficial for them whereas about 26% (29) of the study group said that it was not beneficial for them.

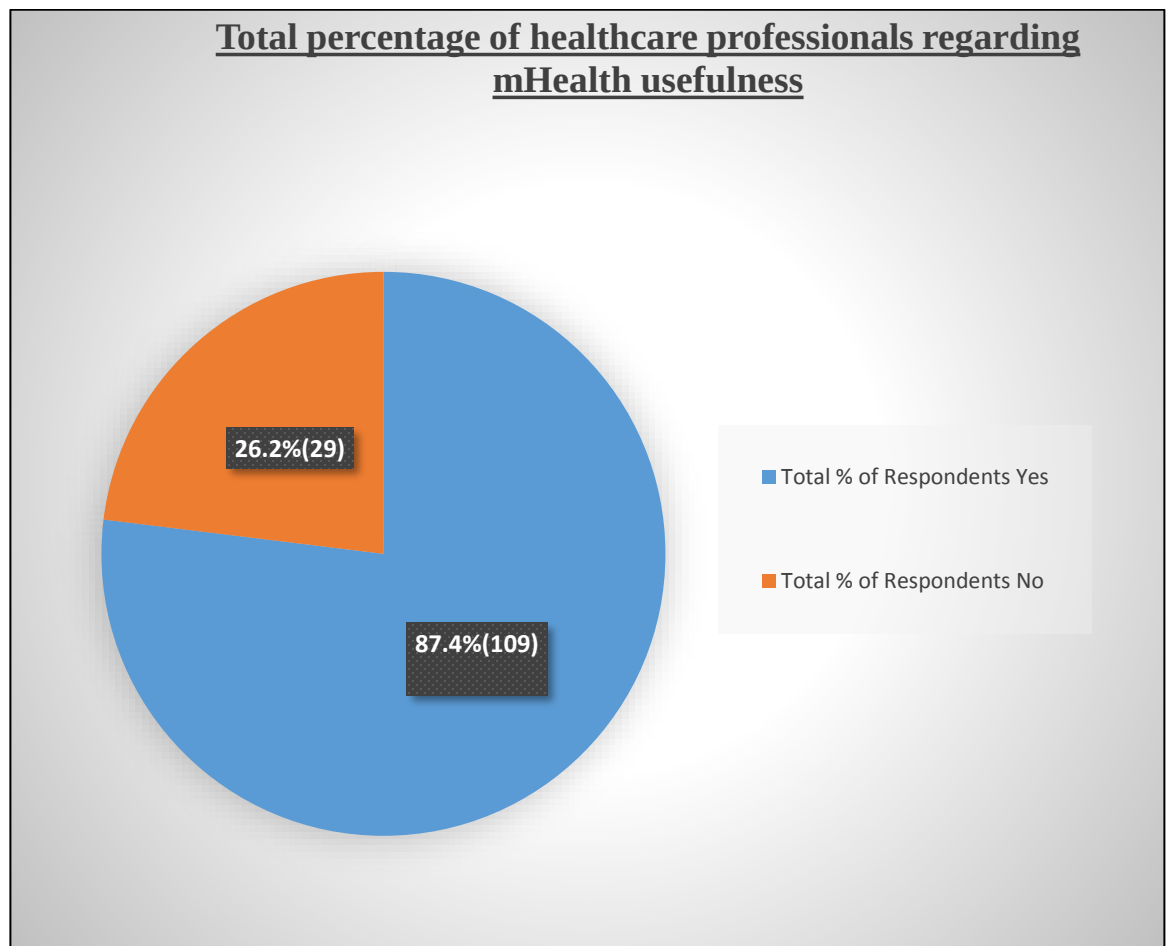


Figure 7.11: Total percentage of healthcare professionals regarding mHealth usefulness

10.) With respect to the practice of using any kind of healthcare applications or personal digital assistants (PDAs) amongst the nurses and doctors, it was found that about 56 % (29 out of 52) Doctors said that they had used some kind of personal digital assistants and healthcare applications in their work setting, whereas 44% (23 out 52) said they had not used any of the apps or devices yet.

Similarly, among the Nurses; about 54% (47 out of 87) said they had used them and 46 % (40 out of 87) said they had not used any PDAs or applications in their organization yet.

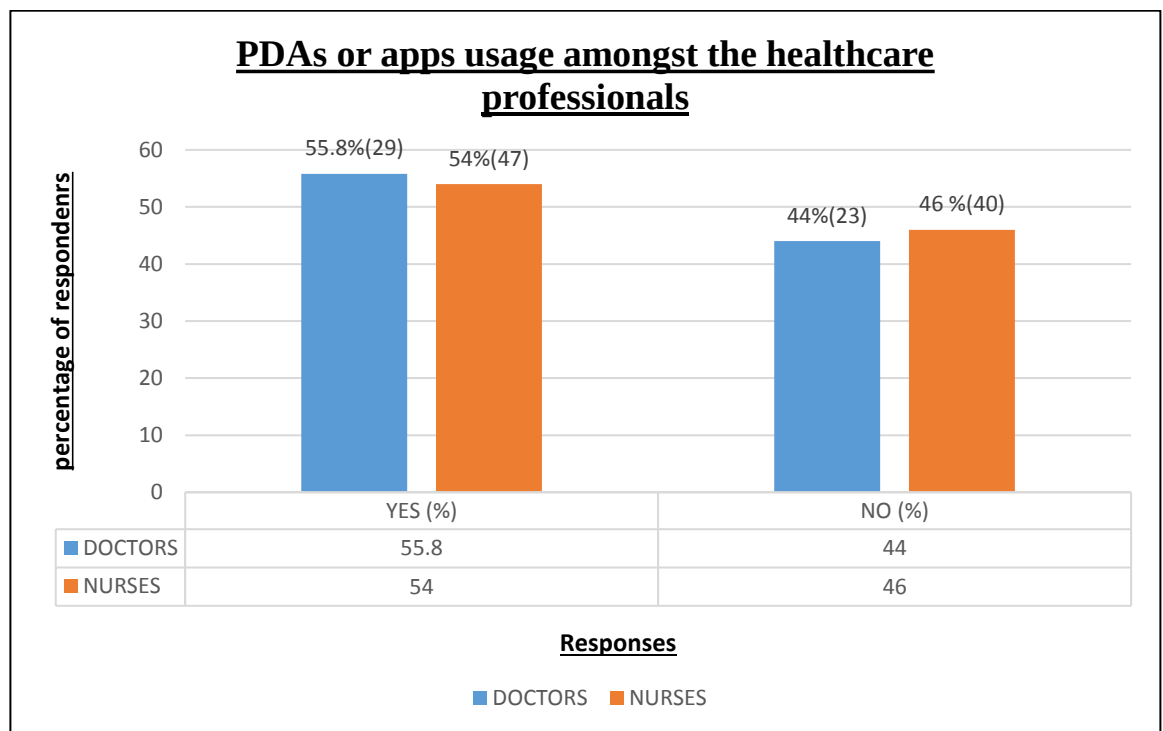


Figure 7.12: PDAs or apps usage amongst the healthcare professionals

Out of the total respondents, it was found that about **62% (76)** of the study group had used some kind of application or device in their work setting whereas about 51% (63) have not used any device or application.

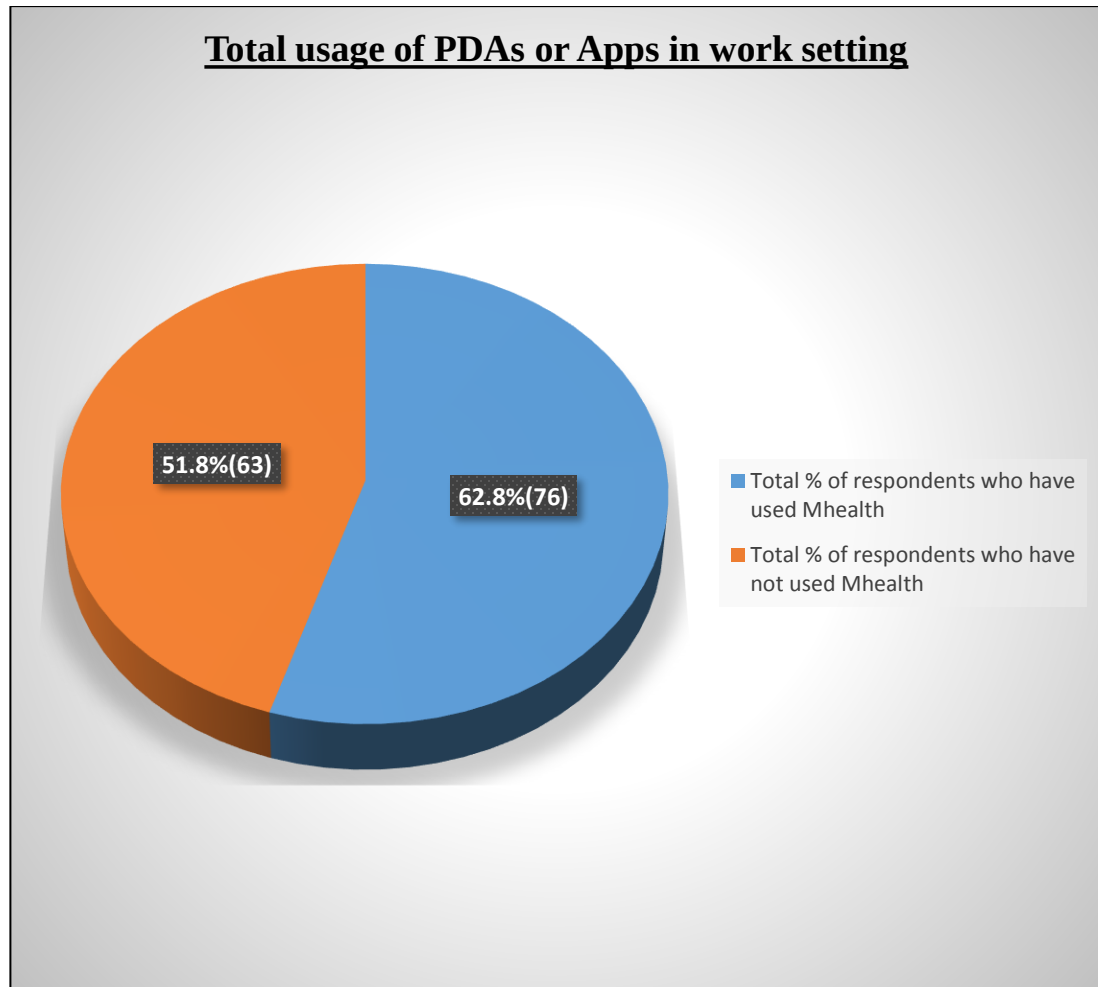


Figure 7.13: Total usage of PDAs or Apps in work setting

11.) Following were the purposes of using mHealth by the healthcare professionals. 24.1% (7 out of 29) doctors said that they use mHealth mostly for reference purpose such as medical guides, textbooks etc. while 24% (7 out of 29) said they use it for clinical purpose. About 21% (6 out of 29) of the doctors used it for scheduling appointments and 13.8% (4 out of 29) doctors used it for storing and transferring information.

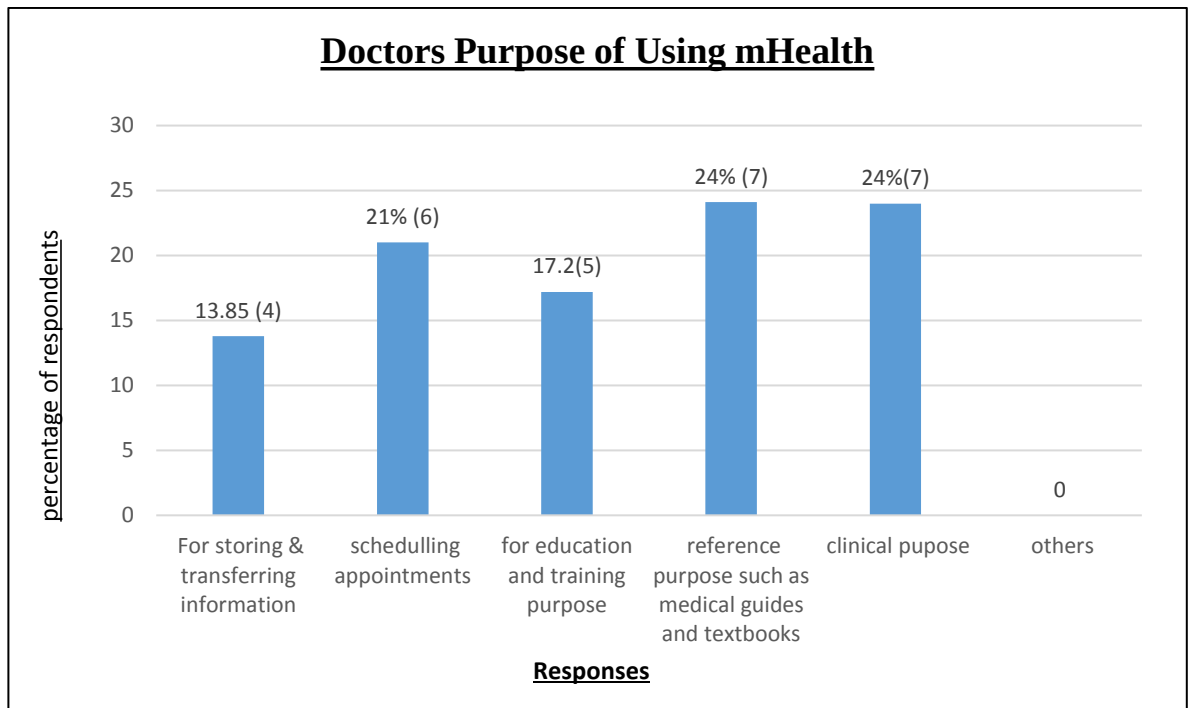


Figure 7.14: Doctors purpose of using mHealth

Most of the nurses i.e. 66% (31 out of 47) were found to be using mHealth for education and training purpose. About 51% (24 out of 47) nurses used it for storing

and transferring information. 27.7% (13 out of 47) of nurses used for clinical purpose while 12.8% (6 out of 47) nurses used it for scheduling appointments

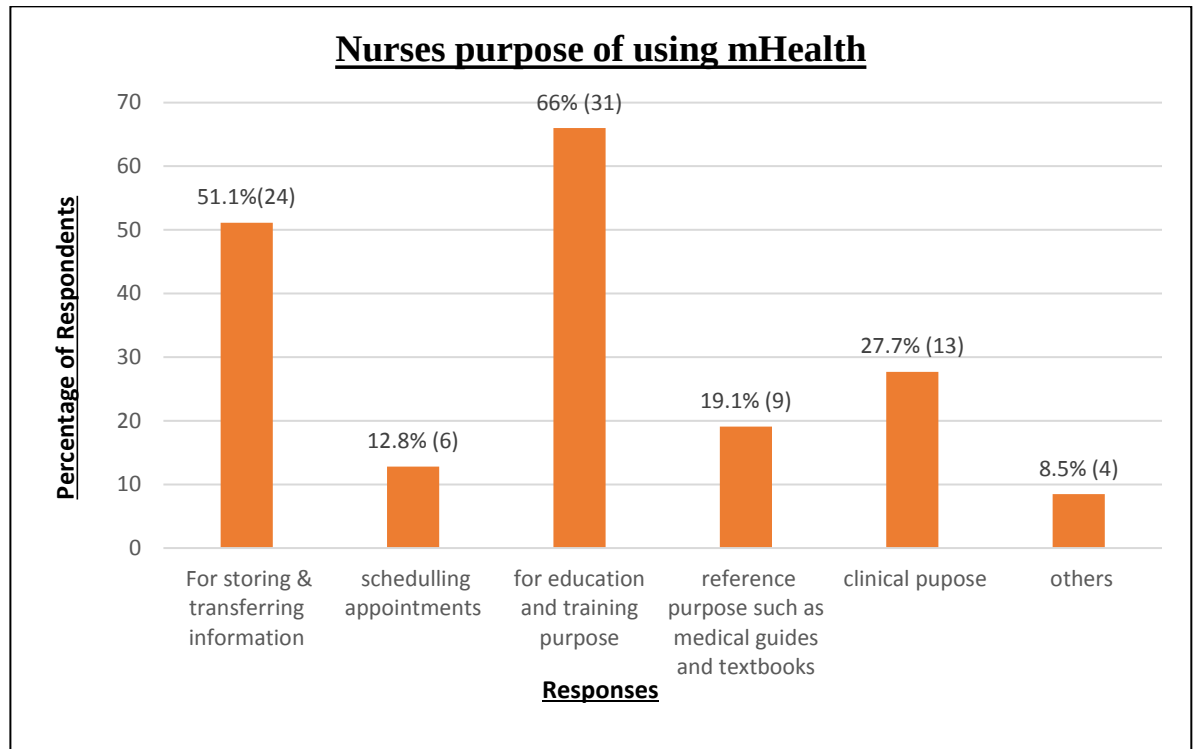


Figure 7.15: Nurses purpose of using mHealth

12.) The frequency of using mHealth among the study group (who had used some kind of device or application in their organization) was found to be rare i.e. 33% of the doctors (17 out of 29) and 36% (31 out of 47) nurses said they had used rarely in their work setting.

33% (17 out of 29) doctors and 25% (22 out of 47) nurses said they have used mHealth on a daily basis, while 27% (14 out of 29) doctors and 26% (23 out of 47) nurses have used on a weekly basis.

Very few doctors i.e. 7.7% (4 out of 29) and 12.6% (11 out of 47) nurses said they have used mHealth on a monthly basis.

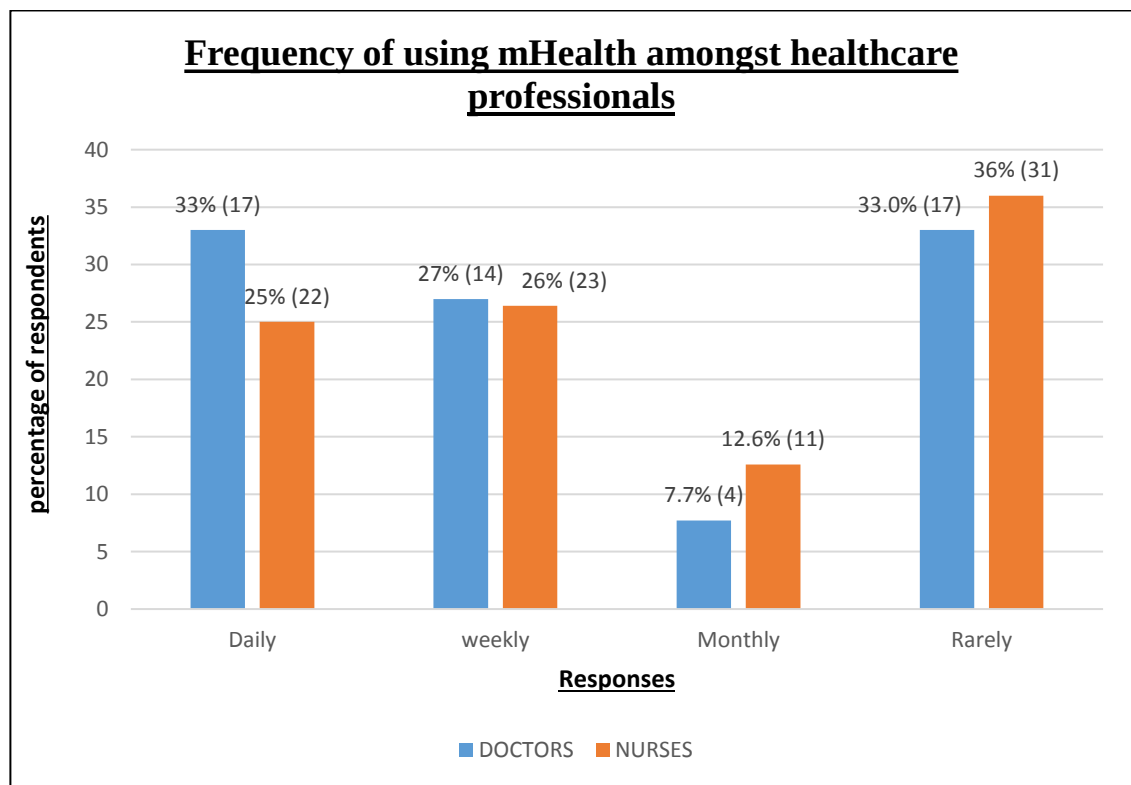


Figure 7.16: Frequency of using mHealth amongst healthcare professionals

13.) When asked to the study group, whether they had received any sort of formal or informal training prior to use of any kind of medical devices or applications in their current organization, it was found that, about 40.4% (21 out of 52) doctors said that they were given some sort of formal or informal training while about 59.6% (31 out of 52) of them said they did not receive the same.

Likewise, among the Nurses; it was found that 41.4% (36 out of 87) had been given some kind of training while majority i.e. 58.6% (51 out of 87) were not given any training.

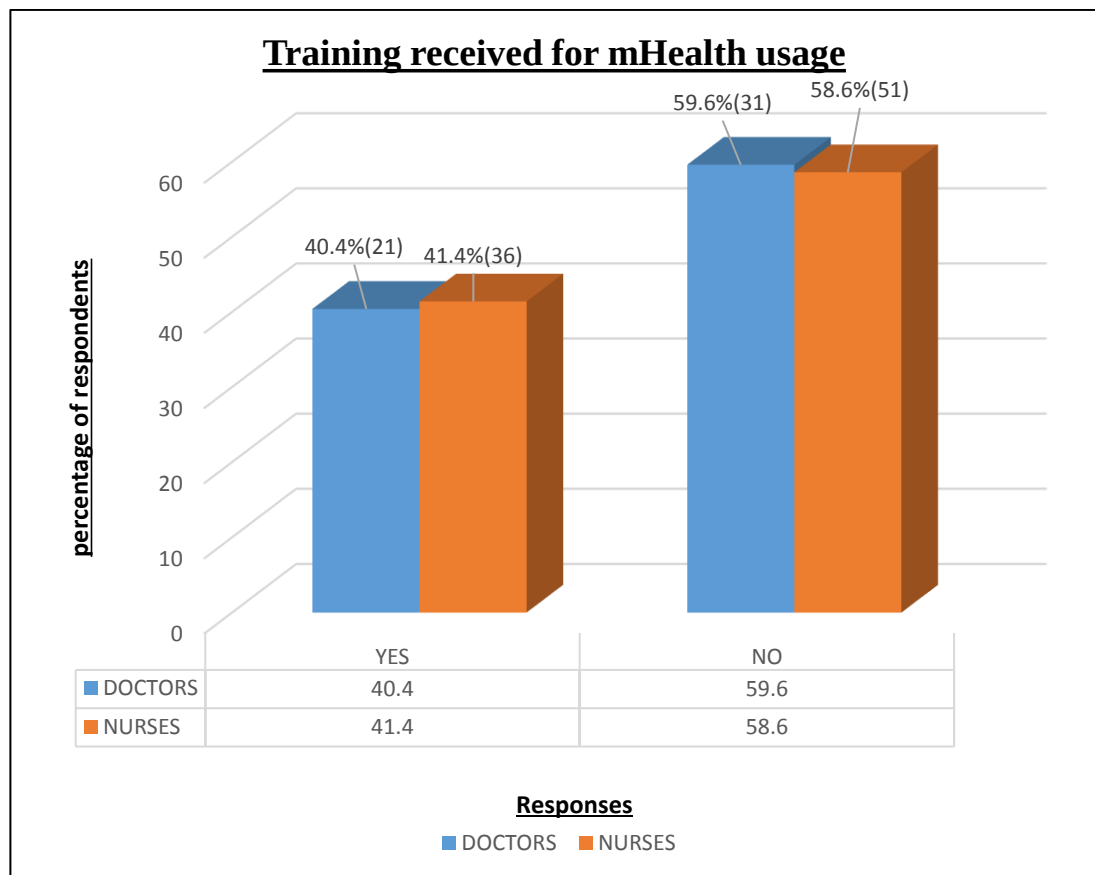


Figure 7.17: Training received for mHealth usage

So, from the total population; it was found that **46.9% (57 out of 139)** of the healthcare professionals had been given either some form of formal or informal training in their organization regarding the usage of Mobile medical devices or the applications.

While **67.7% (82 out of 139)** of the healthcare professionals said they were not given any type of training prior to the use of medical devices and healthcare applications in their organization.

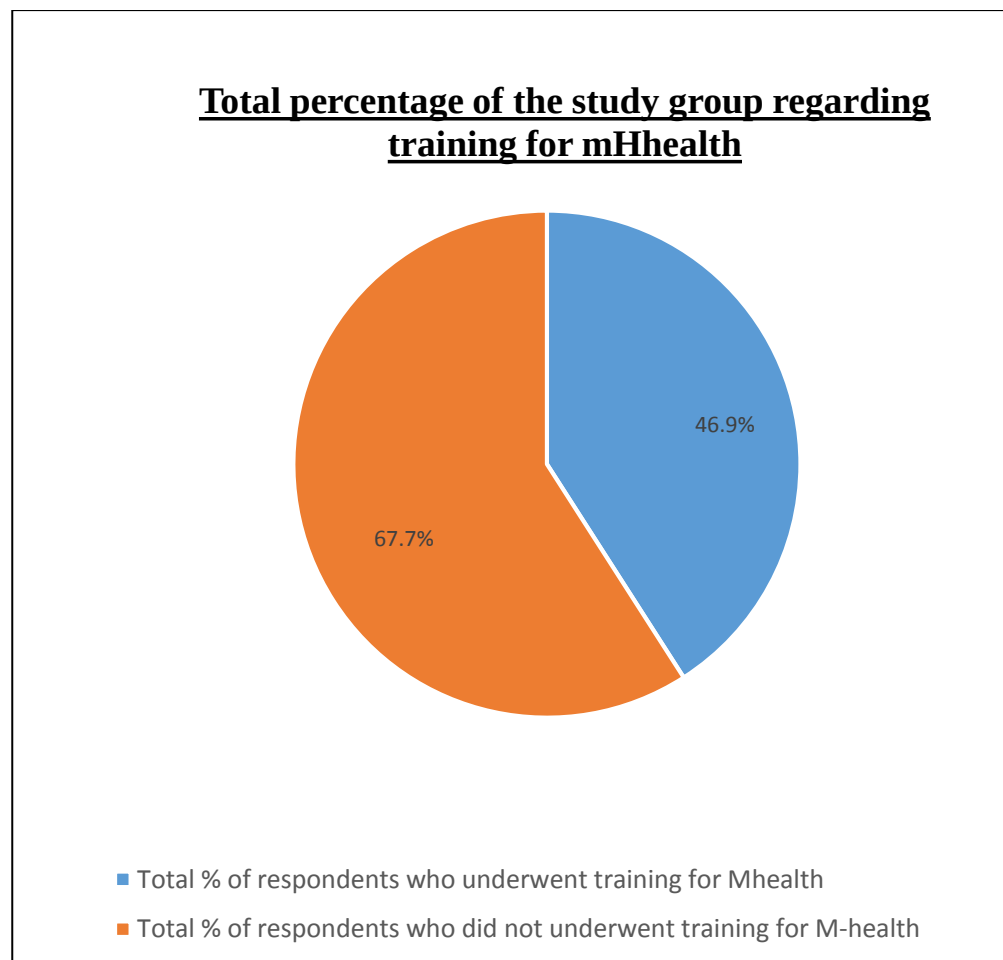


Figure 7.18: Total percentage of the study group regarding training for mHealth

14.) The level of comfort of using mHealth among the healthcare professionals was found to be mostly moderate. About 38% (20 out of 52) doctors and 18.4% (16) nurses said they were very comfortable with the usage. 34.6% (18 out of 52) doctors and 50.6% (44 out of 87) nurses said their level of comfort was medium.

About 25% (13 out of 52) doctors and 18.4% (16 out of 87) nurses said that their level of comfort for using mHealth was low. Very few nurses i.e. 6.9% (6 out of 87) said that they were not at comfortable with the usage of same.

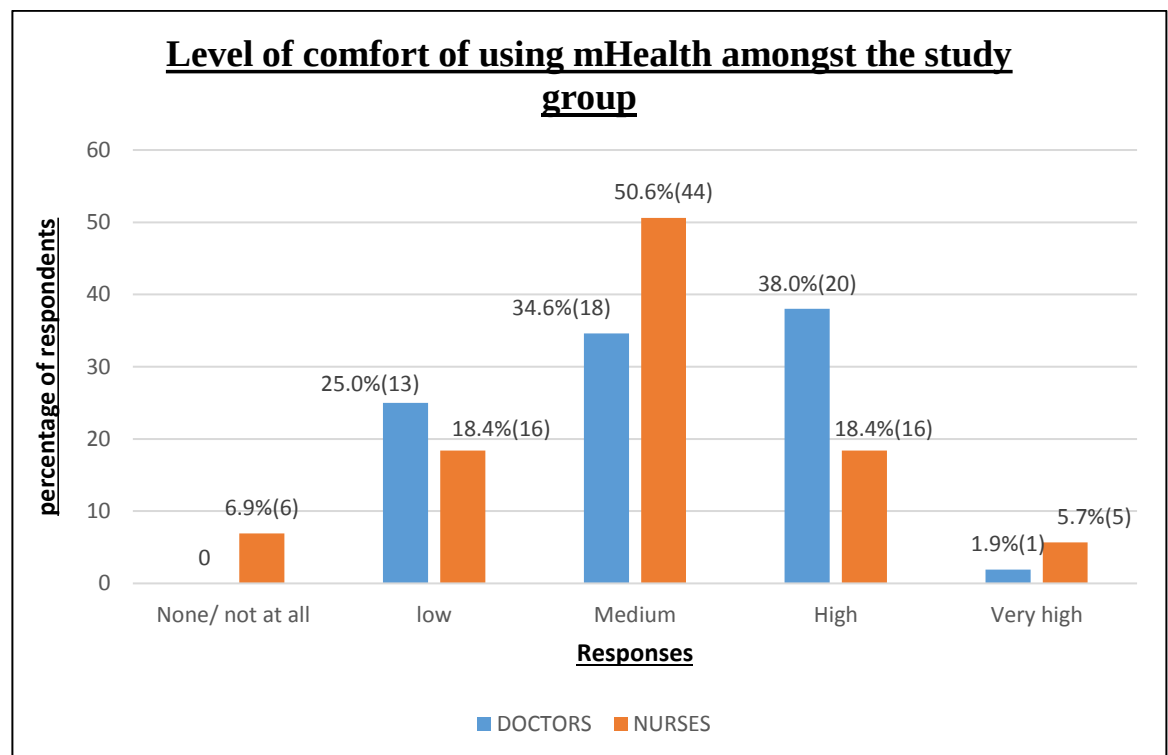


Figure 7.19: Level of comfort of using mHealth amongst the study group

15.) When asked about the issues or problems faced by the doctors in using mHealth, it was found that majority of the doctors i.e. about 38.5% (20 out of 52) faced some kind of network and connectivity related issues. About 29% (15 out of 52) doctors said they had encountered data security and privacy related problems. While 9.6% (5 out of 52) of the doctors felt that cost was a concern for them, whereas 9.6% (5) said that data was inaccurate by using M-health. Also, 8% (4 out of 52) felt that M-health was not user friendly and 5.8% (3 out of 52) had faced some other problems.

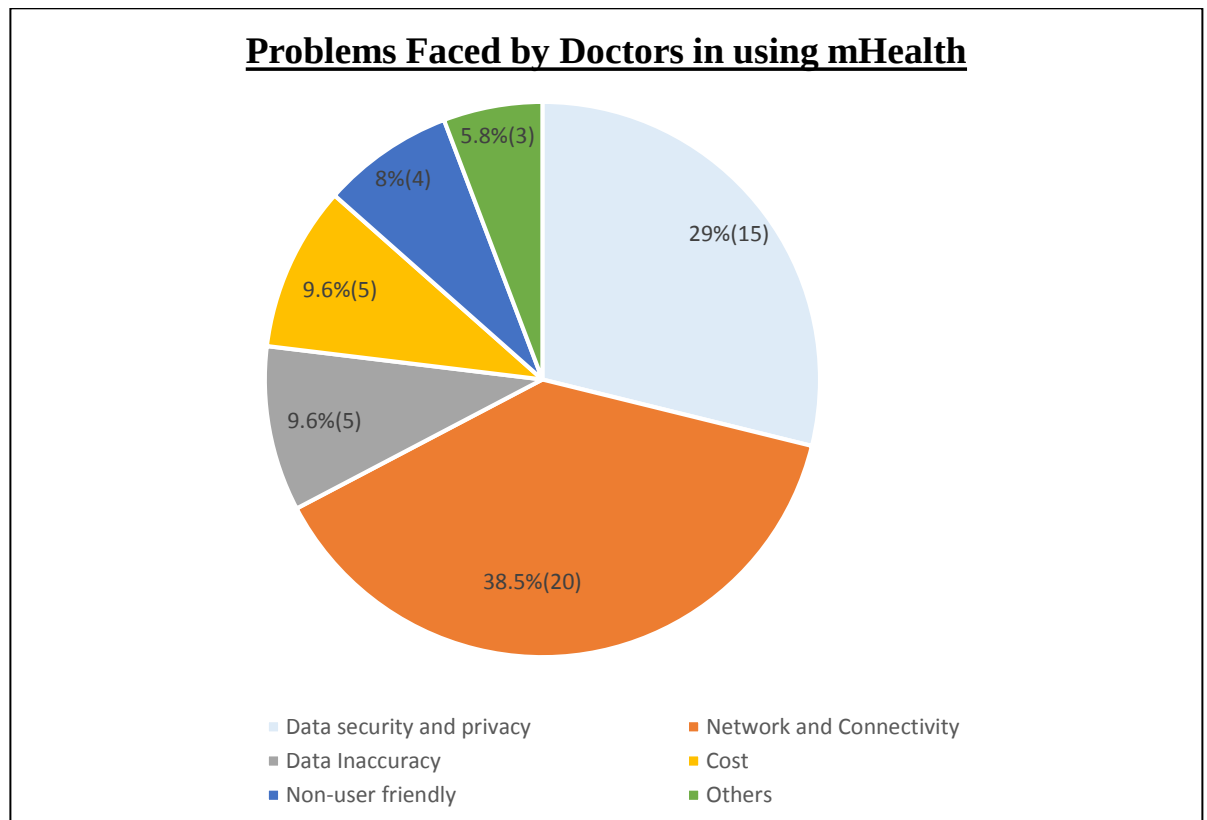


Figure 7.20: Problems Faced by Doctors in using mHealth

Among the Nurses, mostly the issue were related to the connectivity and network i.e. 36 % (31 out of 87), followed by insufficient knowledge 23% (20 out of 87). About 9% (8 out of 87) of the nurses faced device related issues while 8% (7 out of 87) felt that the mHealth platform was not user friendly and 5.7% (5 out of 87) had some kind of other problems.

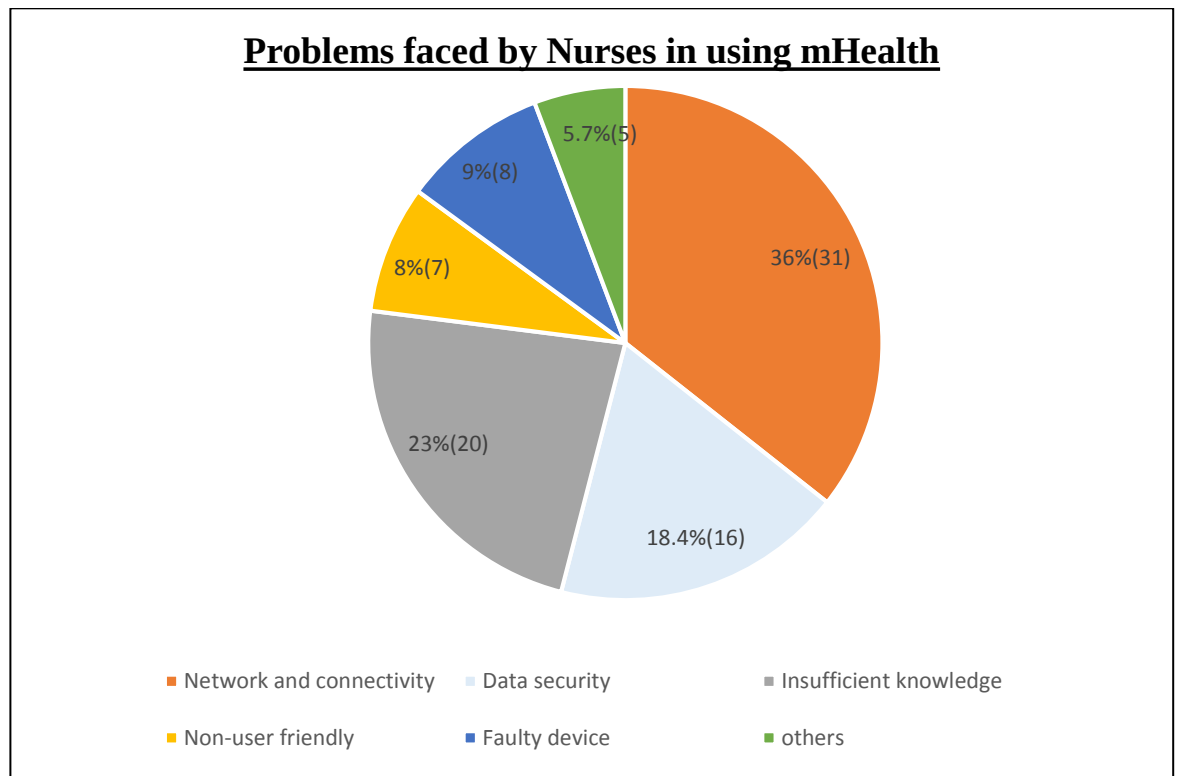


Figure 7.21: Problems faced by Nurses in using mHealth

16.) When asked the healthcare professionals that how likely are they to use mHealth in the near future. The following answers were received.

About 50% (26 out of 52) doctors and 44.8 % (39 out of 87) nurses said that they would possibly use mHealth in the future. 27% (14 out of 52) doctors and 34.5% (30 out of 87) nurses said they would likely use the same.

19.2% (10 out of 52) doctors and 18.4% (16 out of 87) nurses said they would very likely use it in the near future.

Very few i.e. 3.8% (2 out of 52) doctors and 2.3% (2) nurses said they would not like to use mHealth in the near future.

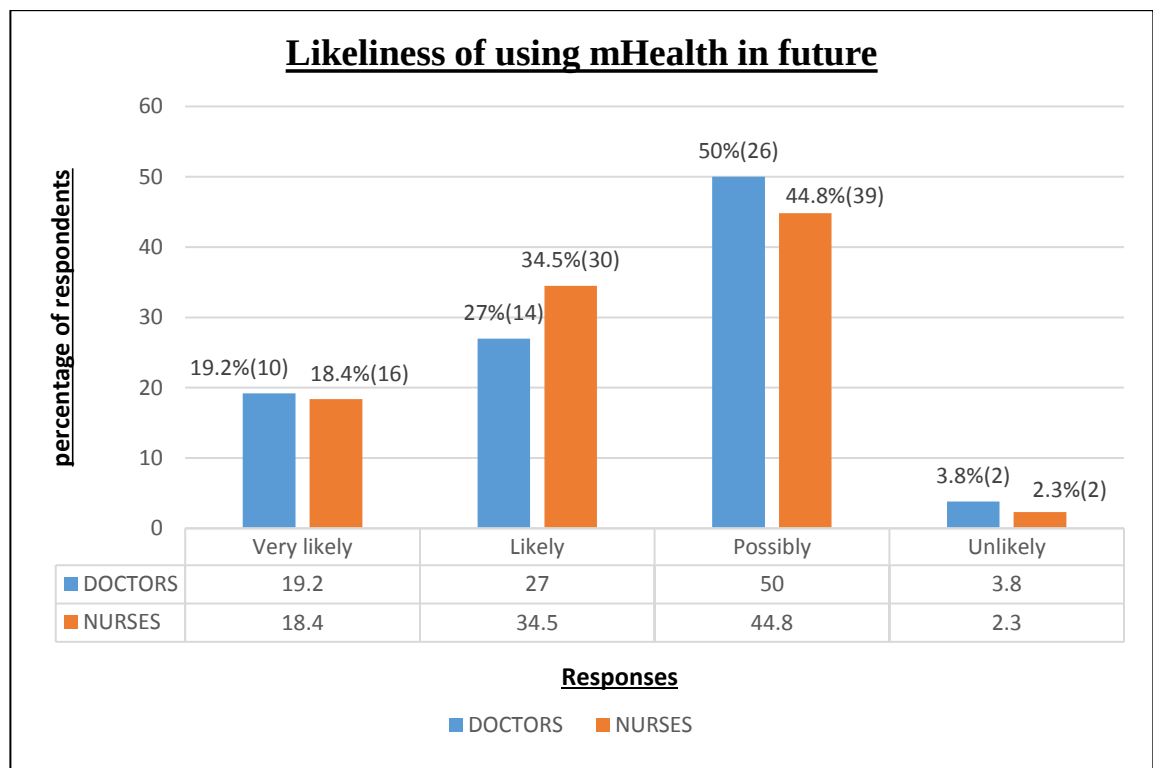


Figure 7.22: Likeliness of using mHealth in future

7.3. Objective 3

From the secondary analysis of different healthcare applications and mobile medical devices, in different articles and journals, the following strengths, weakness, opportunities and threats were analysed.

7.3.1. SWOT Analysis

<u>STRENGTHS</u> 1. Medication/ treatment compliance 2. Improved information access 3. Enhanced patient care 4. Improved data accuracy 5. Increased efficiency and time saving 6. Healthcare cost reductions 7. patient engagement	<u>WEAKNESSES</u> 1. Not building to Regulatory specifications 2. Lack of information control 3. Security of health information. 4. Cost of implementation
<u>OPPURTUNITIES</u> 1. Can strengthen the health system 2. Allows healthcare services to get in touch with more people across the world 3. Innovative technology 4. Digital literacy 5. Real time health monitoring 6. Chronic disease management	<u>THREATS</u> 1. Authentication threats- misusing of patient identities 2. No federal legal protections against the disclosure of data 3. No evaluation of the usability of the medical applications 4. Access threats- unauthorized access to PHI.

7.3.2. Global mHealth market

According to a report by Zion market research, the global mobile market had USD 11.47 billion in the year 2014 and is expected to arrive at USD 102.43 billion by the year 2022, rising at a CAGR of at 32.5% amid 2016 and 2022.³⁹

The mHealth market is in its promising stage which is expected to give considerable revenues along with growing awareness. Penetration of mobile phones in the medical and healthcare segment has had a major impact on the overall healthcare industry.

Currently mobile penetration rate is more than 100% in developed market and is predicted to increase in developing market such as Africa, Asia-Pacific, and Latin America. In addition, increasing exposure to smart phones alongside 3G and 4G networks will eventually increase the use of mHealth in most of the sectors, especially in the healthcare systems.

The expansion of mHealth device market is mostly attributed to the elevated revenue generated from blood glucose monitoring device, cardiac monitoring device and BP monitors, which together accounted for 5/7th of the global mHealth devices revenue in the year 2015. This is attributed to the rising number of cardiac and BP disorders. BP monitors is the maximum revenue generating segment in global market for mHealth devices, whereas, blood glucose monitoring device is the greatest growing segment. Cardiac monitors market is eventually the third largest segment increasing with a CAGR of 37.5% during the projected period.⁴⁰

7.3.3. Value chain of global mHealth market

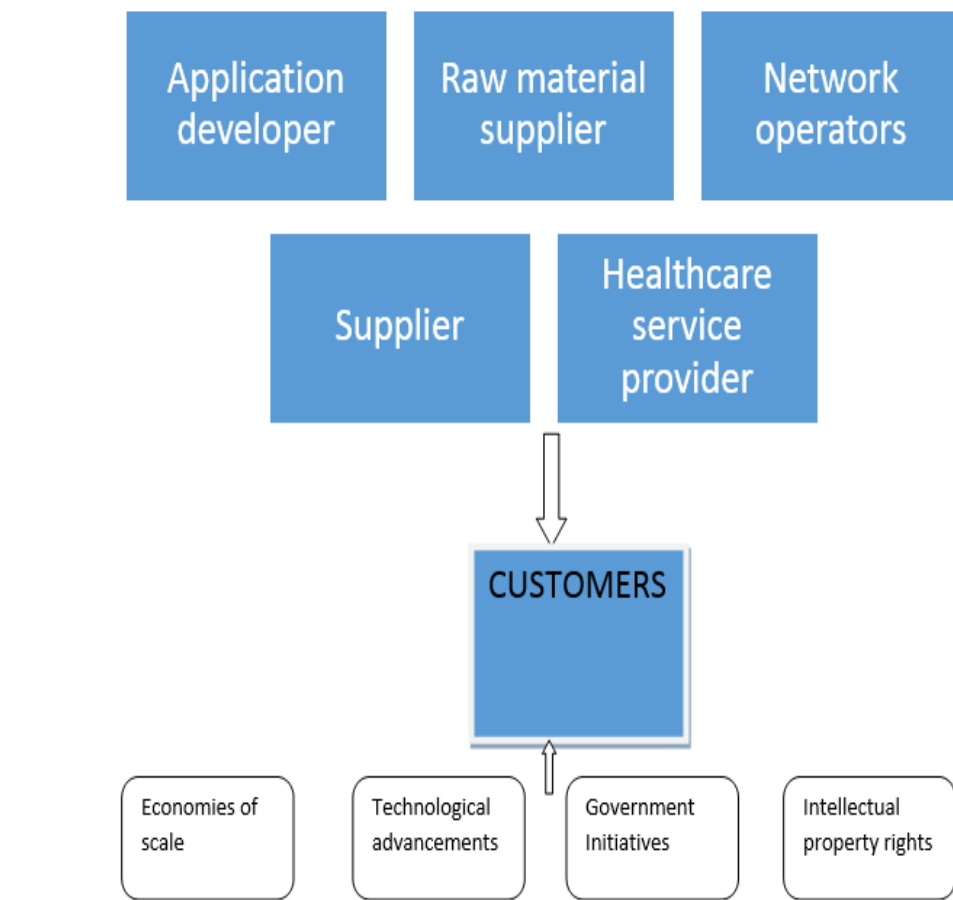


Figure 7.23: Value chain of global mHealth market

(Redrawn from Franco. J. "mHealth market- global opportunity analysis and industry forecast, 2014-2020" May 2015)

7.3.4. mHealth market key segments:

Table 7.6: mHealth Market Key Segments

By Devices	By Services
• BP monitoring device	• Monitoring services
• Blood glucose meters	• Diagnosis services
• Pulse oximeter	• Treatment
• Neurological monitoring device.	• Prevention
• Sleep and apnea monitors	• Wellness and healthcare system strengthening solutions
• Wearable health sensor device & heart rate meters	
• Others	

Table 7.7: mHealth Market Key Segments

By Stakeholders		By Application	
• Device vendors		• Cardiovascular diseases	
• Mobile operators		• Diabetes	
• Healthcare providers		• Respiratory diseases	
• Application players		• Neurological diseases	
		• Others	

Table 7.8: mHealth Market Key Segments

By Geography			
North America	Europe	Asia-Pacific	LAMEA
US	Germany	Australia	Latin America
Canada	France	Japan	Middle East
Mexico	United Kingdom	China	Africa
	Italy	India	
	Russia	Rest of Asia-pacific	
	Rest of Europe		

7.3.5. Challenges of mHealth

The various challenges of mHealth or mobile health are as follows:

- A. In developing world, although due to mobility, it has become easy to access mHealth, but still there are network challenges persists which reduces the effectiveness.
- B. A third generation i.e. 3G network is required for the voice recognition application used in mobile phones which could be of great importance in providing the healthcare where the illiteracy levels are high. But, this kind of network is currently unavailable in resource-poor countries.^{41,42}
- C. An actual barrier to mHealth implementation is the internet which is either unreliable or expensive in many developing countries. As a result, various countries are unable to access the health information due to limited internet connectivity.
- D. Fourth, another obstacle is the cost of mHealth devices. While the medical mobile devices are affordable for many people in the developing countries, but still some are unable to afford them.⁴⁴
- E. There is a lack of needed knowledge, availability of relevant training and the lack of required education are also the important challenges for people in the developing world for using mHealth.⁴⁴
- F. Security and privacy of information is another important challenge. Some personal devices, such as the PDAs and smart phones have very less security features that cannot restrict unauthorized access to private information or they have complicated security mechanisms which decrease the accessibility of the device itself .⁴⁵
- G. Another important challenge in the developing country is to develop mHealth apps based on the centre of population requirements and resources. Generally, in the developing countries, rural and urban areas have different resources which may influence the mHealth structure and content.⁴⁶
- H. The existing policy environment and the deficiency of mobile phone usage guidelines plus the standards also impact the development of the mHealth project in the developing world.⁴⁷

8. DISCUSSION

There is a diversity of different devices and apps used according to the major necessities: for example majority of applications in Africa focus on improving the efficiency of healthcare workers as well as awareness preventions e.g. Medic mobile, Weltel etc. commonly used in Africa, In Asia Pacific, mostly provide health information to the patients along with Personal assisted devices/mobile-phone based services that help the remote healthcare workers e.g. Apollo telemedicine, Health line Telenor etc. As far as Europe is considered, Patient treatment along with remote monitoring solution constitute approximately 60% of the total mobile health deployments in Europe; e.g: Simap, Amcom etc. In countries like US and Canada the system is already developed much and just needs more strengthening along with monitoring and treatment of patient e.g: MyFitnessPal, Dr. Chrono etc.

Heading towards the direct responses received, it was derived that the familiarity amongst the study group i.e. doctors and nurses are found to be high. The knowledge amongst doctors and nurses about mHealth applications for quality improvement was found to be average but the understanding of the various mobile medical devices and health applications along with its safety and privacy amongst doctors and Nurses was found to be moderate. The awareness of the healthcare applications among the doctors was to be more than the medical mobile devices but the need felt by them is partially high as well as moderate. While most of the doctors felt that mHealth is important for the healthcare delivery but for majority of the nurses did not feel the same. But finally it was found that 87% (majority) of the study group (including Doctors and Nurses) said that the use of mHealth was found to be beneficial for them.

Summarizing the strengths and weaknesses, it was found that, there are more strengths and opportunities of different healthcare applications and mobile medical devices used. The mHealth market is in its promising stage which is expected to give considerable revenues along with growing awareness. The penetration of mobile phones in the medical and healthcare segment has had a major impact on the overall healthcare industry, while the expansion of mHealth device market is mostly attributed to the elevated revenue generated

from devices like blood glucose monitoring device, cardiac monitoring device and BP monitors. Overall the market strengths and opportunities are quite high for these devices.

To summarize, although mHealth has vast opportunities in the developing world, still there are many significant barriers and challenges which persists with the same. These type of issues seriously needs consideration and well-organized involvement from the government side, different types of stakeholders who has an interest in this matter and finally the healthcare providers who will also get the benefit of this cutting-edge technology.

9. LIMITATIONS OF THE STUDY

Although the study aimed its objectives, but there were certain unavoidable limitations of the study.

- The time frame was less to conduct the whole study.
- Because of the above limitation, the study was conducted on a small size of population.
- There was no permission to go each and every hospital in Bengaluru for data collection.
- In few of the instances, the respondents were given less time for the interview.

10.RECOMMENDATIONS

Based on the survey conducted among the healthcare professionals, the recommendations are as follows:

- Since only about 40% of both the doctors and nurses received the training for the mHealth usage, so there is a need for strong education and training among them so as to develop skills for using mHealth technology more effectively.
- Developing hospital specific branded applications which can be used by both physicians and nurses and also evaluation of the same by developing a certification system for these medical applications.
- Currently there is an absence of mHealth platform usage guidelines and standards for the growth of the mHealth projects. So, there is a need for mHealth technical architecture and data exchange standards as well.
- About 38% of the healthcare professionals faced some kind of network related issues, where the internet connection is unreliable. So, a stable data connection, either a 3G or Wi-Fi is the need of the hour so that the process of healthcare delivery is not hampered anytime.
- Almost 36% of the study group has expressed concerns about the mHealth data security and privacy. Hence, security protocols must be maintained so that the data is protected against a breach. As because, some applications and devices have limited security features which cannot restrict the unauthorized access. So, simple process for data security should be applied first for the participants at the start of the study such as passwords, numerical-pin, and pass-phrase followed by locking protocols on phones and tablets or enable remote data wiping.

11. CONCLUSION

mHealth is a very significant platform which are being used by the healthcare professionals and as their uses and features expand, they will be more widely incorporated into every aspect of clinical practice. There is a vital need for using mHealth to overcome various healthcare issues. Although the healthcare applications and medical devices provides the healthcare professionals with so many benefits, they are currently used without having a proper understanding of the associated benefits and risks. With period, the mHealth apps will be used by all individuals regardless of their qualification level or social classes. They will distantly monitor their health information, refer their doctors, see their extraordinary quality health related pictures and videos each and every time they want, and use the valued applications to regulate their health at home which will result in improved communities in the developing world.

12. ETHICAL CONSIDERATIONS

The respondent's informed consent was taken before filling of the questionnaire and the interview. The nature and purpose of the study was communicated to them. It was mentioned to the respondent that he/she can withdraw anytime during the filling of questionnaire and interview according to his/her wish. It was also mentioned that the confidentiality and privacy of the information will be kept maintained and this data would be solely used for dissertation purpose.

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Appendix 1

A SURVEY QUESTIONNAIRE FOR KNOWLEDGE, ATTITUDE AND PRACTICE OF mHEALTH TOWARDS HOSPITAL SETTINGS IN BENGALURU

(Please note that the data collected is purely confidential and only for the dissertation purpose)

NAME:

ORGANIZATION/ WORK SETTING:

AGE:

QUALIFICATION:

PROFESSION:-

1. Are you familiar with the different healthcare applications and mobile medical devices in the market?

YES

NO

☐☐

2. Do you think the use of Mobile health platform can improve the quality of healthcare?

Yes, it can
extent

☐

No, it cannot

☐

to a certain

☐

3. How would you rate your understanding of the various health apps and mobile medical devices?

None/not at all

☐

Low

☐

Medium

☐

High

☐

Very High

☐

Comments (Please mention in brief your reason of giving such rating):

4. Do you think the Usage of the Mobile devices and applications can make the process of healthcare delivery hassle-free?

Yes, it can
extent

☐

No, it cannot

☐

to a certain

☐

5. As per your opinion, how will you rate the safety and privacy of using mobile technology for the purpose of healthcare?

None/not at all

☐

Low

☐

Medium

☐

High

☐

Very High

☐

6. Which Mobile health application or device are you aware of?

7. How do you rate the importance of mHealth or mobile health in your workplace?

None/not at all

☐

Low

☐

Medium

☐

High

☐

Very High

☐

8. As per your understanding, to what extent is there a need for these Medical devices and applications in our daily life?

None/not at all

☐

Low

☐

Medium

☐

High

☐

Very High

☐

9. In your opinion, is the mHealth platform beneficial for the healthcare professionals?

YES

NO

☐☐

10. Have you ever used the personal digital assistants (PDAs) or any other health apps in your organization?

YES

NO

☐☐

11. If yes, then for what purpose you have used them.

- a) For storing and transferring information
- b) Scheduling appointments and meetings.
- c) For education and training purpose
- d) For reference purpose such as medical guides and textbooks
- e) For clinical purpose
- f) Others: please specify_____

12. How frequently you use them in your work setting?

On a daily basis

Weekly

Monthly

Rarely

☐☐☐☐

13. Did you get any kind of formal or informal training for usage of these Mobile medical devices or running of Healthcare applications?

YES

NO

☐☐

14. What is your level of comfort for using these devices?

None/not at all

Low

Medium

High

Very High

☐☐☐☐☐

15. What are the problems have you encountered while usage of these devices? (Please specify in brief)

16. If you have not used mobile health, how likely are you to use them in the future?

Very likely
unlikely

likely

possibly

☐☐☐☐

Comments:
