International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2020): 7.803

Evaluating the State of Healthcare and Innovations through Mhealth before & Post COVID-19 Era and the Obstacles to its Development

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Abstract: ***This research focuses on addressing the issue of whether there has been any advancement in the state of healthcare through mobile health before and after the COVID-19 pandemic that shook the world. Furthermore, it aims to investigate and discover the reasons for the lack of growth of mobile health technology in certain countries around the world. In addressing these issues, this work utilizes mainly secondary data analysis method by first comparing the state of mobile health technology and the other technological innovations in the healthcare system generally before the Cocis-19 pandemic to what now obtains. The findings of this study thus, reveal that COVID-19 served as a catalyst to several inventions and innovations in the mobile health space and healthcare in general, as all these were geared towards curbing and controlling the pandemic. Similarly, it further discovered that certain factors such as poverty, lack of technological advancement, and others play vital roles in hindering the spread of this technological advancement to specific countries worldwide.***

Keywords: mobile health, COVID-19 pandemic, technology

1. Introduction

To begin with, it is pertinent first to conceptualize some relevant terms in this work. On the one hand, mobile health (mHealth) refers to the use of mobile computing and communication technologies in health care and public health. " Thus, it is the practice of using technological devices such as phones and computers to address medical issues in a person and provide relevant medical assistance. This is quite different from the traditional means of healthcare, where individuals are required to go physically to hospitals, clinics, dispensaries, and other health facilities to receive medical assistance. Notable, mHealth can be seen as one of the laudable intersections between healthcare (medicine) and technology.

With the advancement of technology, mHealth has acquired much popularity in the medical space. Thus, there has now been the invention of a series of AI software and applications utilized to deliver medical services.

On the other hand, it is now common knowledge that the COVID-19 pandemic is a reality instead of persons' previously held conspiracy theories. As a result of the viral and contagious nature of the virus, the pandemic outbreak led to the loss of millions of lives across the globe. Thus, in a bid to control the spread of the virus, several laudable technological innovations have been recorded.

However, what remains unclear is whether such innovations trickled down into the administration of medicine and healthcare system in general, particularly mHealth, and the impediments leading to the development and innovations in mHealth and the healthcare system in general. Thus, despite the numerous materials and literature in the field of mHealth and COVID-19 innovations, there is little or no clarity both in the innovations which COVID-19 has brought to the practice of mHealth and the obstacles hindering the spread of these innovations. It is highly pertinent that clarity should be channeled to these areas. This is because doing so would determine whether technological progress is being made and the extent of the same if any. Furthermore, it would also identify the several barriers to the effective implementation of these innovations in specific countries around the world, which is a step to remedying the same.

2. Literature Survey

1) History and development of mHealth

Before the development of mHealth, what was in operation was the practice of traditional medicine, which involved patients physically coming to healthcare facilities to obtain medical attention and treatment. However, with the development of technology, particularly in medicine, coupled with the need for chronic disease prevention and management, among others, there was the rise of Electronic Healthcare (eHealth). For this work, it simply means "the use of emerging interactive technologies (e. g., Internet, CD-ROMs, personal digital assistants, interactive television and voice response systems, computer kiosks, and mobile computing) to enable health improvement and health care services. "

As the practice of eHealth began taking foundation and expanding, it started splitting up into specific branches, one of which became known as mHealth. Thus, mHealth became one of the specialized branches of eHealth that focuses on using mobile devices and computers to diagnose, prescribe, and treat patients. Some of the specific media adopted by mHealth technology include but are not limited to mobile phone text messaging to manage diseases such as diabetes, hypertension, asthma; mobile phone text messaging as an aid to smoking cessation, bodyweight loss, sexually transmitted infection prevention, and testing; PDAs

for data collection in healthcare and health research among others.

2) The outbreak of COVID-19 and the need to control the virus

The origin of the epidemic of the COVID-19 pandemic can be traced to Wuhan, China, where the pilot case was reported in December 2019. Because of the rapid spread of the virus and its high rates of casualties, the WHO declared it a pandemic on March 11, 2020. .

Considering its nature, COVID-19 is an acute respiratory disease that is caused by the coronavirus (SARS CoV-2), which weakens the immune system and has adverse health effects such as pneumonia, respiratory tract infection, organ failure, and may, in certain instances, lead to the death of the victim. The unique yet distressing thing about the virus is that the incidence kept growing at a geometric rate worldwide to the extent that hospitals and health personnel became overwhelmed. For instance, it was reported by the World Health Organization that as of December 28, 2020, the amount of confirmed COVID-19 cases worldwide had risen to about 281, 808, 270, out of which 5, 411, 759 casualties were recorded. There was no known cure or permanent treatment of the virus or an effective vaccine capable of controlling and preventing the virus from worsening the situation.

To this end, as a result of all these, various countries and organizations worldwide became desperate and began making alternative efforts to control the incidences and spread of the virus, which cut across multiple spheres of society. One of such notable efforts has been recorded in technology through specific innovations in mHealth and other advancements, as seen later in this work.

3. Problem Definition

Notwithstanding the plethora of literature, articles, and materials that exist in the field of healthcare, mHealth innovations and development, and COVID-19, respectively, a key area where minimal attention has been paid is to the significant role which the emergence of COVID-19 has played in leading to several laudable innovations in the healthcare system generally and in mHealth in particular. This means that several grey areas exist about the development in healthcare technology, and as a result, individuals hastily overlook the emergence of COVID-19 in facilitating such technological innovations. This would be the primary focus of this research article.

Similarly, it has become evident that the development in the healthcare sector is not uniform across countries of the world. While this has been established in specific research literature, the reasons have been mainly left unidentified and codified in a single academic piece. For instance, the technological development in developed countries is far more than that obtained in developing countries. Thus, this research will also trace the specific reasons for the limitation in the spread of such innovations and developments in the healthcare sector.

4. Methodology/Approach

This research utilizes a secondary data analysis approach, incorporating both quantitative and qualitative data analysis. This method is preferred because it is strongly believed that its results would be more authentic than sticking to one type of data study. Similarly, through the sifting and sorting of already carried out research, we can achieve objective and broader results.

1) Nature of Healthcare and mHealth before COVID-19

To begin with, it is pertinent to mention that the nature of mHealth and technological innovations before the outbreak of the virus in 2019 was developed to a large extent. For instance, Ventola (2014) reports that the following were some of the mobile applications used in healthcare:

Table 1: Medical apps for health care professionals

Information Management	
Evernote	Note-taking and organization
Notability	Note-taking and organization
iAnnotate	PDF viewer
GoodReader	PDF viewer
Box	Cloud storage and file sharing
Dropbox	Cloud storage and file sharing
Google Drive	Cloud storage and file sharing
Communication and Consulting	
Doximity	Social networking site for MDs
Reference and Information Gathering	
Epocrates	Drug and medical reference
Dynamed	Drug and medical reference
Skyscape/Omnio	Drug and medical reference
Micromedex	Drug reference
Dynamed	Medical reference
UpToDate	Medical reference
Medscape	Medical reference
Johns Hopkins Antibiotic Guide	Medical reference
Sanford Guide to Antimicrobial Therapy	Medical reference
Medpage Today	Medical news
Patient Management and Monitoring	
Diagnosaurus	Differential diagnosis

Pocket Lab Values	Laboratory reference
Lab Pro Values	Laboratory reference
Archimedes	Medical calculator
MedCalc	Medical calculator
Mediquations	Medical calculator
Calculate	Medical calculator
AHRQ ePSS	Screening and prevention tool
Medical Education and Training	
MedPage Today	Continuing medical education
QuantiaMD	Continuing medical education

Source:

Table 2: The six themes in mHealth

Theme	**Description**
Education and awareness	One-way communication system which incorporates the use of SMS.
Data access	Mobile phone and computer-based software to manage data of patients.
Monitoring and compliance	Multipurpose communication system used for observing health conditions such as diabetes, heart-related diseases, etc., appointments scheduling, amongst others.
Disease and emergency tracking	Mobile phone and computer-based software to monitoring diseases infection and tracking incidences of emergency.
Health information systems	Mobile phone and computer-based software which permits access to other mHealth-based software
Diagnosis and consultation	Specialized software capable of diagnosing illnesses in patients as well as connecting them to healthcare personnel.

Source:

Adopted from Vital Wave Consulting

2) Obstacles in the spread of technology in healthcare across countries

Table 3: Amount and Distribution of Total Biomedical Research and Development (BMRD) Funding, 1980 (in millions of 1975 US dollars)
Source: Institute of Medicine (US) Committee for Evaluating Medical Technologies in Clinical Use.

Washington (DC): National Academies Press (US) ; 1985

Country	BMRD Funding	Percentage of Total BMRD in all Countries
United States	5, 256	48.18
Japan	1, 523	13.96
West Germany	1, 271	11.65
France	712	6.53
United Kingdom	495	4.54
Italy	299	2.74
The Netherlands	257	2.37
Sweden	251	2.3
Switzerland	229	2.1
Canada	176	1.62
Belgium	122	1.13
Denmark	94	0.86
Australia	69	0.63
Spain	52	0.48
Norway	41	0.37
Finland	32	0.29
New Zealand	14	0.13
Portugal	10	0.09
Ireland	6	0.05

Source: Shepard and Durch (1984).

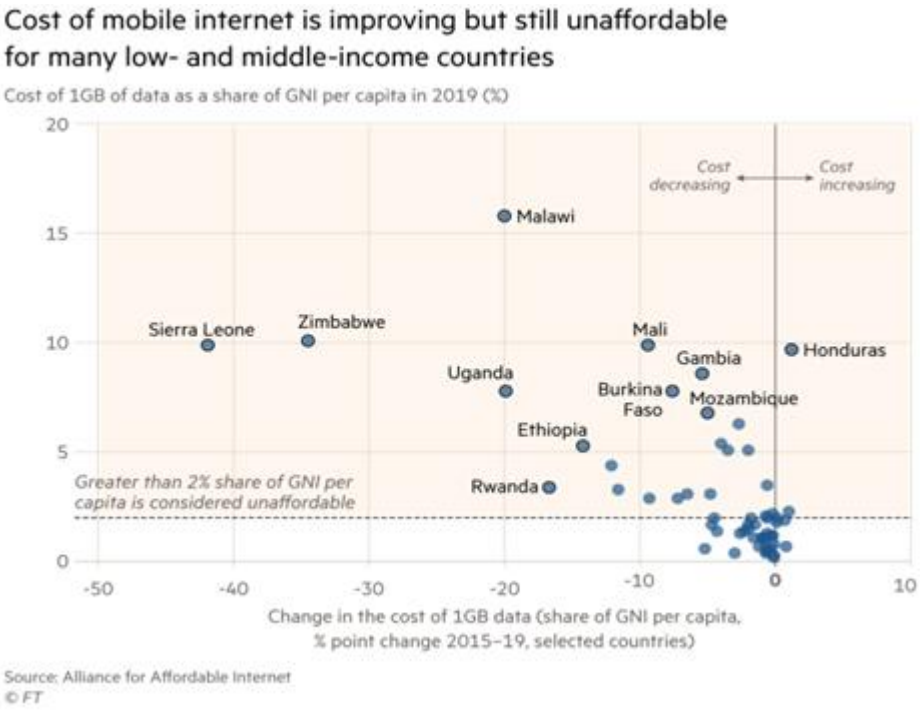

Figure 1

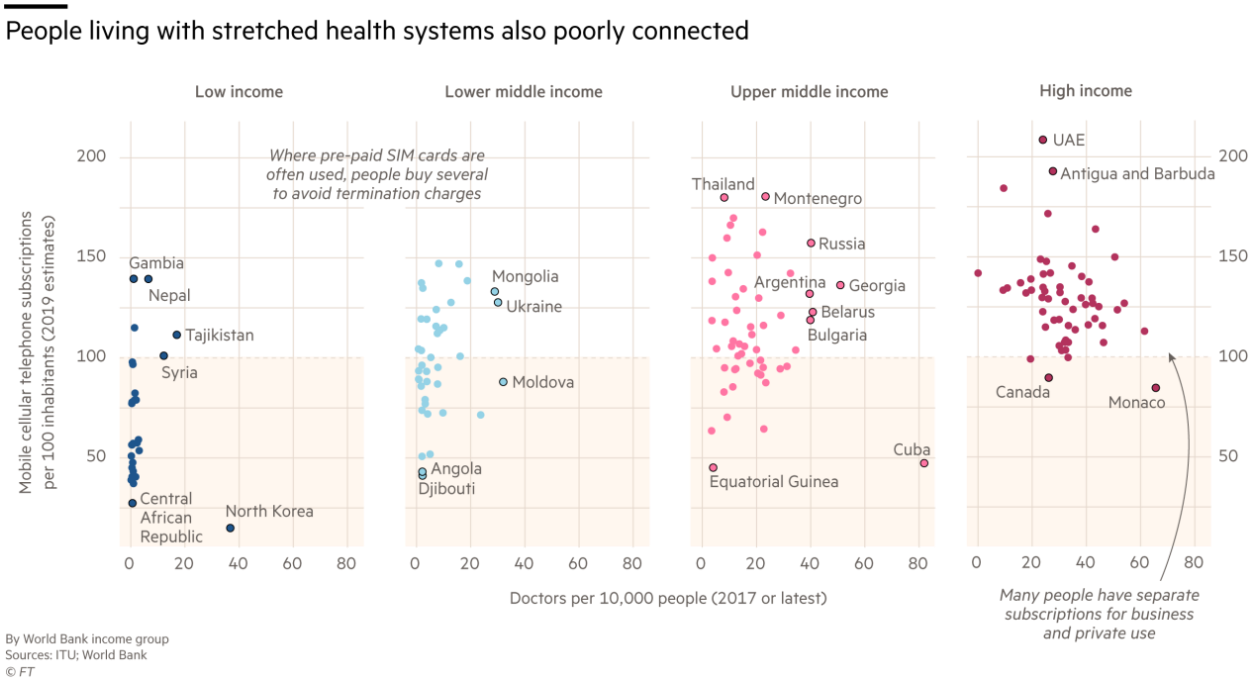

Figure 2

5. Result & Discussion

Drawing from the methodology highlighted above, the following results were deduced:

a) Nature of Healthcare and mHealth prior to COVID-19

From the preceding method adopted, technology was already established in the healthcare system, and mHealth had already taken reasonable shape. Table 1 shows how specialized software had been developed and used to deliver medical services across the globe as of 2014. It further indicates that this various software was served specific but diverse purposes in the medical space, thereby underscoring the extent of development during this period. For instance, while Diagnosaurus software was used for diagnosis, MedCalc was developed to perform medical calculations.

Asides from this, Table 2 shows six major themes (branches) of mHealth all of which vary in their description. From this source, it could be deduced that specialized software was developed to tackle and address the needs in the respective fields in each of these specific branches. For instance, in the Disease and Emergency tracking theme, the software developed functioned with GPS technology to track the spread of disease incidence and emergency monitoring. All

these further highlight the development prior to the pandemic in 2019.

b) Technological Innovations in Healthcare and mHealth during COVID-19

The uncontrolled and rapid rate in the spread of the virus, coupled with the high rate of mortality recorded amongst victims of the virus, *among other things*, necessitated specific innovations and development in mHealth and healthcare technologies around the world. Some of the notable innovations include but are not limited to the following:

- **AI Robots:** In a bid to control the virus, Rwanda is taking proactive steps at exploiting Artificial Intelligence, Machine Learning, and other high-tech initiatives in its efforts. One of such notable innovations is the incorporation of the five robots – Akazuba, Ikirezi, Mwiza, Ngabo, and Urumuri – in COVID-19 treatment and management.
  Notable, these robots are programmed to administer medical and health services such as temperature checks, storage of patients' medical biodata (which aids contact tracing), and delivery of food and other essential services in treatment. Additionally, the bots can detect individuals not wearing facemasks and remind them, thereby aiding the enforcement of governmental directives.
  In doing all these, the multipurpose bots have essentially helped reduce patient-doctor contact, thereby minimizing the risk and chances of exposure of healthcare workers to the virus, and at the same time, facilitating telemedicine.
  More so, their employment facilitates efficiency and speed in both the detection and treatment of COVID-19 patients. Interestingly, these bots can test 50 to 150 people per minute, one of the fastest in Africa and the world by extension.
- **Exposure Notification& Tracking Mobile Software:** Taking a look at countries around the world who have adopted this tech, the contact tracing software has helped them gain control over the virus spread to a large extent while at the same time making it reasonably safe to resume economic activities. For instance, given its emphasis on social distancing, the coronavirus tracking website was instrumental in reducing the reproductive rate of infection figures (R0) in various regions of China, thereby giving them reasonable control of the virus spread and confidence, gradually easing the lockdown orders.

Furthermore, taking a long-term view of the contact tracing applications and technology in general, it would appear that, with the requisite level of innovation, it would make the world better prepared to handle similar health challenges should the situation arise in the future. Also, the technology could be adapted to the security industry to enhance surveillance and investigations alike.

However, despite these laudable benefits of the technology, the same still raises several pressing concerns in several countries worldwide. One of these is as regards privacy. As earlier stated, the software tracks the individual's movement to fish out those with whom the patient has interacted during a specified time range. In some instances, private information is even accessed. For example, in South Korea, the government has developed and currently runs a public database of patients with confirmed cases, including age, gender, occupation, and travel routes. Also, in Taiwan, hospitals have been given access to patients' travel details, and authorities track phone location data for anyone under quarantine.

c) Obstacles in the spread of technology in healthcare across countries

It has already been established in the earlier portion of this work that the levels of technological advancement in healthcare and the practice of mHealth are radically different amongst countries of the world. Ordinarily, the technological developments in the healthcare system ought to have evenly spread across nations, but due to specific reasons, the reverse is the case. Some of the particular reasons responsible for this include the following:

- **Poverty and Lack of Sufficient Investment in Health Sectors:** one of the significanthindrances to technological development in the healthcare systems is the low amount allocated to the healthcare sectors of the respective countries. From a careful analysis of Table 3, it appears that developed countries such as the USA, UK, Japan, and Germany have a high quota channeled to their health sectors, while less developed countries such as Ireland and Portugal have comparatively low amounts. It is no wonder why the technological advancement in the health sector of such developed countries is remarkably high. To buttress this further, Figure 1 above shows that as a result of the poverty, the government is unable to provide the individuals with mobile internet, thus making it outrageously expensive for the people. It is because of this high cost that the majority of the individuals lose interest in utilizing this technological development through mHealth. Similarly, Figure 2 reveals that in low-income countries such as Central African Republic, the mobile cellular telephone subscription is low as compared to other high-income countries such as UAE, and Canada.
- **Brain drain:** another reason is the emigration of geniuses and elites from one country to another in search of greener pastures. A classical illustration could be seen in the IMF report that about 180, 000 Iranians flee their country to other developed countries yearly. . Thus, such individuals develop themselves and settle in foreign countries where they contribute to their development, thereby neglecting their home country.
- **Low Quality and level of education:** The saying 'you cannot give what you do not have; ' is highly relevant. Because of the low levels of education amongst less developed countries, it becomes difficult to raise elites capable of initiating brilliant innovations in the healthcare sectors of their countries. For instance, Pakistan was reported to have an alarming 24 million children out of school.

6. Conclusion

To sum this article all up, specific significant facts have been established in this work. First, this research work has shown that notwithstanding the extent of development in mHealth and technological development in Healthcare

sectors of countries worldwide, the epidemic of COVID-19 in 2019 served as a boost to more development and innovations in this field. Additionally, it has been shown that these technological innovations are expected to be equally enjoyed by countries worldwide. However, due to particular hindrances such as poverty, brain drain, amongst other factors, some less developed countries are sidelined from the full enjoyment of the benefits of the same.

7. Future Scope

This research work is of immense benefit to readers, state actors, and the world for several reasons. First, as opposed to other research works that predate this, this work is broader in scope and more objective as it incorporates findings from a plethora of already conducted researches. Also, the study adopts a comparative approach in analyzing the growth in technological development, thereby giving a more detailed research result. Asides from this, the research work is specific in addressing societal issues like the obstacles to the development of technology in the healthcare sectors of economies of the world.

However, this article has certain limitations which would serve as a basis for the recommendation for future research. The principal limit is that the report relied primarily on already conducted studies without carrying out much original research. Thus, it is recommended that future studies should consider incorporating personal research methods such as official statistics, questionnaires, and observation, to mention a few.

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Author Profile

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