Factors affecting sustainable adoption of e-health technology in developing countries: an exploratory survey of Nigerian hospitals from the perspective of healthcare professionals

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Background. E-health technology applications are essential tools of modern information technology that improve quality of healthcare delivery in hospitals of both developed and developing countries. However, despite its positive benefits, studies indicate that the rate of the e-health adoption in some developing countries is either low or underutilized. This is due in part, to barriers such as resistance from healthcare professionals, poor infrastructure, and low technical expertise among others.

Objective. The aim of this study is to investigate, identify and analyze the underlying factors that affect healthcare professionals decision to adopt and use e-health technology applications in developing countries, with particular reference to hospitals in Nigeria.

Methods. The study used cross sectional approach in the form of a close-ended questionnaire to collect quantitative data from a sample of 465 healthcare professionals randomly selected from 15 hospitals in Nigeria. We used variable of modified Technology Acceptance Model (TAM) as dependent variable and external factors as independent variables. The collected data was then analyzed using SPSS statistical analysis such as frequency test, reliability analysis, and correlation coefficient analysis.

Results. The results obtained, which correspond with findings from other researches published, indicate that perceived usefulness, belief, willingness, as well as attitude of healthcare professionals have significant influence on their intention to adopt and use the e-health technology applications. Other strategic factors identified include low literacy level and experience in using the e-health technology applications, lack of motivation, poor organizational and management policies.

Conclusion. The study contributes to the literature by pin-pointing significant areas its findings can positively affect or be found useful, by healthcare policy decision makers in Nigeria and other developing countries. This is in making them understand their areas of priorities and weaknesses when planning for e-health technology adoption and implementation.

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10   **ABSTRACT**
11   **Background.** E-health technology applications are essential tools of modern information
12   technology that improve quality of healthcare delivery in hospitals of both developed and
13   developing countries. However, despite its positive benefits, studies indicate that the rate of the e-
14   health adoption in some developing countries is either low or underutilized. This is due in part, to
15   barriers such as resistance from healthcare professionals, poor infrastructure, and low technical
16   expertise among others.
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18   affect healthcare professionals decision to adopt and use e-health technology applications in
19   developing countries, with particular reference to hospitals in Nigeria.
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21   collect quantitative data from a sample of 465 healthcare professionals randomly selected from
22   15 hospitals in Nigeria. We used variable of modified Technology Acceptance Model (TAM) as
23   dependent variable and external factors as independent variables. The collected data was then
24   analyzed using SPSS statistical analysis such as frequency test, reliability analysis, and
25   correlation coefficient analysis.
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29   technology applications. Other strategic factors identified include low literacy level and
30   experience in using the e-health technology applications, lack of motivation, poor organizational
31   and management policies.
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34   other developing countries. This is in making them understand their areas of priorities and
35   weaknesses when planning for e-health technology adoption and implementation.

36   **INTRODUCTION**

37   **Background of the study**

38   Over the past few decades, the field of e-health technology has witnessed significant

39   development worldwide *(Luna et al., 2014)*. E-health, as defined by the World Health

40   Organization (WHO) is "the cost-effective and secure use of Information and Communications

41   Technologies (ICT) in support of health and health-related fields, including healthcare services,

42   health surveillance, health literature, and health education, knowledge and research" *(Blaya,*

43   *Fraser & Holt, 2010)*. E-health technology applications such as Hospital Information Systems

44   (HIS), Electronic Medical Records (EMR) system, internet-based telemedicine, and m-health are

45   essential tools of information technology that improve quality of healthcare delivery, increase

46   patient safety, and reduce healthcare costs *(Shekelle, Morton & Keeler, 2006)*. Other strategic

47   benefits of e-health technology include access to up-to-date health related information, e-

48   prescription, clinical decision support systems, well-organized information sharing among

49   different departments, enhanced administrative system, and easy maintenance of hospital services

50   *(Ludwick & Doucette, 2009; Meier, Fitzgerald & Smith, 2013)*.

51   In most developed countries of the world, there is enormous investment of resources into

52   acquiring the latest e-health tools and applications as a way of providing the most effective and

53   efficient healthcare services for their citizens. These healthcare services include sharing of health

54   information with relative ease, improvement of interaction between healthcare professionals and

55   their patients, making access to the best healthcare services and expertise to poor and remote

56   rural communities of a country *(Marques, et. al., 2011)*.

57   In Germany for example, the government, through the Federal Ministry of Health developed

58   electronic Health Cards for citizens covered by insurance. The smart card contains users' personal

59   information, history of medical records, and insurance details. The card is used by patients to

60   access healthcare services that are covered by the insurance, which significantly eases interaction

61   between healthcare professionals and patients *(Nzuki & Mugo, 2014)*. In Canada, the federal

62   government created an independent organization called Canada Health Infoway, which is fully

63   funded by the government and managed by Deputy Ministers of Health. This organization is

64   charged with the responsibility of creating and promoting the use of electronic health records

65   (EHRs) and electronic health information systems (eHIS). This ensures the sharing of medical

66   records and health knowledge among the federal, provincial and territorial areas across the

67   country *(Protti, 2008)*.

68   According to *Eason & Waterson (2013),* the United Kingdom has a well-established technology

69   infrastructures that support e-health system. Healthcare providers have computers with internet

70   connectivity, which they use during interaction with patients. Also, there is widespread use of

71   Decision Support Systems (DSS) by physicians to assist in taking clinical decisions for patient's

72   healthcare. High network connection also enables the sharing of medical data among healthcare

73   professionals through the use of electronic health records systems. Other advanced health

74   services in the UK includes ePrescription service, eRadiology solutions, and appointment

75   scheduling solutions.

76   These strategic benefits of e-health technology make it significantly relevant for developing

77   countries, where access to basic social amenities such as quality healthcare is hampered by poor

78   government policies, political unrests, and lack of modern technology infrastructure *(Luna et al.,*

79   *2014)*. A comparative analysis of four developing countries namely Turkey, Saudi Arabia, Egypt,

80   and United Arab Emirates was conducted by *Uluc & Ferman (2016)* to determine the challenges

81   faced by healthcare professionals in using e-health technology. The study identified ICT

82   infrastrucuture, policy regulations, clinical adaptation of users, healthcare financing, and supply

83   chain management as the major challenges faced by the healthcare professionals.

84   However, despite the challenges faced by developing countries, studies have shown that a few

85   have adopted and implemented a wide range of e-health tools and applications in health

86   institutions *(Blaya, Fraser & Holt, 2010)*. Studies conducted by *Verbeke, Karara, & Nyssen*

87   *(2013)* which evaluate the impact of ICT tools on healthcare delivery in sub-Saharan Africa have

88   revealed the extent to which the said tools can help to improve efficiency and effectiveness of

89   health services in hospitals. The result disclosed that clinical services such as patient

90   identification, structured reporting, and financial management improved significantly after

91   implementation of e-health tools in a set of 19 African health institutions. The study found also,

92   that average waiting time decreased in 15 out of the 19 health centers, and real-time financial

93   management metrics helped hospitals to quickly identify fraudulent practices and defective

94   invoicing procedures. Similarly, a study conducted by *Qureshi (2016)* on creating a better world

95   with ICT, found that technology applications such as GPS, data analysis, and cell phone records

96   were used to track suspected cases of Ebola virus epidemic in Nigeria in 2014. So too, were the

97   social media and SMS also used to create awareness and inform the public about the danger of

98   the deadly disease.

99   Another study conducted by *Burney, Mahmood, & Abbas (2010)* examined the emerging

100   technologies in e-health in the context of developing countries. The findings showed that e-health

101   tools such as telemedicine, m-health, bar code technology, radio frequency identification, and

102   clinical decision support systems, picture archiving & communication system significantly

103   improve patient safety, dietary management, and document management, which generally

104   improve the quality of healthcare services delivered to the patients. Another study in similar vein

105   was conducted by *Malaquias RF, Malaquias FF, & Hwang (2017)* on the role of ICT for

106   development in Brazil, with specific focus on IT advances in the health area. The findings

107   showed that e-health applications such as telemedicine applications for cancer and prescription

108   processes, electrocardiogram in the clouds, and remote tele-monitoring of chronic patients have

109   direct effect on social and human development.

110   **Problem statement**

111   Despite the potentials of e-health solutions to improve quality healthcare in developing countries

112   like Nigeria, studies indicate that the rate of their adoption in developing countries is either low

113   or underutilized. This is due in part, to perceived barriers such as resistance by healthcare

114   professionals, poor infrastructure, and low technical expertise *(Simon et al., 2007)*. According to

115 *Sapirie (2000)*, there exists a wide gap between planning for adopting new technology, and

116 sustainable implementation of such technology to achieve strategic or expected benefits. In order

117 to adopt a new technology (such as e-health), there is need to conduct readiness assessment of

118 health institutions by healthcare workers and managers to provide guidelines capable of

119 addressing potential challenges after implementation. This assessment should be conducted both

120 at an early stage of development and intermittently after implementation in order to evaluate the

121 successes and challenges of the system *(Kgasi & Kalema, 2014)*. Nigeria, like most developing

122 countries, is yet to cover this gap between planning to adopt e-health technology applications,

123 and their sustainable implementation as policy objective *(Justice, 2012)*.

124 Nigeria has a population of 186 million as at 2016 and majority of these reside in remote rural

125 and poor areas, where access to basic social amenities such as quality healthcare services, good

126 roads, electricity supply etc. is either poor or non-existent *(Erondu & Oladejo, 2015)*. According

127 to statistics by the Nigeria Medical Association (NMA), there are over 45,000 medical doctors in

128 Nigeria. This indicates a ratio of one doctor to 4000 patients *(NMA Report, 2016)*. Clearly, it

129 represents a far cry from the recommendations of the World Health Organization (WHO) of one

130 doctor to not more than 600 patients. In Nigeria, the Federal government has made efforts to

131 develop and deploy e-health technology applications in hospitals to improve healthcare services.

132 However, healthcare workers reported that they were not carried along in the planning process,

133 and implementation is largely at pilot stages, uncoordinated, and yet to be scaled up, due to lack

134 of comprehensive e-health national policies and strategies *(Luna et al., 2014)*. Other barriers to

135 acceptance of e-health by the healthcare professionals include apathy in embracing ICT tools, and

136 poor awareness of e-health advantages *(Adebayo & Ofoegbu, 2014)*.

137 **Study objective**

138 This study specifically focuses on the factors affecting e-health technology adoption and

139 utilization from the viewpoint of healthcare professionals in Nigeria. The objective of the study is

140 to identify, investigate, and analyse the drivers and main barriers for e-health technology

141 acceptance by healthcare professionals. These professionals are the primary users of the system;

142 hence, understanding their willingness, beliefs, attitudes, and behaviours towards accepting and

143 using the new technology is an important area to investigate and study. The findings of the study

144 can assist healthcare administrators and policy makers in Nigeria to become better informed

145 about e-health technology benefits, and how it can be utilized effectively to derive the maximum

146 benefits. Moreover, by comparing the findings of the study with the existing literature, it can

147 serve as a guide to the stakeholders to understand their areas of priorities and weaknesses when

148   planning for e-health technology adoption and implementation in hospitals and health

149   institutions.

150   The research questions for the study are:

151   a. What is the level of adoption and utilization of ICT tools in Nigerian hospitals?
152   b. What is the level of ICT literacy and experience of the healthcare professionals?
153   c. What are the challenges affecting the adoption and utilization of the ICT tools?
154   d. How can a developing country like Nigeria adopt and utilize ICT tools in hospitals?
155   e. Is there correlation between the independent variables and the dependent variable of

156   intention to use e-health technology by healthcare professionals in the country?

157   The modified TAM model (see Figure 1) shows the relationship between the independent

158   variables of security concerns, information sharing, staff IT experience, technical infrastructure,

159   perceived usefulness, and attitude towards e-Health, with the dependent variable of intention to

160   use e-Health. These variables form the basis for developing the research hypotheses that serve as

161   the principal guides in conducting the research in order to answer the research question "e". The

162   research hypotheses are:

163   *Hypothesis (H1): Attitude towards e-Health will positively influence intention to use e-Health.*

164   *Hypothesis (H2): Perceived usefulness will positively influence intention to use e-Health.*

165   *Hypothesis (H3): Information sharing will positively influence intention to use e-Health.*

166   *Hypothesis (H4): Staff IT experience will positively influence intention to use e-Health.*

167   *Hypothesis (H5): Technical infrastructures will positively influence intention to use e-Health.*

168   *Hypothesis (H6): Security concerns will positively influence intention to use e-Health.*

169   **Theoretical model**

170   Technology Acceptance Model (TAM) is a popular tool that is used to understand the factors

171   affecting the adoption and usage of new technology by healthcare professionals *(Yarbrough &*

172   *Smith, 2007)*. This model focuses exclusively on factors determining users' behavioral intentions

173   from healthcare professionals' perspectives. However, the TAM model is deficient in terms of

174   integrating user interaction and task, which is an important aspect of ICT integration in

175   organizations *(Durodolu, 2016)*. Therefore, an extended TAM model is proposed and utilized in

176   this study to identify the relative factors that contribute to the healthcare professionals'

177   acceptance of e-health technology. Our research introduces new variables to the TAM model in

178   order to suit this particular study. These new variables include staff IT experience, technical

179   infrastructures, security concerns, and information sharing. These additional independent factors

180   enhance the TAM's predictive power *(Steininger & Stiglbauer, 2015)*. Figure 1 shows the

181   proposed research model.

182   **[FIGURE 1 PLACE HERE]**

183   The proposed theoretical model is a simple flow chart depicting the relationship between the

184   dependent variable of intention to use e-health technology, with the independent variables of

185   perceived usefulness, attitude towards e-health, security concerns, information sharing, staff IT

186   experience and technical infrastructure. The theoretical model would serve as the principal guide

187   to this study.

188   **MATERIALS AND METHODS**

189   **Study design, setting and participants**

190   This study is a cross sectional study design that was used to investigate, identify and analyze the

191   underlying factors that affect healthcare professionals' decision to adopt and use e-health

192   technology applications in developing countries, with particular reference to hospitals in Nigeria.

193   The setting involves 15 hospitals in Northwest region of Nigeria. A cluster random sampling

194   method was applied for hospital selection *(Teddlie & Yu, 2007)*, while the participants were

195   selected randomly from healthcare professionals such as doctors, nurses, radiologists, laboratory

196   technologists, and medical directors of the hospitals. The participants were informed that

197   participation was voluntary, and their responses would be treated as confidential. Therefore, each

198   individual consented to participate in the survey. Previous literature studied showed that only

199   medical doctors were considered in this type of survey, without according due consideration to

200   other healthcare professionals. This results in a kind of bias in the research findings. Therefore,

201   this study takes a step further by including other healthcare professionals in the survey. This

202   ensures a balanced opinion of the participants as well as the generalizability of the research

203   findings.

204   **Data collection tools**

205   The study uses quantitative survey method in the form of a close-ended questionnaire to collect

206   data from 15 different hospitals in the Northwest region of Nigeria. The questionnaire items (see

207   Appendix) were adopted from a number of studies *(Tome et al., 2014; Erasmus, Rothmann &*

208   *Van Eeden, 2015; Melas et al., 2011; Abu-Dalbouh, 2013)*. These consist of demographic and

209   survey questions asking the participants to express their opinions on their knowledge, perception,

210   and experiences with e-health technology applications. The survey questions were rated on a 7-

211   point Likert scale, where 1=strongly disagree, 2=disagree, 3=slightly disagree, 4=neutral,

212   5=slightly agree, 6=agree, and 7=strongly agree. While the participants' level of Information

213   Technology (IT) literacy and experience is measured at a scale of "None = no IT literacy";

214   "Minimum = little IT literacy"; "Fairly = average IT literacy"; and "Maximum = sufficient IT

215   literacy". A total of 600 questionnaires containing 24 items were distributed, out of which 481

216   copies were successfully retrieved, achieving a response rate of 80.2%. However, 16

217   questionnaires were considered invalid due to incomplete or blank response, and thus were

218   discarded. Therefore, only 465 surveys were included for further analysis using SPSS software

219   version 21.

220   **Survey procedure**

221   Hard copies of the questionnaires were administered by the author in person. A covering letter

222   was attached to the questionnaire that highlights the objectives and importance of the survey.

223   Before administering the questionnaire, the author in collaboration with the Medical Director of

224   each hospital made a brief introduction to the participants explaining the importance of e-health

225   and the survey in general. In order to actualize the validity of the measuring instrument used for

226   the data collection, the questionnaire was cross-checked by academics in the field of

227   Management Information Systems (MIS) and senior personnel in the health sector. These experts

228   provided corrections and suggestions that result in some modifications of the items in the

229   questionnaire, which ensure its content and face validity.

230   **Data analysis and management**

231   The 465 completed surveys were then sorted, and the data was entered into SPSS software for

232   further analysis. Each question was analyzed using a coding system that summarized the

233   responses into subjects. Statistical tests were conducted to analyze the data, which include,

234   reliability analysis to determine the Cronbach's Alpha value of the questionnaire, frequency test

235   for the demographic questions, and descriptive analysis for the survey questions. The results of

236   the demographic information and survey questions were then interpreted and analyzed in order to

237   determine the objectives of the study, proffer solutions, recommendations, and possible direction

238   for future research.

239   **Ethics**

240   Ethical approval was obtained from the Health Research Ethics Committee (HREC) of the

241   Federal Republic of Nigeria, with HREC clearance number: [MOH/ADM/SUB/1167/II/69].

242   **RESULTS AND ANALYSIS**

243   **Demographic analysis**

244   The result of the demographic information that includes variables such as gender, profession of

245   participants, and their working experience are shown on Table 1.

246   **[TABLE 1 PLACE HERE]**

247   The result shows that majority of the participants are male (64.9%), while female constitute

248   (35.1%). This is an expected characteristic that is common in developing countries, where there is

249   gender inequality in employment opportunities. According to findings by *Dormekpor (2015)*,

250   there is gender inequality in employment opportunities, especially in developing countries.

251   However, this did not affect the outcome of the research. The participants' working experience in

252   terms of distribution ranged from those having 6-10 years on the job (51.6%). According to

253   findings by *Simon et al. (2007); Or & Karsh (2009)*, users of new technology in organizations

254   tend to be younger than the average population, and have potentially higher IT literacy.

255   A simple descriptive analysis was conducted to determine the participants' level of IT literacy and

256   experience, which is shown in Figure 2:

257   **[FIGURE 2 PLACE HERE]**

258   Majority of the participants representing 53% reported having minimum level of IT literacy and

259   experience. Similarly, 34% have fair knowledge of IT, which implies being able to use the

260   computer, browse the internet, and send emails. About 8% reported having sufficient IT

261   knowledge, while only 4% reported not having any knowledge of IT at all. This is an important

262   measurement in adopting and implementing a new system. The result shows good level of IT

263   literacy, but there is still need for improvement.

264   **Reliability analysis**

265   A reliability analysis was conducted to determine the Cronbach's Alpha value of the Likert scale,

266   which determines the consistency and reliability of the questionnaire. Reliability means that

267   scores from the instrument are stable and consistent. The value of the Cronbach's Alpha was

268   calculated as ($\alpha = 0.899$), which was above the recommended threshold value of 0.7 *(Tavakol &*

269   *Dennick, 2011)*. This further confirms the evidence of internal reliability of the measuring

270   instrument, where the result is expected to remain consistent even with different samples.

271   **Correlation coefficient analysis**

272 The correlation coefficient statistical analysis was conducted to determine the degree of
273 relationship between the dependent and independent variables of the research model.

274   **[TABLE 2 PLACE HERE]**

275 The results of the correlation coefficients shown in Table 2 indicate significant positive
276 correlation among the variables of the hypotheses at a moderate range of $(0.34 < r < 0.40)$. This
277 means that the dependent variable from the modified TAM model can be linearly predicted from
278 the independent variables with a significant degree of accuracy. According to *Krehbiel (2004)*,
279 the recommended threshold value to indicate significant correlation among the variables ranges
280 between 0.3 and 0.9.
281 A statistically significant positive correlation of moderate effect was obtained between attitude
282 towards e-health and intention to use e-health *(hypothesis 1) at r =* 0.34. Similarly, a significant
283 positive correlation exists between perceived usefulness and intention to use e-health *(hypothesis*
284 *2) at r =* 0.38. However, the independent variable information sharing has weak positive
285 correlation with intention to use e-Health *(hypothesis 3) at r =* 0.05. Therefore, the hypothesis is
286 rejected. The variable staff IT experience has significant positive correlation with the dependent
287 variable of intention to use e-health *(hypothesis 4) at r =* 0.34. The independent variable of
288 technical infrastructures also has significant positive correlation with intention to use e-health
289 *(hypothesis 5) at r =* 0.35. Finally, security concerns have weak positive correlation with intention
290 to use e-health *(hypothesis 6) at r =* 0.09. Therefore, the hypothesis is also rejected.

291 **DISCUSSION**
292 This study was conducted to answer five principal questions, which were outlined in the
293 introduction section.
294   a. *What is the level of adoption and utilization of ICT tools in Nigerian hospitals?*
295   Findings from our study identified that the level of technology adoption is at a lower ebb,
296   and even in the hospitals that were able to acquire such systems, implementation is largely
297   at pilot stages, uncoordinated, and yet to be scaled up, due to lack of technology
298   infrastructure and comprehensive e-health national policies and strategies. Consequently,
299   there was poor utilization of the technology by the healthcare professionals. This finding
300   corresponds to those reported in other published literature *(Lee, Ramayah & Zakaria,*
301   *2012; Qureshi et al., 2013)* who stated that lack of technology infrastructure is the main
302   barrier affecting healthcare professionals' decision to adopt e-health technology

303   applications. Similarly, *Quaglio et al (2017)* in their study on the use of Technology-

304   Based Interventions (TBI) for healthcare delivery identified poor infrastructure and the

305   lack of digital literacy as the major barriers to the diffusion of TBIs.

306   *b.* *What is the level of ICT literacy and experience of the healthcare professionals?*

307   The result of the study indicates that majority of the participants have fair knowledge of

308   IT and a relative experience with the technology tools and applications. This finding

309   corresponds to those obtained by *Venkatesh, Thong & Xu (2012)*, who stated that IT

310   literacy and experience of healthcare professionals have significant influence on their

311   willingness, perception, attitude, and intention to use health technology applications. In a

312   similar vein, *Kabashiki & Ngozi (2014)* in his study on healthcare professionals' challenge

313   in using ICTs to manage patients identified that healthcare professionals who have

314   sufficient information technology literacy and experience constitute positive

315   characteristics for the use of new technology such as e-health technology applications.

316   *c.* *What are the challenges affecting the adoption and utlization of the ICT tools?*

317   Based on the findings from our research and the findings from previous published

318   literatures on technology acceptance studies *(Steininger & Stiglbauer, 2015; Melas et al.,*

319   *2011; Venkatesh, Thong & Xu, 2012)*, we identified the major barriers to e-health adoption

320   in Nigeria and other developing countries, which we categorized into six principal areas,

321   these include: (1) Technology infrastructure barriers related to hardware, software, and

322   networking; (2) Information Technology literacy barriers related to knowledge and

323   experience in using ICT tools and applications; (3) Monetary barriers related to budgeting

324   and funding; (4) Human resource barriers related to attitude, willingness, and belief of the

325   healthcare professionals to use the e-health technology; (5) Administrative barriers related

326   to organizational and management policies; and (6) Security barriers related to privacy

327   and trust in using the technology. This findings corresponds to those published in other

328   studies. For example, *(Qureshi et al., 2013; Hoque, Mazmum & Bao, 2014; Jaroslawski*

329   *& Saberwal, 2014)* identified some challenges affecting the adoption and utilization of

330   ICT tools in hospitals, which include poor user acceptance, lack of infrastructure,

331   financial constraints, lack of computer literacy, and organizational policies.

332   *d.* *How can a developing country like Nigeria adopt and utilize ICT tools in hospitals?*

333   Findings from our study identified that there is low funding for the health sector in

334   Nigeria. Therefore, it needs to be improved in line with the recommendations of the

335   World Health Organization benchmark, which requires countries to allocate at least 13

336   percent of their annual budget to the health sector. However, Nigeria budgeted only 4.4

337   percent in 2016 and 4.1 percent in 2017 national budget for the health sector, which is

338   grossly inadequate when compared with other developing countries. This finding

339   corresponds to the findings of *Obansa (2013)*, who stated that Nigeria has a very low par

340   capita health spending for healthcare delivery. Similarly, this findings also corresponds

341   with those reported by *Eneji, Juliana & Onabe (2013),* who stated that allocation of

342   limited resources to healthcare expenditure is the major challenge facing policy makers,

343   which in turn affects the health status and national productivity of the country. Therefore,

344   the study identified that there is low budget and funding for the healthcare sector in

345   Nigeria, which needs to be improved as reported by other studies.

346   e.   *Is there correlation between the independent variables and the dependent variable of*

347   *intention to use e-health technology by healthcare professionals in the country?*

348   The results obtained through correlation coefficient statistical analysis for hypothesis

349   testing to determine the degree of relationship among the variables indicated the

350   significant positive correlation between the dependent variable of intention to use e-health

351   and the independent variables of the research hypothesis (See Table 2). These findings

352   corresponds with results from other published studies *(Adebayo & Ofoegbu, 2014;*

353   *Bergoeing, Loayza & Piguillem, 2010; Hoque, Mazmum & Bao, 2014; Qureshi et al.,*

354   *2013)*, who stated that technical infrastructures, IT literacy and experience, as well as

355   attitude, belief, and willingness of the healthcare professionals have significant influence

356   on their intention to use the e-health technology applications.

357 **Limitations and future research**

358 Our study is limited by geographical scaling, having been conducted in one country and focused

359 on 15 hospitals only. This is owing mainly to shortage of funds, as grants for research are not

360 easily accessible or readily obtainable. Therefore, there is room for making its scope wider and its

361 findings more reliable and generalized if more countries and additional hospitals are visited and

362 examined. However, based on the related literature reviewed, we were able to identify and study

363 the situation in other countries. We suggest that future researchers would fill in whatever yawning

364 gap that is perceived between our current findings and what vistas remained to be uncovered.

365 Another limitation is that the study is cross sectional, which is considered fast, simple, and less

366 expensive to perform. However, a cross sectional study could be biased, where participants who

367 took part in the study failed to represent the views of the whole population, affecting

368 consequently, the generalizibility of the research findings. This is because it is based on a

369 questionnaire survey, and participants are interviewed only once *(Sedgwick, 2014)*. Hence, future

370 study should consider adopting a longitudinal approach, where participants are interviewed

371 severally over a period of time.

372 However, despite these limitations, this study was able to investigate and identify the critical

373 factors that affect healthcare professionals' decision and willingness to adopt and implement e-

374 health technology applications in developing countries with specific focus to Nigerian hospitals.

375 **CONCLUSION**

376 This study focused mainly on the pertinence and necessity of adopting and implementing e-health

377 technology applications in hospitals and medical institutions in a developing country like Nigeria.

378 The main objective of the research was to determine the critical barriers and drivers for adopting

379 e-health technology applications from the viewpoint of healthcare professionals in developing

380 countries. The findings from this study would make significant contribution both to theory and

381 practice of sustainable information system adoption in Nigeria relating to the health sector and its

382 effective delivery and management. The technology acceptance theory which evolved from our

383 research could be refined for the attainment of the said objective, as much in Nigeria, as in other

384 developing countries.

385 **Acknowledgment**

386 We would like to thank all those healthcare professionals who participated in filling the

387 questionnaire, and we particularly acknowledge the contribution of Dr. Mustafa Abu-Yaro (The

388 Chief Medical Director), who assisted in mobilizing the participants of the survey.

389

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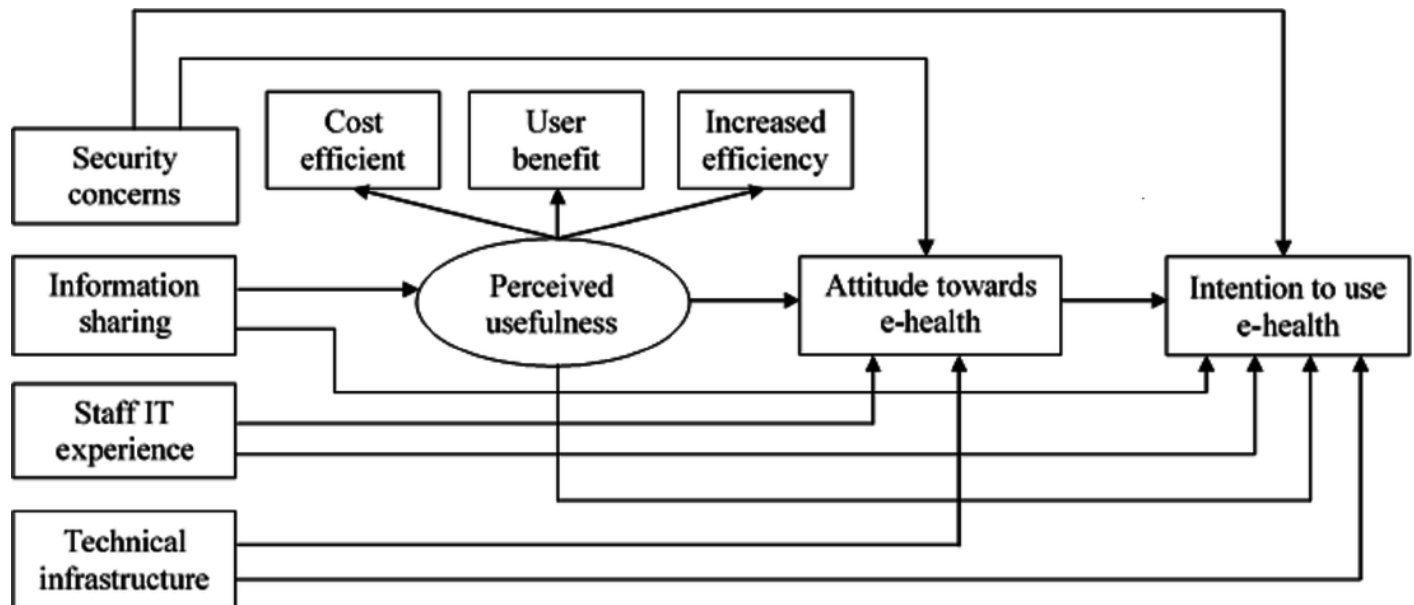
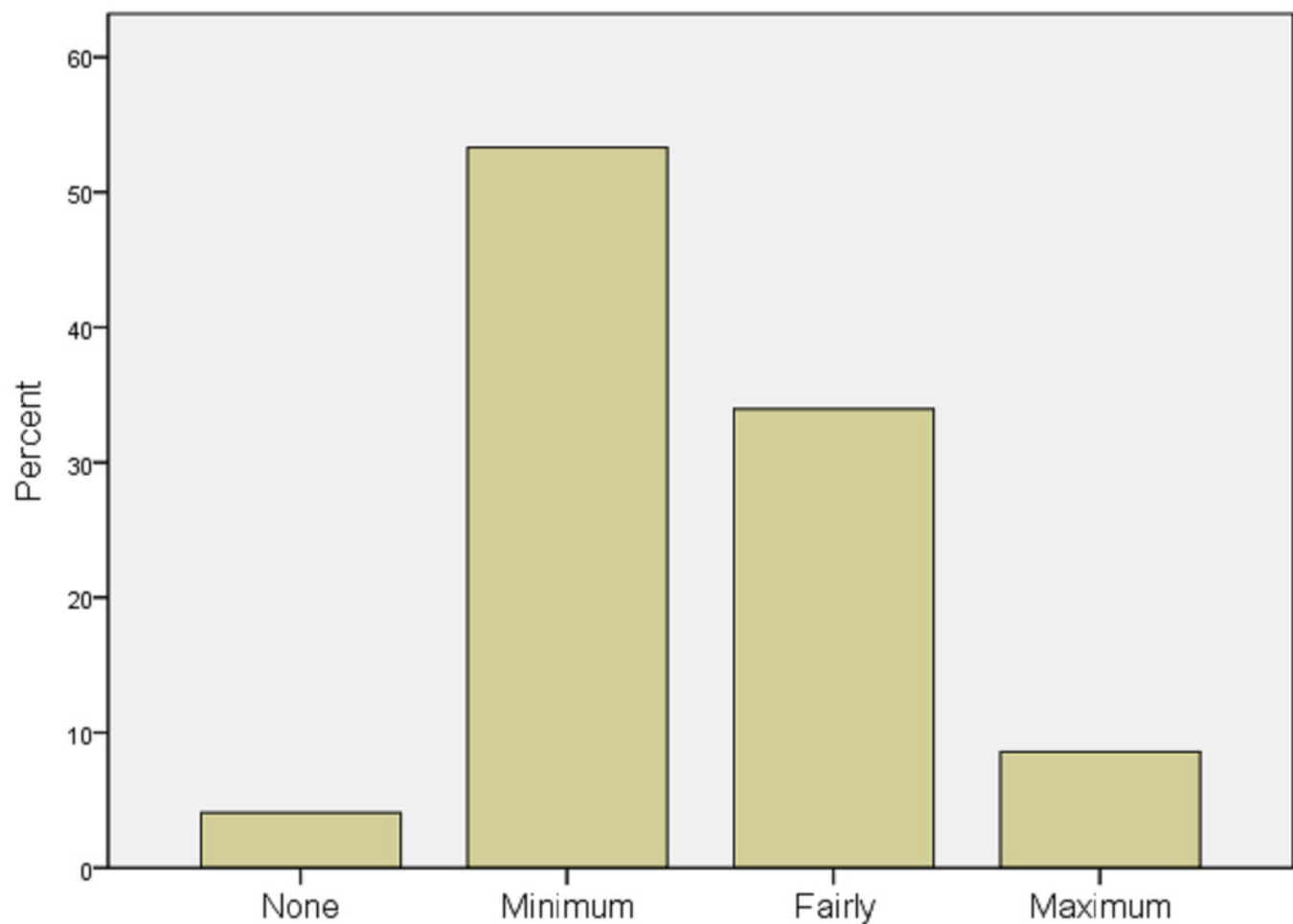
Figure 1

Proposed theoretical research model

Demographic analysis for the survey data *(n = 465)*

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	302	64.9
	Female	163	35.1
Profession of respondents	Doctors	44	9.5
	Nurses	144	31.0
	Others	277	59.5
Experience of respondents in hospital	1-5	105	22.6
	6-10	240	51.6
	11-25	120	25.8

Figure 2

IT literacy and experience of respondents

Correlation coefficient for items of the hypotheses

INT: Intention; ATT: Attitude; PU: Perceived Usefulness; SC: Security Concerns; IS: Information Sharing; ITE: Information Technology Experience; TI: Technical Infrastructures. N/A: Not Applicable

VARIABLES	INT	ATT	PU	TI	IS	ITE	SC
INT	–						
ATT	.34	–					
PU	.38	.36	–				
TI	.35	.38	N/A	–			
IS	05	N/A	N/A	N/A	–		
ITE	.34	.37	.40	N/A	.11	–	
SC	.09	.10	N/A	N/A	.09	N/A	–