

Determinants of Mobile Telephone Usage for Healthcare Service Utilization

Femi Ola Aiyegbajeje¹ and Dickson 'Dare Ajayi²

¹Department of Geography, University of Lagos, Nigeria

²Department of Geography, University of Ibadan, Nigeria

Mobile telephone technology has penetrated all areas of life, and developing nations are enjoying the benefits it brings to various sectors, particularly healthcare. Existing literature have shown various determinants of mobile telephone usage for different purposes. However, very little attention has been given to the factors that determine the use of mobile phone for healthcare service utilization. This is crucial to healthcare service delivery planning processes. This paper, therefore, examines the factors influencing mobile phone use for healthcare services in Lagos. Using a structured questionnaire, information on demographic profile of patients, mobile telephone ownership and usage, and the determinants of use of a mobile phone for medical purposes was obtained from seven-hundred and eleven out-patients in Lagos University Teaching Hospital (LUTH) and Lagos State University Teaching Hospital (LASUTH). The independent and joint contribution of determining factors was analyzed using logistic regression model. The result shows that patient's travel-time to the hospital is the major determinant of mobile phone usage for medical service utilization (Odd Ratio: 3.257). This implies that the long hours spent on travelling by patients to the healthcare centre due to heavy traffic congestion in Lagos metropolis may have encouraged the use of mobile telephone for healthcare utilization purposes. The paper suggests that healthcare policymakers should make a concerted effort to effectively manage the chaotic traffic congestion and encourage the use of mobile phones as one of the methods for providing medical services in Lagos metropolis.

Keywords: Mobile telephone technology, medical service, utilization, Lagos metropolis, Nigeria

Introduction

Mobile telephone technology is greatly supporting the improvement efforts of increasing access to medical services among patients. The use of customary mobile communication technologies to support medical objectives has gained wider acceptance globally. WHO (2011) describes mobile health, often known as mHealth, as the use of traditional mobile and wireless technologies to assist medical objectives. Also, Akter and Ray (2010) and Odendaal *et al.* (2015) explained that the ability of digital communication technologies to produce, save, receive, and disseminate information among users has the potential to ameliorate and assist medical solution delivery. The potential of mobile telephone technology to be incorporated into existing health-care systems has received widespread recognition in the literature

(Ruxwana, 2007; UN, 2012; Labrique *et al.*, 2013). Nezamdoust, Abdekhoda and Rahmani (2022) examined nurses' adoption of mobile health application in healthcare delivery. The study found that perceived ease of use and perceived usefulness affects the rate of using mobile applications by nurses directly and significantly. In the same vein, Gunamany and Subramanyam (2022) wanted to determine whether Indian women's ownership and use of mobile phones are associated with indices of maternal health utilization such as postnatal care and institutional delivery services. The most developed infrastructure in Africa is the mobile phone infrastructure, which has made mobile phone services available to many rural families. At the same time, most African cities and rural areas have shortage of health professionals (Beratarrechea *et al.*, 2017). However, this study could help establish

if affordable, effective, and accessible mobile health solutions can help improve access and utilization of healthcare services. Accessibility to healthcare service is largely measured by utilization. And there are many physical barriers that could inhibit healthcare service utilization, particularly in a metropolitan city such as Lagos. In order to expand the body of research on mobile phone technology and healthcare service use, it is critical to better understand the elements that drive mobile phone use in the sector. Mobile telephone technology today has become an essential part of human life due to its huge importance to man's day-to-day activities. Its deployment has penetrated into the health sector as it now provides solutions that improve access to healthcare services among patients which could enhance healthcare service utilization. According to WHO (2011), the application of traditional mobile and wireless technologies has helped in supporting healthcare service delivery. Today, majority of the people use mobile telephone to access and utilize healthcare services just like in other human endeavours, but the reason for using mobile telephone for healthcare service utilization may be different from using it for other purposes not related to healthcare.

Research on mobile phone use in the healthcare industry have mostly concentrated on improving the management of public health information systems and dissemination of information among healthcare professionals (Cox and Scott, 2002). According to Idowu, Ogunbodede and Idowu (2003), mobile telephone investment represents a vital part of humans' livelihood and has been found to be useful in every human endeavour. Few studies (Idowu, Ogunbodede and Idowu, 2003; Akadiri, Olusanya and Omitola, 2009; Donner, 2004; Beedasy, 2010) have demonstrated the value of mobile phones in healthcare service delivery. This research looked at several ways that information and communication technology (ICT) has aided in the administration and dissemination of health information, particularly in avoiding the problem of misplaced case files in transportation and keeping the contents of the case files private from patients. Some researchers investigated mobile phone usage to monitor patients' responses to treatment (Ryan, Cobern and Wheeler, 2005; Menon-Johansson, McNaught, Mandalia and Sullivan, 2006; Franklin, Waller, Pagliari and Greene, 2006; Patrick,

Griswold, Raab and Intille, 2008). These studies looked at how patients were monitored using mobile phones by delivering short message service (SMS) to them, monitoring their health index, and data tracking to locate them. They also examined the variation of mobile phone usage in the context of establishing clinical bridges between patients and medical service providers. Additional research (Friedman, Kazis, Jette, Smith, Stollerman and Torgerson, 1996; Ericsson and the Earth Institute, 2010) investigated the reduction of processing time at healthcare centres and effective management of patients. Currell, Urquhart, Wainwright and Lewis (2010) studied the use of mobile phones as a substitute for face-to-face medical care (2010). More recently, Aiyegbajeje and Ajayi (2016); Aiyegbajeje and Ajayi (2020) have emphasized the usefulness of mobile phones to access medical services among patients. Despite much explanation stressing the usefulness of mobile communication technology to medical service provision, there exists a serious need to identify the determining factors. This is so important because it will further enrich the discussion on the use of mobile communication and medical service provision. Surprisingly, no study has identified the factors that influence mobile phone use to obtain medical services. This study, therefore, examines the factors that influence how often outpatients use their mobile phones to access medical services from healthcare service providers. This study is divided into six sections. Section one provides the introduction while a brief description of the healthcare system in Lagos State is provided in Section two. Section three, procedures for data collection and analysis are provided while section four provides the results. Section five discusses the findings and section six provides the conclusion.

Aim and objectives

The purpose of the study is to examine the factors that influence how often outpatients use their mobile phones to access healthcare services from healthcare service providers. The specific objective of this study is to ascertain those factors (physical distance, waiting time, travel time and travel cost) that determines the use of mobile telephone in seeking healthcare services among out-patients.

Research questions

To what extent do these physical barrier attributes (physical distance, waiting time, travel time and travel cost) determines the usage of mobile phones to obtain healthcare services by outpatients?

Hypothesis

The following is the study's hypothesis: Outpatients' use of mobile phones to access healthcare services will be greatly influenced by physical distance, waiting times, travel time, and travel costs.

Healthcare system in Lagos State

The healthcare system in Lagos metropolis includes the primary, secondary and tertiary healthcare systems. The Lagos state ministry of health is responsible for providing citizens with quality, economical, and equitable medical services by utilizing appropriate technology and highly motivated employees. The Lagos State Ministry of Health (LSMOH), the Primary Healthcare Board (PHB), the Board of Traditional Medicine (BTM), the College of Health Technology Board (CHT), the Health Facility Monitoring and Accreditation Agency (HEFAMAA), and the Blood Transfusion Committee (BTC) are the major players in the state's health sector; the 24 public secondary health facilities' Hospital Governing Boards, the Health Service Commission (HSC), the Lagos State University Teaching Hospital (LASUTH), which is the only tertiary healthcare facility, and the Lagos State University College of Medicine (LASUCOM). The Ministry coordinates the health system of the state with a special functional obligation to oversee state health service supervision, quality control, compliance monitoring & assessment, and leading sector policy formulation. Various health reform programmes have aimed at addressing the problem of accessibility to healthcare services. Among these are Planning for health policies, legislation and regulations, the state health system's accountability, openness, and responsiveness. Other programmes include universal access to the basic set of medical services, including demand for medical services, access to medical services, and the standard of medical treatment.

Mobile telephone technology has great potential in the health care delivery system of Lagos state in many areas if properly and adequately

deployed. One of the most significant opportunities for healthcare delivery in Lagos is the use of automated mobile phone technology to aid in illness control. Also, it is quite helpful in medical emergencies which could strengthen the healthcare delivery system of Lagos state. Mobile telephone technology has the potential to widen healthcare access where there are so much physical accessibility barriers, scarce resources, and overstretching of available system as largely found in Lagos state. "mConsulting" or doctor consultations over mobile phones, is one feature of this technology that is capable of solving the problem of physical distance by reducing distance covered by patients between their locations and the hospital (Aiyegbajeje and Ajayi, 2020). In the area of maternal and neonatal services, mobile telephone technology can enhance healthcare delivery in this regard. It is found to be useful for follow-up care services for patients. Mobile telephone can serve as a platform for mHealth (mobile health) which is healthcare precaution and therapy made possible by expanding technologies such as wireless access and connection and others (Tucker, 2015). This revolutionary medical technology strategy fosters extraordinary improvement in patient care and access to affordable care (Qureshi *et al.*, 2019).

In Nigeria, the already low patient-doctor ratio continues to fall as healthcare professionals seek better working and living conditions elsewhere. The doctor-to-patient ratio in Nigeria is approximately 1:2500, which is not equivalent to the WHO suggested ratio of 1:600 (WHO, 2020). Yet, new mobile telemedicine projects are presenting opportunities to mitigate the impact of medical doctor shortages by developing digital platforms where doctors from across the world can effectively offer numerous medical services including providing aid for patient treatment remotely. Because of transportation constraints created by the COVID-19 outbreak in Nigeria, cell phones have recently played a significant role in providing access to high-quality health care from everywhere in Lagos state.

The Federal Government of Nigeria is the owner of LUTH which is situated in the Mushin Local Government Area (LGA) of the state while the LASUTH located in Ikeja LGA belongs to the Lagos State Government (see Figure 1). The choice of LUTH and LASUTH was mainly to ensure the collection of appropriate and adequate data for the

study since both teaching hospitals serve as reference facilities for several smaller medical centres with diverse specialty endeavours within and outside Lagos vicinity. These teaching

hospitals (LUTH and LASUTH) also serve as postgraduate medical training institutions.

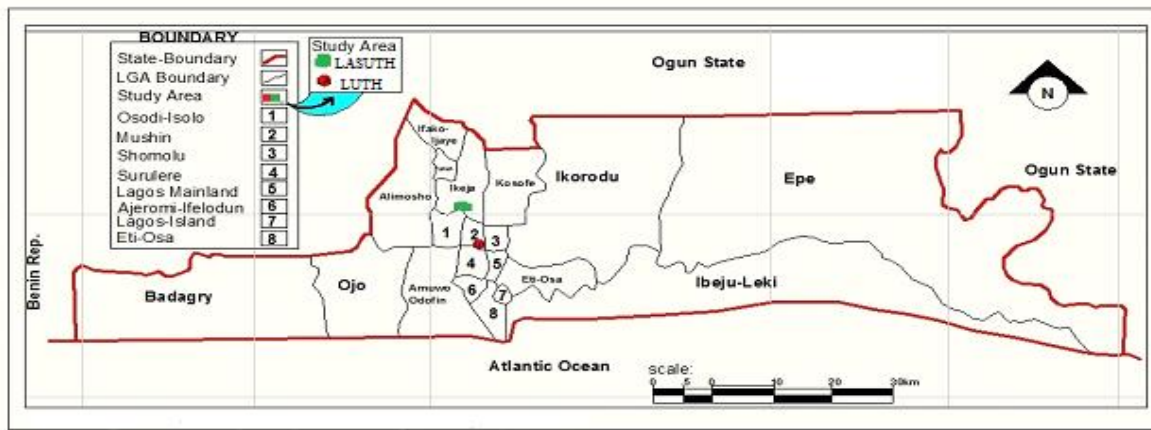


Fig. 1: Map of Lagos state showing the study area (LUTH and LASUTH)
Source: Lagos State Ministry of Physical Planning, Alausa, Ikeja (2021)

Methods

Collection of data

This section explains the procedures adopted for data collection. We used both primary and secondary data. The data was collected from the primary source by administering a standardized questionnaire to out-patients. The structured questionnaire contained information on demographic profiles of patients, the utilization of medical services via mobile phones among patients, types of health consultation done via mobile telephone and determinants of patient's use of mobile phones to access medical services were obtained and analyzed. Secondary data were gathered from hospital records and published documents. The participants used for this study are out-patients who are duly registered with the selected hospitals. The two selected hospitals are tertiary healthcare facilities. They were selected because they offer all form of healthcare services which include primary, secondary and tertiary healthcare services to a large number of out-patients. The two selected hospitals are Lagos University Teaching Hospital (LUTH) and Lagos state University Teaching Hospital (LASUTH) both within Lagos metropolis.

Procedure

This section provides the step-by-step details on processes involved in the collection of data for the study. The primary data and secondary data form the main data used for the study. The structured questionnaire forms were administered to 800 out-patients using the Taro Yamane's sampling technique to determine the sample size.

The Yamane's technique is given as:

$$n = \frac{N}{1+N(e)^2}$$

Where, n= sample size, N=sampled population and (e) = significant level or level of precision 0.05²

Patients

$$\text{For LUTH: } 1+26,400 \times 0.0025 = 66.0025$$

$$26,400 \div 66.0025 = 399.984849$$

N is equals to 399.98

As a result, approximately 400 out-patients were selected in LUTH.

$$\text{For LASUTH: } 1+22,800 \times 0.0025 = 57.0025$$

$$22,800 \div 57.0025 = 399.982457$$

N = 399.98

Approximately, In LASUTH, 400 out-Patients were also sampled.

A total of 800 patients were sampled in total. The structured questionnaire forms, on the other hand, were filled and submitted by 711 patients. This amounted to 88.9% response level. The systematic random sampling technique was adopted in the distribution of the questionnaire. Applying this method, two respondents were skipped after a respondent had been sampled. The basis for this was that the participants were known and were found in one location.

Data analysis

The procedure for testing the stated hypothesis is explained in this section. Data collected for the hypothesis which states that physical distance, waiting time, transport cost, and travel time significantly determine patients' mobile telephone usage to access healthcare service by the patients were analysed using logistic regression analytical tools. Logistic regression was employed due to the categorical nature of the data as well as to identify salient determinants that predict respondents' mobile phone usage to seek medical services. As a result, logistic regression was employed to investigate the associations between a dichotomous dependent variable and dichotomous independent factors. The logistic regression model looks like this:

$$\text{Logit } \{p(x)\} = \log [p(x)/1-p(x)] = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 \dots \dots \dots \text{eqn (1)}$$

Where: Logit (p) = log (to base e) of the odds ratio or likelihood ratio that the dependent variable is 1; p = probability of the dependent variable.

The dependent variable, patients' use of mobile phones to access medical services, was measured as follows: those out-patients that uses mobile telephone to seek healthcare services from their healthcare providers were asked to respond with 'yes' while those out-patients that do not use mobile telephone to seek healthcare services from their healthcare service providers should respond with 'No'. The responses were coded as 'Yes' = 2 and 'No' = 1. The independent variables were denoted as X₁ to X₄ which are X₁ = Physical distance: Answers to the question (Do you use mobile telephone to access healthcare service because of your physical distance from the hospital) were re-classified as: If yes, then 1; otherwise, 0; X₂ = Average Waiting-Time: Answers to the question

(Do you use mobile telephone to access healthcare services because of waiting-time at the clinic) were measured as: If yes, then 1; otherwise, 0; X₃ = Travel time: Answers to the question (Do you use mobile telephone to access healthcare service because of the travel time to the hospital) were re-classified as: If yes, then 1; otherwise, 0; X₄ = Average Travel cost: Answers to the question (Do you use mobile telephone to access healthcare service because of transport cost to the hospital) were re-classified as: If yes, then 1; otherwise, 0); b₁ – b₄ = parameter estimate for the independent variables.

Participants characteristics

This section examines participants' characteristics which include sex, age, mobile telephone ownership among others. Table 1 shows that 711 patients comprising 370 (52.1%) in Lagos University Teaching Hospital (LUTH) and 341 (47.9%) in Lagos State University Teaching Hospital (LASUTH) were surveyed. Out of this, a total of 703 (98.9 %) possess mobile telephones. In total, 367 (99.2%) of the patients are owners of mobile phone in LUTH while 336 (98.5%) in LASUTH. 61.3% were females while 38.7% were males. This may be due to the fact that females have more reasons to use health facilities than their male counterparts. The age distribution of the patients surveyed ranged between 18 and 76 years old. The distribution in Table 1 shows that 220 (30.9%) of the patients were under the age of 20. Whilst 190 (26.7%) of the patients were between the ages of 21 and 30, 136 (19.1%) were between the ages of 31 and 40. These age groups were below 40 years and they constitute about 76.7% and form the largest proportion of the patients, implying that younger people utilize the health facility more than older ones. A total of 79 (11.2 %) were aged 41-50 years, 43 (6.0 %) were aged 51-60 years, 16 (2.3 %) were aged 61-70 years, and 27 (3.7%) were aged 71-80 years. In a nutshell, patients between < 20 – 40 years (young) are much higher in LUTH (86%) than LASUTH (66.8%). while patients between 41-80 years (old) are much higher in LASUTH (33.2%) than in LUTH (14.0%).

Table 1: Demographic profile of out-patient

Variable	Item	LUTH	LASUTH	Total	Percentage
Mobile telephone ownership	Yes	367	336	703	98.9%
	No	3	5	8	1.1%
Sex distribution	Male	160	115	275	38.7%
	Female	210	226	436	61.3%
Age	<20 years	132	88	220	30.9%
	21-30 years	105	85	190	26.7%
	31-40 years	81	55	136	19.1%
	41-50 years	20	59	79	11.2%
	51-60 years	10	33	43	6.0%
	61-70 years	6	10	16	2.3%
	71-80 years	16	11	27	3.7%

Source: Authors' Analysis

Patients' use of mobile phones

This section explains the prevalence of patients' use of mobile phone. According to Table 2, the prevalence of patients using mobile phones to access medical services is 33.2%. In all, 134 (36.2%) and 102 (29.9%) people were proven to

have used a mobile phone to receive medical services at LUTH and LASUTH, respectively. In the Table below, LUTH is regarded as Hospital 1 while LASUTH is regarded as Hospital 2.

Table 2: Use of mobile phone among patients

Variable	Responses	Hospital 1	Hospital 2	Total	Percentage
Use of mobile phone access medical services	Yes	134	102	236	33.2%
	No	236	239	475	66.8%
Total				711	100

Source: Authors' Analysis

Results

Determinants of mobile telephone usage for healthcare services utilization

The use of mobile telephone by patients to access healthcare services is a function of some determining factors. These factors pertain to those elements that determine the level of mobile phone usage in accessing medical services. These elements are patients' physical distance from the hospital, waiting-time at the doctors' office, travel time (i.e., time spent on travelling to the hospital) and transport cost (the cost of travelling to the hospital). The unified theory of acceptance and use of technology (UTAUT) model by Venkatesh et al. (2003) provides the basis for the choice of the independent variables listed above.

As shown in Table 3, the patients' distance from the hospital, 210 (29.5%) of the patients consisting of 127 (34.3%) in LUTH and 83 (24.3%) in LASUTH indicated that the distance between them and the hospital determines their use of mobile phone to access medical services. In the case of waiting-time, 213 (22.9%) of the patients comprising 97 (26.2%) in LUTH and 116 (34.1%) in LASUTH reported that waiting time determined their use of mobile phone to access medical services. Similarly, 174 (38.5%) of the patients, informed that the amount of time spent on travel because of heavy traffic congestion (Bashiru, 2008) in the metropolis encouraged the use of mobile telephone, whereas 122 (17.2%) accounted for travel cost. However, from the forgoing, it implies

that travel time is a crucial influence of patients' use of mobile phones to obtain medical services.

Table 3: Determinants of patients’ use of mobile phone for medical services utilization

Variables	Item	LUTH	LASUTH	Total	%
Physical distance patients from the hospital	No	243	258	501	70.5
	Yes	127	83	210	29.5
	Total	370	341	711	100.0
Waiting time	No	273	225	498	70.1
	Yes	97	116	213	22.9
	Total	370	341	711	100.0
Travel-time	No	301	236	537	61.5
	Yes	69	105	174	38.5
	Total	370	341	711	100.0
Travel cost	No	311	278	589	82.8
	Yes	59	63	122	17.2
	Total	370	341	711	100.0

Source: Author’s Analysis

Findings

This section discusses the findings of the results of the stated hypothesis. The results in Table 4 show that the variables of patient mobile phone usage (physical distance, waiting time, travel cost, and travel time) were investigated using logistic regression analysis. The result obtained indicated that the model of logistic regression was significant, demonstrating that the independent variables (physical distance, waiting time, and travel time) significantly predict the dependent variable (mobile telephone usage by patients) Chi-square = 43.822, $P < 0.05$. The table also shows the strength of the logistic regression association (model summary). In this situation, the Nagelkerke R square value indicates the level of variability there is in the dependent variable, the result revealed that 27.9 per cent (0.279) of the variability in the dependent variable (mobile telephone usage by patients) was explained by the model's set of independent variables.

Furthermore, the goodness of fit result demonstrated that the model adequately fits the data with a p-value (sig) greater than 0.05. If the Hosmer and Lemeshow Test-goodness-of-fit test value is greater than 0.05, it indicates that the model is well fit, and so the hypothesis that travel time, waiting time and physical distance of patients significantly determine mobile telephone usage is accepted. This

is because there is no difference between observed and model-predicted values. This implies that the model’s estimates fit the data at an acceptable level. That is, well-fitting models show non-significance on the *H-L goodness-of-fit test*. This desirable outcome of significance indicates that the model prediction is significantly different from the observed (Pampel, 2000; Agresti, 2007). The usefulness of the logistic model is evaluated by comparing the overall percentage accuracy. The categorization accuracy percentage is 81.6%, according to the results, suggesting that the model is highly useful.

The Wald statistic and associated probabilities represent the index of the significance of each predictor variable in the equation. The Chi-square distribution is contained in the Wald statistic. The simplest way to evaluate Wald is to take the significance values and reject the null hypothesis if they are less than .05, indicating that the variable does have a meaningful contribution. In this example, we can see in Table 4 that among the predictor variables included in the model to predict the likelihood of the dependent variable, travel time of patients helps greatly in the prediction of mobile phone usage ($X^2 = 13.575$, $p < 0.05$). This is followed by waiting time ($X^2 = 6.097$, $p < 0.05$) and the patients' proximity to the hospital ($X^2 = 5.739$, $p < 0.05$). The odd ratio shows how increasing the

appropriate measure by one unit affects the odds ratio. We can explain the odd ratio in terms of the change in odds. If the figure is greater than one, the odds of an outcome occurring increase; if the figure is less than one, any increase in the predictor results in a decrease in the probability of the outcome occurring (Agresti, 1996 and Pampel, 2000). As an example, the odd ratio value associated with travel time is 3.257. Therefore, if monthly travel time is increased by one unit (one person), the odds ratio triples, and so, monthly travel time is 3 times more

likely to predict patients' mobile telephone usage. The 'B' values are the logistic coefficients that can be used to create a predictive equation (like the b values in linear regression). Therefore, the analysis above shows that the predictor variables significantly predict the criterion variables, and among the predictors considered, travel time exerts the strongest prediction of mobile telephone use. The least determinant of mobile telephone usage among patients is physical distance.

Table 4: Results

Variables	β	SE	Wald	df	Sig.	Exp(β)	Odd ratio (e^{β})
Physical distance	0.770	0.321	5.739	1	0.017*	2.159	2.159
Waiting time	0.854	0.346	6.097	1	0.014*	2.350	1.193
Travel time	1.181	0.321	13.575	1	0.000*	3.257	3.257
Travel cost	-0.038	0.283	5.018	1	0.893	0.963	0.963
Constant	0.239	0.138	2.978	1	0.034	1.270	

Overall model estimation

	Chi-square	df	Sig.
Step	43.822	5	0.000*
Block	43.822	5	0.000*
Model	43.822	5	0.000*

Chi-square = 43.822*; Cox & Snell R Square = 0.171; -2 Log Likelihood = 545.671^a; Nagelkerke R Square = 0.279;

Overall model classification = 81.6; OR = Odd ratio; N=236

*Significant at 5% confidence level

Source: Author's Analysis

Conclusion

The study indicated that travel time, waiting time and physical distance are the predicting variables for patients' usage of mobile phones to obtain healthcare services. However, it was discovered that travel time exerted more influence on mobile telephone usage among patients. This implies that the long hours patients spent travelling to the healthcare centre may be because of the significant traffic congestion in the Lagos metropolis, resulting in patients using mobile phones to get healthcare services due to high traffic congestion. Waiting time was also a determining factor for patients' mobile telephone usage. This is particularly the

case because patients will rather use their mobile telephones to obtain medical services than spend hours waiting for their doctors at the clinic. Physical distance was also found as one of the determining factors of mobile telephone usage. Since healthcare facilities are unevenly distributed (Coeytaux, 1993), the problem of distance will always exist. Therefore, it is easier for patients to use mobile telephones rather than cover a long distance to the hospital. Although, previous studies have stressed the importance of mobile phone technology in the medical sector but have failed to identify the determinants of mobile phone usage in accessing medical services. This study, therefore,

filled the existing research gap in this area of research interest.

References

- Adamson, I. & Shine, J. (2003). Extending the New Acceptable Model to Measure the End User Information Systems Satisfaction in a Mandatory Environment: a Banks' Treasury. *Technology Analysis and Strategic Management*, 15(4), 441-457.
- Agresti, A. (2007). *An Introduction to Categorical Data Analysis*. John Wiley and Sons.
- Aiyegbajeje, F. O. & Ajayi, D. D. (2016). Mobile Telephone Technology for Better Healthcare Service Provision in Lagos Metropolis, Nigeria. *Digital Transformation and Global Society Communications in Computer and Information Science*, 674, pp. 532-543. Springer International Publishing.
- Aiyegbajeje, F. O. & Ajayi, D. D. (2020). Mobile health communication: Effective reduction of patients' travel needs to hospitals. *International Journal of Healthcare Management*, 13(1), 28-34. Taylor and Francis.
- Akadiri, O. A., Olusanya, A. A. & Omitola, O. O. (2009). Impact of Improved Telecommunication Services on Health Care Delivery in Nigerian Teaching Hospitals - A Survey of Opinions. *Journal of Information Technology Impact*, 9(3), 125-134.
- Akter, S. & Ray, P. (2010). MHealth-an ultimate platform to serve the unserved Yearbook Med Inform, pp. 94-100.
- Amosa, B. M. G., Longe, O. L. & Akinbode, O. P. (2012). Mobile-Phone Based Patient Compliance System for Chronic Illness care in Nigeria. *JCS&T*, 12(1).
- Bashiru, A. R. (2008). Analysis of Intra-Urban Traffic Problems in Nigeria: A Study of Lagos Metropolis. *Indonesia Journal of Geography*, XL(1).
- Beedasy, J. (2010). "Rural Designations and Geographic Access to Tertiary Healthcare in Idaho." *The Online Journal of Rural Research and Policy*, 5(2), 1-21.
- Beratarrechea, A., Moyano, D., Irazola, V. & Rubinstei, A. (2017). mHealth interventions to counter non-communicable diseases in developing countries: still an uncertain promise. *Cardiol. Clin.*, 35, pp. 13-30.
- Buor, D. (2003). Analyzing the Primacy of Distance in the Utilization of Health Services in the Ahafo-Ano South District, Ghana. *The International Journal of Health Planning and Management*, 18(4), 293-311.
- Coeytaux, F., Leornard, A. & Bloomer, C. (1993). Abortion: Scope and Magnitude of the Problem. In M. Koblinsky, J. Timyan & J. Gay (eds.). *The Health of Women: A Global Perspective*. Boulder, Westview Press, 217-234.
- Cox, P. & Scott, R. (2002). The Official Report of the 1st Asia Pacific Forum on Quality Improvement in Health Care. <http://www.adc.bmjournals.com>.
- Currell, R., Urquhart, C., Wainwright, P. & Lewis, R. (2010). Telemedicine versus Face to Face Patient Care: Effects on Professional Practice and Health Care Outcomes (Review). The Cochrane Collaboration. John Wiley & Sons, Ltd.
- Donner, J. (2004). Innovation in Mobile-Based Public Health Information Systems in the Developing World: An Example from Rwanda. The Center for Global Health and Economics Development. The Mailman School of Public Health. The Earth Institute at Columbia University. Draft Document for Workshop on Mobile Technologies and Health: Benefits and Risks. Udinese (Italy), 7-8 June, 2004.
- Ericsson and the Earth Institute Columbia University (2010). Millennium Villages Project: The Impact of Mobile Connectivity on the Millennium Development Goals in Africa. The Earth Institute Columbia University, USA. 2009.
- Franklin, V. L., Waller, A., Pagliari, C. & Greene, S. A. (2006). A Randomized Controlled Trial of Sweet Talk, a Text-Messaging System to Support Young People with Diabetes. *DiabetMed*. 23(12), 1332-1338.
- Friedman, R., Kazis, L., Jette, A., Smith, M., Stollerman, J. & Torgerson, J. (1996). A Telecommunications System for Monitoring and Counseling Patients with Hypertension. Impact on Medication Adherence and Blood Pressure Control. *American Journal of Hypertension*, 9(4 Part 1), 285-292.
- Gunamany, S. & Subramanyam, M. (2022). Utilization of maternal health care services and ownership and use of mobile phones among Indian women. *International Journal of Community Medicine and Public Health*, 9(5), 2239-2245.
- Idowu, B., Ogunbodede, E. & Idowu, B. (2003). Information and Communication Technology in Nigeria: The Health Sector Experience. *Journal of Information Technology Impact*, 3(2), 69-76.
- Idowu, P. A. & Ajayi, S. A. (2008). GSM Based Referral System for Primary Health Care Centres in Nigeria. *International Journal of Soft Computing*, 3(6), 421-427. *Medwell Journals*.
- Isola, S. (2012). The Use of Mobile Telephone in reducing Pre-Natal Maternal Mortality: Case Study of Abiye (Safe Motherhood) Project in Ondo State, South-West Nigeria. Retrieved From: <http://www.ifra-nigeria.org/IMG/pdf/sola-isola-case-study-abiy-e-project-repor.pdf>.
- Labrique, A. B., Vasudevan, L., Kochi, E., Fabricant, R. & Mehl, G. (2013). mHealth innovations as health

- system strengthening tools: 12 common applications and a visual framework. *Global Health: Science and Practice*, 1, pp. 160-171.
- Lee, Y., Kozar, K. A. & Larsen, K. R. T. (2003). The Technology Acceptance Model: Past, Present and Future. *Communications of the Association for Information Systems*, 12, 752-780.
- Lewis, A. (2012). WorldWeb Dictionary. WordNet database, Princeton University.
- Lu, J., Yu, C-S., Liu, C. & Yao, J. E. (1999). Technology Acceptance Model for Wireless Internet. *Internet Research*, 2003, 13(3), 206-222.
- Menon-Johansson, A. S., McNaught, F., Mandalia, S. & Sullivan, A. K. (2006). Texting Decreases the Time to Treatment for Genital Chlamydia Trachomatis Infection. *Sex Transm Infect*, 82(1), 49–51.
- Nezamdoust, S., Abdekhoda, M. & Rahmani, A. (2022). Determinant factors in adopting mobile health application in healthcare by nurses. *BMC Med Inform Decis Mak*. Springer. 22, 47. doi.org/10.1186/s12911-022-01784-y.
- Odendaal, W. A., Goudge, J., Griffiths, F., Tomlinson, M., Leon, N. & Daniels, K. (2015). Healthcare workers' perceptions and experience on using mHealth technologies to deliver primary healthcare services: qualitative evidence synthesis (Protocol) *Cochrane Database Syst. Rev.*, pp. 1-14.
- Pampel, F. C. (2000). *Logistic regression: a primer*. Sage Quantitative Applications in the Social Sciences Series, No. 132. Thousand Oaks, CA: Sage Publications.
- Patrick, K., Griswold, W. G., Raab, F. & Intille, S. S. (2008). Health and the Mobile Phone. *American Journal of Preventive Medicine*, 35(2), 177–181.
- Qureshi, S., Xiong, J. & Deitenbeck, B. (2019). The effect of mobile health and social inequalities on human development and health outcomes: mHealth for health equity Hawaii International Conference on System Sciences.
- Rosen, M. J. (2004). Surfactants and Interfacial Phenomenon. Surfactant Research Institute at Brooklyn College of the City University of New York.
- Ruxwana, N. L. (2007). Technology Assessment of Rural Hospitals in the Eastern Cape Province Thesis Tshwane University of Technology.
- Ryan, D., Cobern, W. & Wheeler, J. (2005). Mobile Phone Technology in the Management of Asthma. *J Telemed Telecare*, 11(1S), 43–46.
- Tucker, S. (2015). Welcome to the world of mHealth! *mHealth*, 1(1), 10.3978/j.issn.23069740.2015.02.01 <http://mhealth.amegroups.com/article/view/5836/6575#>.
- Venkatesh, V., Michael, G., Morris & Fred D. Davis (2003). User Acceptance of IT. *MIS Quarterly*, 27(3), 425-478/September 2003 425.
- WHO (2011). New horizon for health through mobile technologies. Global Observatory for e-Health Series. World Health Organization.
- World Health Organization (2020). Achieving the Health-Related MDGs. It Takes a Workforce! WHO. Available at: http://www.who.int/hrh/workforce_mdgs/en/. (Accessed: 5th February, 2022).