

An Investigation of the Effects of Internet Universality Indicators on the Adoption of Telemedicine in Covid-19 Era in Africa

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ABSTRACT

Information and communication technology (ICT) has revolutionized all human fields including medicine. Telemedicine was introduced to make healthcare services reach the entire world. The current United Nations' Sustainable Development Goals (SDGs) has "good health and well-being" as its third goal and telemedicine is one of the tools for achieving it. However, health management using ICT-based technology including telemedicine faces diverse challenges in Africa. Hence, this paper investigates the internet universality indicators (rights, openness, accessibility and multi-stakeholder participation) affecting the diffusion of telemedicine in Africa. Datasets were collected from four international organizations' websites to understudy the effects of these indicators on telemedicine diffusion in Africa. Finding from the study showed that low internet penetration, obsolete mobile network, low household with internet, low individual internet users and slow internet speed hinder telemedicine diffusion. Consequently, to give adequate healthcare especially during COVID-19 period, African leaders should formulate policies to address the low paces of internet penetration to greatly explore the opportunities of telemedicine towards making SDGs goal on health a reality in Africa.

Keywords: Telemedicine, m-health, ICT, internet, broadband, diffusion

Reference Format:

Abass, Olalere A; Egejuru, Ngozi C; and Dawodu, Adekunle A. (2020), An Investigation of the Effects of Internet Universality Indicators on the Adoption of Telemedicine in Covid-19 Era in Africa, *Afr. J. MIS*, Vol. 2, Issue 4, pp. 1 - 10.

© Afr. J. MIS, October 2020; P-ISSN 2714-5174

I. INTRODUCTION

There has been increasing pressure on the healthcare system due to societal changes especially during COVID-19 period as well as global growing prevalence of chronic diseases. Aside inadequate human resources in healthcare and increased demands from patients for more quality in provision of healthcare services, the COVID-19 has indeed affected the physical contact between patients and medical personnel making healthcare services not reaching the citizenries. Within this challenging context, healthcare costs are rapidly increasing that pose fundamental questions on how to (i) achieve sustainable and equitable healthcare delivery and (ii) successfully fashion out contactless health service programmes in a time like COVID-19 pandemic. In the era of automation, humans are becoming unmindful about the most precious gift we possess in terms of our health but the biggest challenge is sustainable ICT (Firdaus et. al., 2018). Series of need begin to emerge that establish the use of ICT to address healthcare needs and no doubt that ICT-based healthcare system has the potential to positively improve the quality of healthcare delivery in resource-deprived remote environments.

Nigeria, the most populous and developing country in Africa with an estimated population of 206.1 million people as at March 2020 (World Bank, 2020) has the bulk of the communities in rural areas. Ukaoha and Egbokhare (2012) opined that using a system of healthcare that could allow doctors gain access to patients in remote locations is necessary and useful in achieving government's aim of bringing healthcare to these remote rural and poorer areas. As published by Nigeria's National Universities Commission in the Punch Newspaper on January 23, 2020, doctor-patient ratio is currently 1:3,500 in Nigeria as against 1:600 standard requirement by the World Health Organization – WHO (Punch Newspaper, 2020). This ratio cannot efficiently deliver quality healthcare to the population that needs and deserves it and this has necessitated a need to increase healthcare professionals to patients' ratio in Nigeria and Africa at large (Ajala et. al. (2015). Hence, telemedicine is a viable and productive option to making healthcare available to both urban and rural people in Nigeria.

However, the low quality of Internet services that fall below the minimum standard as contained in worldwide Internet Universality Indicators (IUIs) affects the low adoption pace of the new technology. IUI is a concept and framework adopted by United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2015 to summarize their position on the expected minimum internet standard in the member countries. The concept is based on four principles with the emphasizes that Internet should be human *right-based*,

open, accessible and based on *multi-stakeholder* participation (ROAM).

Tools such as telemedicine, tele-education and health informatics have of late been incorporated in the health sector to enable easy access to essential services, for example, in medical areas from referral centres by the patients on one hand and enabling the doctor-to-doctor consultations for the benefit of patients (Wamala and Augustine (2013). Telemedicine involves the use of ICT in healthcare delivery such as treatment, prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities (Okoroafor et. al., 2017). The recent advancements in hardware and software technologies make multimedia to deliver medical services via the Internet in real-time. Furthermore, ICT handles the services that mainly rely on the physical distances as well as other environmental impacts and people in the rural or difficult areas are thus able to access medical services (Khemapech et. al, 2019).

Many challenges currently contribute to the low pace of telemedicine penetration in Nigeria, making delivery of healthcare services during COVID-19 almost impossible. Internet remains backbone of telemedicine services but unfortunately, not all parts of the country have access to internet and those that have access pay heavily for the service. Telemedicine, as an ICT-based technology that makes services available online (in real-time), makes it important that the services need fast, stable, fast, stable and uninterrupted internet connectivity. Hence, sustaining telemedicine services in any country requires a stable communications strategy that connects the developing country with the global internet, without huge debts to pay for the connectivity (Ajala et. al., 2015). Therefore, this paper attempts to investigate the causative factors militating against full adoption of telemedicine services. Specifically, we examine the influence of IUIs, (global minimum index for effective use of internet-enhanced devices) on telemedicine among the developing countries using Nigeria as a case study and then proffer solutions toward addressing the factors.

The remaining parts of this paper are organized as follow: Section II deals with review of literature on healthcare and telemedicine focusing on its categories, history, benefits and challenges. Section III focuses on material and method. Section IV contains the results and discussions. Section V focuses on findings. Finally, conclusion is made in Section VI.

II. LITERATURE REVIEW

Healthcare and Telemedicine

Healthcare deals with the prevention and healing from illness and healthcare system refers to a system of delivering services for the prevention and treatment of diseases. The natures of technological and scientific medical practices change the healthcare systems. The healthcare providers are now swiftly adopting the technology into their healthcare procedures as modern surgery helped to create the modern hospitals (Eriotis et. al., 2008). The advancement in medical technology makes the cost of treatments higher as many healthcare providers, especially hospitals cannot manage to pay for high cost of gadgets to take care of diseases and wounds. Many resources are only available at hospitals with expert doctors. Therefore, people living in rural areas need to travel long distances to access more costly and complex levels of care (Rasid and Woodward, (2005).

Telemedicine is a rapidly developing application of clinical medicine where medical information are transferred through interactive audio-visual media for consulting in remote medical procedures or examinations. In the developed countries, telemedicine has proven to be a source of relief to the people living in the rural areas. It has become a platform for helping to bridge the healthcare divide. Telemedicine is a combination of different fields as shown in Figure 1. On a lower scale, telemedicine is implemented with the existing technology - global system for mobile telecommunications (GSM). Telemedicine may be as simple as health professionals discussing a case over the telephone or as complex as using satellite technology and videoconferencing equipment to conduct a real-time consultation between medical specialists in different countries.



Figure 1: Fields of Telemedicine (Kakkar et. al., 2017)

Nigeria embraced telemedicine in 2007 when National Space Research and Development Agency (NASRDA) and the Federal Ministry of Health inaugurated a pilot project in two teaching hospitals and six Federal Medical Centres (FMCs) in the six geopolitical zones of the country. The teaching hospitals were the University College Hospital, Ibadan and the University Teaching Hospital, Maiduguri. The FMCs included those in Owo,

Gombe, Makurdi, Yenagoa, Birnin Kebbi and Owerri. Apart from the public institutions, private organizations such as the Lagoon Hospital, Lagos and the Igbinedion University Teaching Hospital, Benin also embraced the use of the technology. In addition, a pilot project implementation that involved mobile-units or vehicles equipped with satellite receivers was unveiled (Ukaoha and Egbokhare, 2012).

Benefits and Applications of Telemedicine

According to Khemapech et al. (2019), Ukaoha and Egbokhare (2012), there are several benefits derivable from using or deploying telemedicine in a developing economy such as Nigeria and some of them are:

- i. It supports health-care delivery in distant remote sites and villages.
- ii. It brings equality in healthcare where people around the world can access the telemedicine services as soon as they are connected to the Internet.
- iii. It connects primary care physicians, providers, specialists and patients.
- iv. It offers improved access to quality healthcare delivery because patients in remote locations have equal access to quality medical healthcare as those in the urban areas.

Figure 2 depicts other areas of application of telemedicine that are beneficial to humanity.

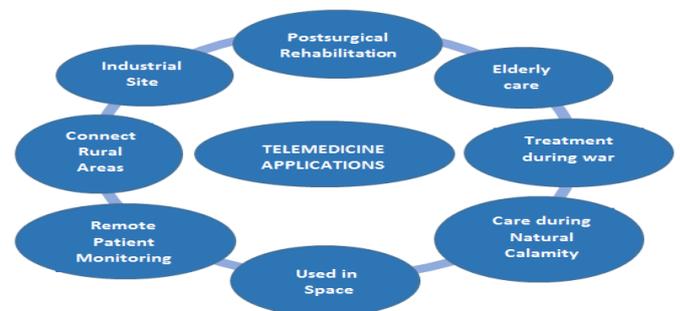


Figure 2. Applications of Telemedicine (Kakkar et. al., 2017)

Challenges of Telemedicine

Combi et al. (2016) highlighted the major challenges of telemedicine as follow:

- i. There is high cost of acquiring telemedicine systems and solutions (especially for rural areas), high maintenance costs for keeping the system alive after acquisition.
- ii. The use of telemedicine by medical personnel witness resistance due to change and slow clinical acceptance of telemedicine.
- iii. Developing countries experience none availability of the required ICT infrastructure for telemedicine e.g.,

- iv. Internet connection, bandwidth for high-speed telecommunications, etc.

Ajala et al. (2015) identified issues affecting the adoption of telemedicine in South Western Nigeria as:

- i. *Unfavourable Government Policy*: The problems facing the public healthcare system in Nigeria could be traced to poor implementation of National Health Policy as well as other health-related policies and programmes due to political instability that affects appointment of healthcare managers.
- ii. *Funding*: Nigerian government funds approximately 31% of the total health expenditure. For example, in 2007 and 2012, paltry allocations of 9.7% and 6.7% respectively were budgeted for the health sector. According to WHO (2020), the total expenditure on health by Nigeria in terms of percentage of 2014 GDP was 3.7%. These statistics showed that the health sector is under-funded and citizens have to pay for the health services they want to enjoy.
- iii. *Lack of Technical Knowledge*: The effects of scarce human resources in the use and maintenance of sophisticated gadgets for healthcare remain a source of concern of full implementation of telemedicine.
- iv. *Internet*: Availability of Internet serves as the backbone of any telemedicine services as well as high level of computer literacy. Therefore, sustaining telemedicine services requires a stable communications strategy that connects the developing countries.

Internet Universality Indicators

According to UNESCO (2018), Internet Universality Indicators (IUIs) are to enable more concrete analysis of the Internet universality concept at country-level. Inherently, Internet universality embraces four principles (or pillars) determining the growth and evolution of the Internet in ways that are conducive to achieving the United Nation's Sustainable Development Goals. These four principles are *Rights, Openness, Accessibility, Multi-stakeholder participation (ROAM)*. Rights-based indicator affirming that the principle of human rights should apply to all aspects of internet. Openness indicator focuses on social and political support for open system in addition to technical principle. Accessibility indicator delves on elimination of digital divide based social exclusion, skill, language gender and disability of individuals. Multi-stakeholder indicator recognises the value of general participation in decision-making in the future of internet.

In this study, the focus is on “accessibility to all” aspect of IUIs. According to ITU (2013), “accessibility to all” indicator includes mobile coverage by type of network, households with Internet access at home, individuals using the Internet, mobile-cellular and mobile-broadband subscriptions.

Related Work

Emdadul-Haque et. al. (2019) investigated the challenges of e-health implementation in developing countries using literature review method. They adopted inductive content analysis and social control method. Findings showed that lack of ICT infrastructure and basic ICT skills are the challenges facing e-health implementation in developing countries. Also, inadequate infrastructure like electrical power within the rural areas leads to the restricted access to the web. All these make it difficult to access ICT infrastructure that depends on electrical power to control.

Nsor-Anabiah et. al. (2019) sought to identify the prospects and challenges in the implementation of m-Health in developing countries and suggest ways to resolve them. They conducted a qualitative and systematic review by surfing sites such as Google Scholar, Web of Science, Health-related and Scopus for articles containing empirical data on m-Health development and implementation. The results of the study showed that technological and other challenges like illiteracy, sociocultural difficulties, lack of qualified health workers, among others, hinder the success of m-Health. The authors pointed out that tackling these challenges would increase accessibility, service quality and reduce the cost of access to m-health.

Chifamba (2018) investigated the challenges of telemedicine implementation the Southern Africa countries with the aim of identifying the problems of implementing telemedicine. The author reviewed telemedicine implementations in the different member states within a period of 10 years. The results showed the financial, power, organizational, ethical, security socio-cultural and political challenges faced when telemedicine projects were implemented in Southern Africa.

Ekanoye et. al. (2017) studied on the diffusion of telemedicine in a developing country using Nigeria as a case study. They explored the various ways telemedicine has assisted in achieving sustainable development goals on the global healthcare coverage, its significance and investigated the current state of telemedicine. Findings from qualitative analysis carried out suggest that despite finance and technical issues as major challenges, telemedicine has proved to be necessary and extremely beneficial to the citizens. Study showed that telemedicine is consistently manifesting signs that it will continue to thrive in Nigeria,

Okoroafor et. al. (2017) examined the prospects and challenges of telemedical practice in Africa through a systematic review of 31 relevant publications in addition to the authors' knowledge and experience in biomedical care in Africa. They opined that the use of

mobile phones cannot be underestimated and that with mobile phone technologies, medical practitioners in rural areas can update and retrieve patients' records from anywhere within a network coverage. Developing telemedical practice in Africa that will take into account our peculiar environment is therefore paramount to the provision of improvement and quality access to healthcare delivery.

Ogundaini (2016) used UTAUT model to study the causes of the limitations regarding the adoption and, particularly, the use (or non-use) of e-health information system by clinical staff in the public healthcare institutions in South Africa. Findings show that the core factors that influence successful adoption and use of e-health information system (IS) include; willingness of an individual (or group) to accept and use a technology, the performance expectancy, social influence among professionals in the healthcare scenery and adequate facilitating conditions.

Ajala et. al. (2015) investigated the acceptability of telemedicine in the South Western Nigeria with emphasis on its prospects and challenges. Structured questionnaires and interviews were used to elicit information from medical professionals who were recruited into the study using a convenience sampling method. Findings showed that despite the awareness of telemedicine by medical practitioners in South Western Nigeria, only few medical facilities have integrated telemedicine into their services. They pointed out that lack of support for telemedicine by government in the hospital, high cost of the technology and lack of computers hardware/software for implementing are hindrances to effective adoption of telemedicine.

From the literatures reviewed, no study has presented any investigation on the effect of core Internet factors on the adoption and diffusion of telemedicine in the developing country. Consequently, the present study aims at determining the effects of various parameters bothering on IUIs on the successful implementation of telemedicine in Africa using Nigeria as a case study as the technology is a panacea to contactless health services especially in COVID-19 period. We examine the rate of Internet penetration in African continent compared to other parts of the world where telemedicine is effectively used. We also critically look into the effects of different internet universality indicators such as mobile coverage by type of network, households with Internet access at home, individuals using the Internet and mobile cellular/broadband subscriptions on the diffusion and adoption of telemedicine. These two issues have significant role to play in the healthcare services during and after COVID-19 pandemic.

III. MATERIALS AND METHODS

To answer the research questions in the study, datasets were sourced from websites of three different international organizations and world-class ICT-based company. These organizations are:

- i. The World Bank.
- ii. International Telecommunication Union (ITU): Headquartered in Geneva, Switzerland is an international organization within the United Nations System where governments and the private sector coordinate global telecom networks and services. It is specialized agency for ICTs which has a global membership of 193 Member States as well as some 900 companies, universities, and international and regional organizations.
- iii. Internet World Stats: An International website that features up to date World Internet Users, Population Statistics, Social Media Stats and Internet Market Research Data, for over 246 individual countries and world regions.
- iv. Speedtest Global Index by Ookla Company located in Seattle and a leader in fixed broadband and mobile network testing applications, data and analysis

The datasets obtained focus on the various internet universality indicators used to measure the suitability, or otherwise, of telemedicine diffusion in Nigeria. Charts in Microsoft Excel® 2016 were used to make graphical presentation of data collected from the websites of The World Bank, International Telecommunication Union, Internet World Stats and Speedtest Global Index for the purpose of analyses of the datasets.

IV. RESULTS AND DISCUSSIONS

This section discusses the influence of various Internet indicators on the diffusion telemedicine in Africa and specifically Nigeria.

Internet Penetration in Africa

As at 2019, the Internet World Stats (2020) revealed that Nigeria now ranks 7th in terms of countries with the highest number of internet users in the world with 111.6 million (56%) of the total of 200.9 million Nigerians use internet as shown in Table 1. As at the First Quarter (Q1), Africa recorded only 526.7 million (11.5%) internet users compared to 4.59 billion internet users in the World with 7.80 billion populations (Figure 3).

circumstance does not allow diffusion and adoption in Africa.

Table 1: Ranking of World Internet User by Countries

Rank	Countries	Population (Estimated 2019)	Internet User (March, 2019)	% of Total Population
1	China	1,429,062,022	829,000,000	58%
2	India	1,368,737,513	560,000,000	41%
3	United States	329,093,110	292,892,868	89%
4	Brazil	212,392,717	149,057,635	70%
5	Indonesia	269,536,482	143,260,000	53%
6	Japan	126,854,745	118,626,672	94%
7	Nigeria	200,962,417	111,632,516	56%
8	Russia	143,964,709	109,552,842	76%
9	Bangladesh	168,065,920	92,061,000	55%
10	Mexico	132,328,035	85,000,000	64%

(2020)Source: International Telecommunication Union

From Table 1, Nigeria is ranked 7th position among countries in the world with 56% of the total population using the Internet. As shown in Figure 3, Nigeria and Africa at large still fall below world average of 58.7% in terms of Internet penetration (ITU, 2013). This low rate of Internet penetration in Africa does not favour the adoption and diffusion of telemedicine in the continent.

Mobile Coverage by Type of Network

Long-Term Evolution is a 4G wireless for up to 10x speeds of 3Gnetwork for mobile devices such as smartphones, tablets, wireless hotspots. From Table 2, it shows that as at 2019, only 396 million (6.32%) Africans migrated to LTE or higher network compared to the Europe, Americans and the rest of the world.

Households with Internet Access at Home and with a Computer

Based on 2019 data by ITU, in all regions of the world, households are more likely to have Internet access at home than to have a computer because Internet access is also possible through other devices. Before the advent of smartphones, computer remained the only device where households had Internet access at home. In recent years, however, more households across the globe have Internet access on computers and other mobile devices such as smartphones. In Africa, very few households have either Internet access or a computer. However, Africa has the lowest households with internet at home and with computer. A 17.8% rate of internet availability at home is far below inhabitants of other world regions. This will make difficult the diffusion and adoption of telemedicine in Africa. Figure 5 affirms that Africans are bound to face huge challenges of telemedicine adoption and diffusion due to low rate households with 17.8% and 10.7% (Speedtest Global Index, 2020) population with Internet access on their computers at home and households with computer respectively. This

Individuals using the Internet

Table 3 shows that there exist an increase in the population of Africans using the internet between 2015 and 2019. However, based on the Africa’s population, a 6.72% increase in 2019 is considered as low in terms of the internet penetration. Figure 4 shows that in the developed countries of Europe and the Americas, most people are online with close to 77.2% of individuals using the Internet. Europe is the region with the highest Internet usage rate, the region of Africa has the lowest internet usage rates with only 19% of individuals were online in 2019 (Speedtest Global Index, 2020). With only 28.2% Africans using Internet, this has negatively affected the adoption and diffusion of telemedicine as well as its successful implementation because availability of Internet remains the bedrock of the technology for healthcare. Broadband penetration measures the extent of access to broadband communications within the population of a particular location.

Table 2: Population covered by Types of Mobile Network (in millions)

	2015		2016		2017		2018		2019	
	3G	LTE/H*	3G	LTE/H	3G	LTE/H	3G	LTE/H	3G	LTE/H
Africa	481	108	563	155	627	214	743	343	825	396
Arab States	296	74	337	110	358	206	377	244	386	253
Asia & Pacific	3,280	1,715	3,580	3,016	3,818	3,655	3,993	3,862	4,049	3,907
CIS	165	101	176	124	191	144	195	160	213	185
Europe	639	499	666	591	670	613	676	626	682	628
The Americas	891	711	914	765	936	828	956	877	966	896

*LTE/H denotes Long-Term Evolution or Higher

Source: International Telecommunication Union

Mobile-cellular and mobile-broadband subscriptions

Broadband penetration measures the extent of access to broadband communications within the population of a particular location. According to ITU (2020), the global average mobile download and upload speeds as at March 2020 were 30.47Mbps and 10.73Mbps respectively with latency (delay) of 42ms while average fixed broadband download and upload speeds were 74.64Mbps and 40.07Mbps respectively with latency of

24ms. Taiwan tops the table at 85.02Mbps and has the fastest internet speed in the world. In Taiwan, an HD movie of 5GB takes 8:02 minutes to download.

Table 3: Population of Individuals using the Internet (in millions)

	2015	2016	2017	2018	2019	Total(2019)	%
Africa	190	215	246	268	294	1,213	6.72
Arab States	165	176	192	208	221	962	5.34
Asia & Pacific	1,428	1,592	1,832	1,955	2,066	8,874	49.21
CIS	143	151	158	168	175	794	4.40
Europe	495	511	530	550	568	2,655	14.73
The Americas	615	675	717	747	779	3,333	9.60

Source: International Telecommunication Union (2020)

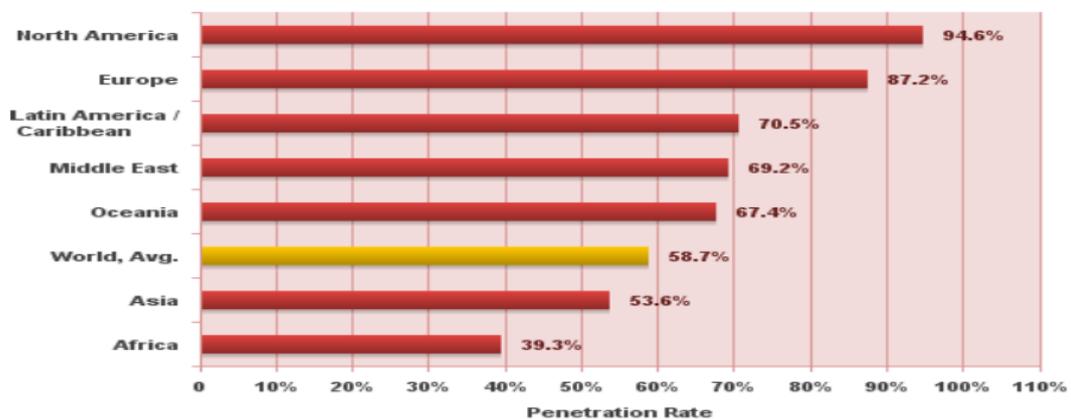


Figure 3. Internet World Penetration Rate by Geographic Regions – 2020 Q1 (ITU, 2013)

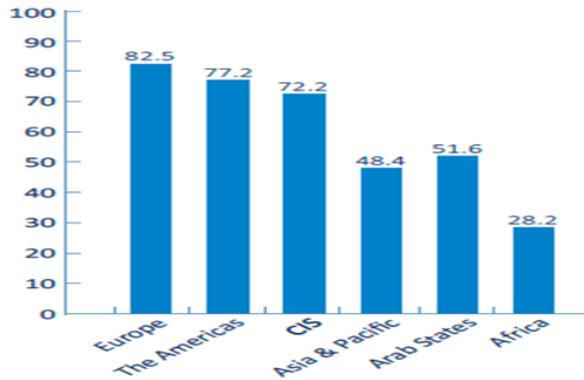


Figure 4: Percentage of individuals using Internet

Nigeria’s internet download speed ranks one of the slowest in the world. Nigeria’s internet download speed is ranked 176th of 207 countries measured globally. The report further shows that it takes an average of over 7 hours (7:18) to download an HD movie of 5GB in Nigeria. This means that Nigeria’s internet download speed has deteriorated in the past two years from 95th in 2017 to 176th in 2019. Taiwan has the fastest internet download speed in the world. Despite rising 3G/4G subscriptions, as at March 2020, Nigeria is ranked 109th in the world’s mobile internet speed with 15.53Mbps download, 7.25Mbps upload and 57ms latency.

From Table 4, Africa recorded an increase in mobile-cellular subscription from 843 million in 2016 to 933 million subscribers in 2019 while mobile-broadband subscription increased from 212 million to 354 million. It also shows that in 2019, Africa accounted for only

of 80.1 and 34.0 mobile-cellular and mobile-broadband subscribers respectively. These values fall short as compared to the remaining regions in the world where Internet access is readily available. This makes the medical personnel in Africa not to adopt, implement and use telemedicine to solve difficult healthcare tasks since the technology relies on high-speed Internet connections.

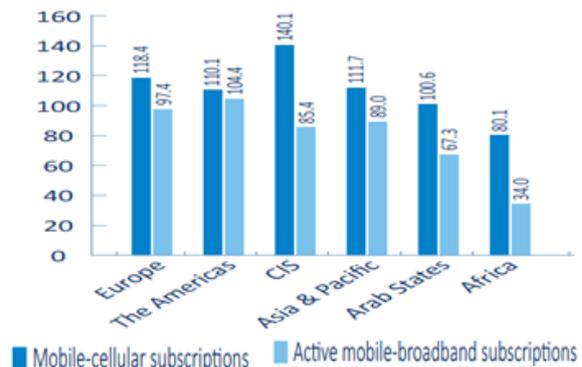


Figure 5. Mobile-broadband subscriptions per 100 inhabitants

Based on the four factors of IUIs, as shown in Figure 3, the rate of Internet penetration is only 39.3% among Africans. This shows that in terms of *rights*, openness and *accessibility* to Internet, Africa is still far short of UNESCO standard. By implication, this means that *multi-stakeholder* participation is very low. That is, both African governments and individuals are not collaborating towards meeting the minimum standard set by UNESCO as enshrined in the IUIs agreement.

Table 4: Population covered by mobile-cellular network mobile-broadband subscriptions (in millions)

	2016		2017		2018		2019			
	MC*	MB*	MC	MB	MC	MB	MC	%	MB	%
Africa	843	212	867	248	904	312	933	12.57	354	5.56
Arab States	381	191	395	228	403	253	412	5.55	288	4.52
Asia & Pacific	4,017	1,927	4,100	2,522	4,145	3,003	4,188	56.43	3,802	59.64
CIS	219	157	223	173	225	187	228	3.07	206	3.23
Europe	677	536	679	579	684	623	686	9.24	671	10.52
The Americas	944	844	961	896	969	950	975	13.14	1,054	16.53

MC = Mobile-Cellular, MB= Mobile-broadband
 Source: International Telecommunication Union (2020)

5.56% of the global mobile-cellular and mobile-broadband subscriptions. Figure 5 shows the global mobile-cellular and mobile-broadband subscriptions per 100 inhabitants. It reveals that Africa recorded an average

V. FINDINGS

The successful diffusion and adoption of telemedicine generally hinged on ICT and specifically on various internet indicators. With only 56% Internet penetration,

it shows that 56 (or less) in 100 Nigerians will have access to qualitative healthcare via telemedicine. This ratio is too low in terms of efficient and effective delivery of ICT-based healthcare to the citizenries. In terms of types of network available to drive telemedicine penetration, only 6.32% Nigerians use LTE or higher network to access the internet (Ajala et. al., 2015). This implies that majority of Africans including Nigerians still use 3G network. Since telemedicine, as a modern technology in healthcare, relies on higher network connection to perform maximally, it means majority of Africans are far behind inhabitants of the developed countries and may not explore the opportunity inherent in telemedicine due to almost outdated network.

Currently, households are more likely to have Internet access at home than to have a computer because Internet access is also possible through other devices. However, a 17.8% rate of Africans having internet at home is not favourable for the diffusion of telemedicine as this may deny majority of Africans access to modern healthcare at home during emergency that demands urgent medical expert's attention. As regards individual using the internet, despite a rise among Africans in 2015 and 2019, a 6.72% increase in 2019 as compared to 14.73% in Europe and 9.60% in America is not a good indicator to the effective access to telemedicine in Africa including Nigeria. The trend implies that even if telemedicine is available, the vast Africa inhabitants do not have the right channel to access telemedicine-based healthcare.

The global average mobile download and upload speeds as at March 2020 were 30.47 Mbps and 10.73 Mbps respectively with latency of 42ms (ITU, 2020). Contrarily, Nigeria currently has internet speed of 15.53 Mbps download, 7.25 Mbps upload and 57ms latency (Ogunfuwa, 2020). The finding also shows that in 2019, Africa accounted for only 5.56% of the global mobile-cellular and mobile-broadband subscriptions. These three internet indicators (speed, delay and subscription rate) do not favour the full diffusion of telemedicine because the efficient and effectiveness of the healthcare technology requires high speed and uninterrupted internet connectivity.

VI. CONCLUSION

At the exit of the Millennium Development Goals (MDGs) in September 2015, the world (including Nigeria) and their leaders, came together at the 70th session of the United Nations General Assembly in New York to sign a new global partnership for development tagged "Sustainable Development Goals" (SDGs) having 17 goals and 169 targets to be achieved by the year 2030. The third goal named "Good Health and Well-being". One of the ways of making the 3rd goal of SDGs achievable across the globe is the use of modern-

day telemedicine for healthcare. Hence, this paper has contributed to knowledge by understudying the internet indicators likely to make or mar the diffusion of telemedicine in Africa and achievement of SDGs goals. Five internet indicators were identified as hindrances to the implementation of telemedicine that will not afford Africans to maximize the benefits of the healthcare platform towards making the 3rd goal of SDGs a reality in Nigeria and Africa at large thereby achieving universal health coverage. Consequently, based on research findings, it is recommended that African leaders should step up their efforts of further internet penetration via good policies, key into higher type of network to access the internet, make internet available at every home, increase individuals using internet and provide above global average download and upload speed of internet connectivity with minimum latency.

Moreover, the lockdown that spanned over five months in Nigeria arising from the ravaging COVID-19 disease has negatively affected many Nigerian due to their inability to access medical care. The effect of the closure is severe due to the conventional method of healthcare delivery through the traditional face-to-face contact between health personnel and their patients. This has paralysed and disrupted the nation's healthcare system. If the facilitating factors for telemedicine adoption and outright usage have been put in place, the technology would have served as a panacea to reliance on age-long conventional physical healthcare method thereby reducing avoidable cases of death during the pandemic. Hence, in the current scenario, telemedicine can be used as an alternative method for effective healthcare delivery using various Internet-based applications as the technology prevents physical contact between the patients and the medical personnel thereby keeping the spread of the disease at bay.

ACKNOWLEDGEMENT

The authors sincerely appreciate the anonymous reviewer(s) for the immense suggestions and positive criticism towards improving the content quality of the paper. We also value the good efforts of the Editorial Office of African Journal of Management Information System for prompt responses to all issues. We wholeheartedly appreciate the efforts of our colleagues and other individuals who have contributed in one way or the other to seeing the success of this paper. All the authors of the previous work cited are recognized.

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