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Assessment of ICT-Based Innovations in Primary Healthcare Delivery in Southwestern Nigeria

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Abstract

This study investigated the recently adopted ICT-based innovations in the primary healthcare sector and also examined the extent of use of adopted ICT-based innovations in primary healthcare delivery in Southwestern Nigeria. This study covered thirty (30) primary healthcare centres selected from Lagos, Ogun and Oyo States across Southwestern Nigeria using multistage sampling technique. Primary data were collected using 2 sets of questionnaire administered on 30 heads of healthcare centres and 180 health workers as well as interviews. The study revealed that Computer, phone and tracker, Digital weight scale, Centrifuge and Nebulizer machine, Blood pressure apparatus, Digital thermometer, Solar refrigerator, oxygen concentrator, Microscope, Contraceptives and DBS Fax result printer were introduced and adopted for use. The study further showed that staff training was rated high among the factors that led to the adoption of ICT-based innovations in the Primary Healthcare Centres. Four strategies (Parallel, pilot, phased and plunge strategies) were used for the implementation of the adopted ICT-based innovations in the primary healthcare centres. Analysis showed that academic and professional qualifications were statistically significant ($p<0.5$) factors that influence the decision of the healthcare professionals to continue to use the adopted ICT-based innovation. The study concludes that the training healthcare professionals undergo introduce them to different ICT-based innovation which when used will further enhance healthcare delivery in Southwestern Nigeria.

Keywords: ICT-Based Innovation, Primary Healthcare Centres, Implementation Strategy, Innovation Knowledge, Nigeria Healthcare Delivery

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INTRODUCTION

Background to the study

Highly effective primary healthcare delivery is known to keep individuals, families and communities healthy. However in Nigeria, primary care is presently in a state of evolution. Policy makers who were preoccupied with cost containment in the early 1990s are now faced with the challenge of providing more effective healthcare services to the public. Concerns about access, particularly with respect to primary care, are compounded by an aging healthcare workforce, the increased prevalence of chronic disease and the complexities of team-based contemporary practice.

As Africa's largest economy and most populous nation, Nigeria is experiencing substantial economic expansion, yet the country's health system is strained. The country's economy is growing at an average annual rate of 7% and is expected to be among the ten largest economies by 2050 (World Bank, 2015). Despite the country's economic gains, over 46% of the population continues to live in poverty (World Bank, 2015) and the overall health status of the Nigerian population is poor as defined by the 2013 Nigeria Demographic and Health Survey. Infectious and non-communicable diseases remain among the leading causes of morbidity and mortality (World Bank, 2015; National Populations Commission, 2013; Centre for Disease Control and Prevention, 2014; WHO, 2014) and health coverage and financing remains low (WHO, 2013; NHIS, 2015; Jenna *et al*., 2013).

The poor performance in primary healthcare (PHC) service delivery may be due to the way innovation is handled in the system. Innovations are the keys to growth, employment, prosperity and quality of life. The significance of technology in healthcare delivery cannot be overstated. Healthcare, for many years, has been characterised by innovation concerning treatments, medications and healthcare information systems. In order to meet the requirements that are placed on healthcare, more and newer innovative solutions are needed (Bessant, Kunne and Möslein, 2012). Innovative technologies are highly needed in healthcare delivery because of the new challenges that are now facing healthcare providers. Some of these challenges are extremely complex and are characterised by rising demand, increasing costs and insufficient funding of healthcare service delivery. Never as much as today have healthcare systems been interested and involved with the potential benefits deriving from innovations.

An organisation may decide to develop a new product, process or method of doing things; or decide to acquire a technology developed elsewhere for use in its operations (adoption of innovation). When one of the two occurs in an organisation, the innovation has to be used by healthcare professionals in their day-to-day activities. When a decision is taken and innovation is used, this is referred to as implementation (Klein and Sorra, 1996; Dong *et al*., 2008; Ika, 2009). Implementation involves the series of activities undertaken to ensure an idea or product has been put to productive use.

The use of ICT-based tools has a high impact on enhancing work performance that makes the project perform better against the plan (Asenuga *et al.*, 2019). Studies have further revealed that the adoption of ICT-based innovation in healthcare is seen as a solution to improving the efficiency and quality of healthcare delivery (Chaudhry, 2006; Kuperman and Gibson, 2003; McCullough, Casey, Moscovice, and Prasad, 2010), yet ICT-based innovation adoption in healthcare is relatively low (Jha *et al*., 2009). However, Gross improvements in healthcare service quality have been achieved by the adoption of ICT-based innovation such as computed tomography scanners, electronic transfer of care communication tools, shared medical appointment (SMA), bar coded medication administration technology and the likes (Olaposi, 2017).

Statement of the problem

In spite of the public display of political will and extensive investment, poor performance of primary healthcare facilities in Nigeria is common knowledge. Although these facilities are mandated to serve the majority of the population, they are unable to provide basic and cost-effective services, especially in rural areas (Okoli, Eze-Ajoku, and Oludipe, 2016).

According to Ogbaisi and Asenuga (2018), a key element of economic accounting is to ensure that public resources are spent according to the electoral and administrative mandate and that funds are distributed in line with stated objectives. Compared with other African countries, Nigeria ranks low in

nearly all PHC performance indicators. Previous studies have shown that Nigeria's performance in healthcare service delivery is low, despite the country's abundance of PHC centres, reasonable geographic access to PHC, and relatively high health worker density. Some scholars (Okoli, *et al*., 2016; Chinawa, 2015; Azu and Chinedu, 2014; Kurfi, *et al*., 2013 and Anie, 2011) have attributed the poor performance of PHC to factors such as poorly equipped health facilities, insufficient staff, lack of clearly defined roles and responsibilities, inadequate political commitment, poor accountability and poor implementation of ICT-based innovations.

Innovation is a highly essential phenomenon in healthcare systems. It is a vital driving force in balancing cost containment and healthcare quality. In the developed world, ICT-based innovations are known to have transformed activities in the health sector, especially in the improvement of quality of care. For healthcare delivery to be effective, ICT-based innovations have to be available and also, properly implemented in the organisations (Paulussen, 1994; Fleuren, Wiefferink, and Paulussen, 2004). In Nigeria, most ICT-based innovations are adopted, not developed and when ICT-based innovations are made available but are not used as intended, it does not benefit the patients for whose care it is developed or acquired. Therefore, this study, having perceived this gap, is designed to examine the extent of usage of adopted ICT-based innovations in primary healthcare delivery in Southwestern Nigeria.

LITERATURE REVIEW

What is Innovation?

Innovation is the process of translating an idea or invention into a product/service that creates value or for which customers will pay. To be called an innovation, an idea must be replicable and must satisfy a specific need. Innovation involves deliberate application of information, imagination and initiative in deriving greater or different values from resources, and includes all processes by which new ideas are generated and converted into useful products.

Ng'ethe (2003) viewed innovation as meaning a change in the way of doing things and/or doing different things. Other definitions view innovation as introducing something new to the world; that is, something that has never existed before. This is where the term 'innovation' and 'invention' are synonymous. Ng'ethe (2003) noted that an innovation might be new to one institution or person but might be practiced elsewhere. In this case, the primary healthcare organisations would be copying best practice from elsewhere. Nge'the's argument was supported by Klein and Knight (2005), who further contended that an innovation need not actually be new but might simply be perceived as new by the adopters. For the purpose of the current study, the definition of innovation that was adopted was "a planned process of introducing change, intended to bring about improvements or solve or alleviate some perceived problem" (Klein and Knight, 2005).

Innovation in healthcare organizations are typically new services, new ways of working and/or new technologies (Lansisalmi, *et al.*, 2006). From the patient's point of view, the intended benefits are either improved health or reduced suffering due to illness (Faulkner and Kent, 2001). Varkey, *et al.*, (2008) define innovation as the successful implementation of a novel idea in a way that creates compelling value for some or all of the stakeholders.

According to Moore (2004) cited in EXPH (2016), Innovation can be categorised by its impact on stakeholders as non-disruptive (or sustaining) or disruptive as shown in Table 1. Non-disruptive innovations, also referred to as incremental (Hamel, 2000; Harvard Business Essentials, 2003), evolutionary, (Govindarajan, 2007), linear, (Hamel, 2000), or sustaining, (VHA Health Foundation, 2006), improve on something that already exists but in a way that allows expanded opportunities to be met, or existing problems to be solved, (Harvard Business Essentials, 2003). A sustaining innovation does not create new markets or value networks but rather especially evolves existing ones with better value, allowing the firms within to compete against each other's sustaining improvements. Sustaining innovations may be either "continuous" or "discontinuous". In contrast to sustaining innovations, disruptive innovations refer to innovations that disorder old systems, create new players and serve new groups of people, or the same groups of people with new products while marginalizing old ones and deliver value to stakeholders who

Table 1: Categorisation of Innovation

Sustaining	**An innovation that does not affect existing markets.**	
	Continuous	An innovation that improves a product in an existing market in ways that customers are expecting.
	Discontinuous	An innovation that is unexpected, but nevertheless does not affect existing markets.
Disruptive	An innovation that creates a new market or expands an existing market by applying a different set of values, which ultimately (and unexpectedly) overtakes an existing market. Main features are: a) improved health outcomes b) create new professional culture c) serve new groups or have new products/services ("create new markets") d) create new players e) disorders old systems	

Source: EXPH (2016)

successfully implement and adapt to the innovation (see Figure 1). Disruptive innovation requires a new professional culture to develop.

Types of Innovation

UNESCO Institute for Statistics (2005) makes the distinction among the four types of innovation as follows:

a. Product innovation: introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user-friendliness or other functional characteristics.

b. Process innovation: implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software. The customer does not usually pay directly for the new process, but the process is required to deliver a product or service and to manage the relationship with the various stakeholders.

c. Marketing innovation: implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing.

d. Organizational innovation: implementation of a new organizational method in the firm's business practices, workplace organization or external relations.

Innovations in healthcare are related to product, process, or structure (Varkey, *et al.*, 2008). The product is what the customer pays for and typically consists of goods or services (for example, clinical procedure innovations). Process innovation entails innovations in the production or delivery method. According to Varkey, *et al.* (2008), the customer does not usually pay directly for the new process, but process is required in order to deliver a product or service. A process innovation, therefore, would be a novel change to the act of producing or delivering the product that allows for a significant increase in the value delivered to one or more stakeholders. Structural innovation usually affects the internal and external infrastructure and creates new business models.

However, it should be noted that many disruptive innovations result from the combination of one or more sustaining innovations and their application (for example through innovative business models) to opportunities which were not originally conceptualized by the investors in and developers of the innovations (Christensen *et al.*, 2015).

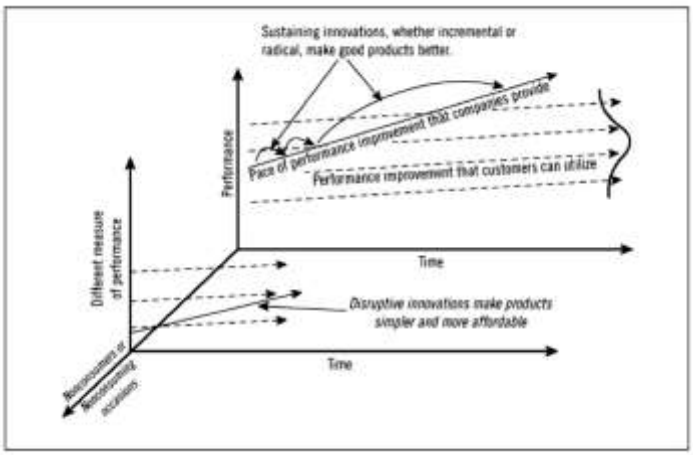

Figure 1: Model of a disruptive innovation (Source: Christensen *et al.* (2008) in EXPH (2016).

RESEARCH METHODOLOGY

This study employed multistage sampling technique. The first stage involved the selection of three states, Lagos, Ogun and Oyo States in Southwestern Nigeria. The second stage is the selection of ten registered Primary Healthcare Centres in each state. The third stage is the selection of the centre head and six heads of department per centre per state. Thus, a total of 210 respondents participated in the study. Data were obtained using two sets of questionnaire as well as interviews. The first set of questionnaire was administered on the heads of primary healthcare centres while the second set was administered on the heads of department. The dependent variable, which measured type of knowledge about the ICT-based innovation, was categorically represented by "Yes" or "No". Yes was equal to 1 and it meant that the respondents agree to possess the type of knowledge about the ICT-based innovation adopted. A "No" was equal to 0 and it meant that the respondents don't possess the type of knowledge about the adopted ICT-based innovation. Secondary data such as number and location of primary healthcare centres were sourced from the reports of Primary healthcare Board. Data obtained were analysed using appropriate descriptive and inferential statistics.

RESULTS AND DISCUSSION

In this study, out of the expected 210 survey respondents, there were 198 completed and usable survey responses, which gave a response rate of 94.3% as presented in Table 2. In addition, interviews were conducted. Gendall (2000) concluded that a 50% response rate could be regarded as"…a rough rule of thumb for a minimum acceptable response rate in survey research". Gendall (2000) further averred that it was possible to achieve a response rate of 60% or more. Nulty (2008), Net (2009) and Schmid *et al.* (2012) supported Gendall's (2000) assertion and affirmed that though a 50% response rate was acceptable, a 60% response rate was desirable and achievable. It can, therefore, be concluded that 94.3% response rate, in this study met the minimum threshold and thus could be considered to be acceptable.

Social and Economic Characteristics of Respondents

Table 3 shows the social and economic characteristics of the respondents. The survey revealed that 85.4% of the respondents were female while only 14.6% were male. This revealed that females participate more in healthcare delivery than males in Southwestern Nigeria. This result may be attributed to the persistence of stereotypical gender roles in Nigeria which assigns certain jobs for women (Kolawole and Fasina, 2009). Healthcare delivery may be one of those professions that males are not encouraged to get into; possibly because of fears that they could not measure up to the physical and emotional requirements demanded by the profession.

Table 2: Primary Healthcare Centres and Respondents' Statistics.

State	No. of Primary Healthcare Centres (%)	Number of respondents					
		Head of Centres		Health Workers		Total	
		Distributed (%)	Retrieved (%)	Distributed (%)	Retrieved (%)	Distributed (%)	Retrieved (%)
Lagos	10 (33.3)	10 (4.7)	10 (4.7)	60 (28.6)	54 (25.8)	70 (33.3)	64 (30.5)
Ogun	10 (33.3)	10 (4.7)	10 (4.7)	60 (28.6)	57 (27.2)	70 (33.3)	67 (31.9)
Oyo	10 (33.3)	10 (4.7)	10 (4.7)	60 (28.6)	57 (27.2)	70 (33.3)	67 (31.9)
Total	30 (100)	30 (14.1)	30 (14.1)	180 (85.8)	168 (80.2)	210 (100)	198 (94.3)

Note: *Figures in parentheses are row percentages.*

Table 3: Demographic Characteristics of the Respondents

Characteristics	Respondents	
	Frequency	Percentage
1. Sex		
Male	29	14.6
Female	169	85.4
2. Age		
19-29yrs	58	29.3
30-39yrs	64	32.3
40-49yrs	54	27.3
>50yrs	22	11.1
3. Academic Qualification		
MPH and MSc	22	11.1
MBBS	7	3.5
B.Sc.	117	59.1
Diploma	51	25.8
Certificate	1	0.5
4. Years of Work Experience		
<2yrs	28	14.1
2-5yrs	37	18.7
6-10yrs	39	19.7
11-15yrs	72	36.4
>15yrs	22	11.1

Table 3 further reveals that 32.3% of the respondents were in the 30-39 years of age group, while 29.3%, 27.3%, and 11.1% were in the 20-29, 40-49, and 50 and above age categories, respectively. This implies that 71% of the respondents were between 30-50 years of age. The high concentration of respondents in this group, which can be considered to be the most active segment of the population, may imply that younger people up to middle age are favourably disposed to the primary healthcare service.

About 59.1% of the respondents possess Bachelors (B.Sc) degree in Table 3, while 25.8% hold diplomas as their highest academic qualification. About 11.1% have postgraduate masters, 3.5% have medical science degree and 0.5% have only training certificate as their highest academic qualification. This implies that about 73.7% of the respondents have at least bachelor's degrees as their highest academic

qualification. This high number of bachelor degrees could have a positive effect on how the respondents are further exposed to strategies of better implementing ICT-based innovation in the primary healthcare sector. Higher levels of education imply a larger pool of technical skills, knowledge and competence which have all been found to enhance innovative capability (Akerele, 2000; Adegbite, 2009).

About 36.4% of the respondents in Table 3 had been in the healthcare profession for between 11-15 years, 14.1% had less than 2years of work experience, while 18.7% had 2-5 years of work experience. About 19.7% were in the 6-10 years of work experience category, while 11.1% had above 15 years work experience. These results indicate that about 67.2% of the respondents have been in the primary healthcare delivery profession for over 10 years. As 70% of businesses in developing countries fail within the first five years of operation (Adegbite, 2009 and Adejuwon, 2014), this result suggests that the respondents have been somewhat successful in their chosen profession.

Most Recently Adopted ICT-based Innovation in Primary Healthcare Centre

The respondents revealed that Database Management system, Tele-health, Computer, Telephone, Tracker, Digital, Thermometer, Digital Weight Scale, Solar Refrigerator, Oxygen, Digital Centrifuge, Nebulizer Machine, microscope and contraceptives were part of the ICT-based innovations adopted within the last three years in the Nigerian health sector.

The information on ICT-based innovation identified by the respondents were grouped in eight (8) distinct types as presented in Table 4. The type of ICT-based innovations identified by the respondents was classified into 2 categories using Christensen *et al*., (2008) classification in Table 5. Table 4 shows that 22.7% of the respondents identified Digital weight scale as the most recently adopted ICT-based innovation in the study area. While 22.2% of the respondents identify computer, phone and tracker as the most recent ICT-based innovation adopted in the sector, 11.1%, 14.7%, 15.7%, and 7.6 identify centrifuge and Nebulizer machine, Blood pressure apparatus, Digital thermometer and solar refrigerator and oxygen concentrator respectively as most recently adopted ICT-based innovation. About 5% and 1% of the respondents identify Microscope and Contraceptives and DBS Fax result printer respectively as most recently adopted ICT-based innovation. About 0.5% of the respondents claimed that all the identified ICT-based innovations were recently adopted.

Interviews revealed that pregnant women on antenatal care and mothers who want Immunization for their babies were the most frequent visitors to the primary healthcare centres. This suggests the need for the digitalization of the weight scale and its introduction to the primary healthcare centres. Interviews further revealed that the head of primary healthcare centres are more familiar with more recently adopted ICT-based innovation in the Nigeria health sector than health workers due to their rotational postings and constant retraining by regulatory agencies of government through the primary healthcare board. This exposes them to different ICT-based innovations for use in the Nigeria primary healthcare sector. Interviews also revealed that the head of the primary healthcare centres have more knowledge of ICT-based innovation than the health workers. Some health workers do not know that ICT-based innovations exist in the Nigerian health sector. This further suggests that Digital weight scale might not be new in Nigeria but it was recently adopted for use as ICT-based innovation within the last three years in Nigeria health sector. During implementation of new ICT-based innovation, the immediate outcome of interest or major goal would be to put the innovation into initial or early use (Weiner *et al.,* 2009; Sawang and Unsworth, 2011; Shea, Pickett and Li, 2005). However, Ng'ethe (2003) noted that an innovation might be new to one institution or person but might have been practiced elsewhere.

Based on Christensen *et al*. (2008) classification cited in EXPH (2016), Table 5 shows that ICT-based innovation, computer, phone and tracker along with Centrifuge and Nebulizer Machine were categorized as disruptive innovation. While Digital Thermometer, Digital weight scale, Microscope and Contraceptives were classified into continuous sub-category of sustaining innovations, solar refrigerator and oxygen concentrator were classified into discontinuous sub-category of sustaining innovations.

Table 4: Most Recently Adopted ICT-Based Innovation in Southwestern Nigerian Health Sector

ICT-based Innovation	Respondents	
	Frequency	**Percentage**
1. Computer, phone and tracker	44	22.2
2. Digital thermometer	31	15.7
3. Digital weight scale	45	22.7
4. Solar refrigerator and oxygen concentrator	15	7.6
5. Blood pressure apparatus	29	14.7
6. Centrifuge and nebulizer machine	22	11.1
7. dbs fax result printer	2	1.0
8. Microscope and Contraceptives	9	4.6
9. All	1	0.5
Total	**198**	**100**

Table 5: Classification of ICT-Based Innovation Adopted in the Nigerian Health Sector

Categories of Innovation		Types of ICT-based Innovations
1. Sustaining	**a. Continuous**	Digital Thermometer, Digital weight scale, Microscope and Contraceptives
	b. Discontinuous	Solar refrigerator and oxygen concentrator
2. Disruptive		Computer, phone and tracker, Centrifuge and Nebulizer Machine

That means that the disruptive ICT-based innovation has disordered the old manual systems, creating new players to serve new groups of people, or the same groups of people with new products while marginalizing old ones and delivering value to stakeholders who successfully implement and adapt to the innovation. This agrees with Dzau *et al*, (2010) and Christensen *et al*, (2008) cited in EXPH (2016) who stated that probably the most disruptive innovation in healthcare in the past 10 years across the globe is the change of the position of the patient from a rather passive actor undergoing procedures and trying to comply with therapeutic regimens towards an active participant formulating goals, monitoring indicators, and contributing to his/her care plan.

Knowledge about the Latest ICT-based Innovation Adopted

Table 6 shows the knowledge the respondents have about the latest ICT-based innovation adopted in the primary healthcare centres. About 11% of the heads of health centres and 68.2% of Health workers agree to have been awareness that the innovation adopted exists and that they also possess knowledge of the innovation's key properties while 4.5% and 16.7% of the Heads of health centres and health workers respectively did not possess the knowledge of the adopted ICT-based innovation. This suggests the reason many respondents supported the notion that ICT-based innovations should be used continuously.

Table 6: Knowledge on ICT-Based Innovation Adopted

Knowledge	Designation			
	Head of Health Centres		Health Workers	
	Yes	No	Yes	No
Awareness Knowledge	21(10.6)	9(4.5)	135(68.2)	33(16.7)
How-to Knowledge	19(9.6)	11(5.6)	84(42.4)	84(42.4)
Principles Knowledge	25(12.8)	3(1.5)	54(27.6)	114(58.2)

Note: *Figures in parentheses are row percentages.*

In Table 6, about 9.6% of the heads of health centres and 42.4% of the health workers agreed they had the information necessary to use the ICT-based innovations adopted properly while 5.6% and 42.4% of the heads of health centres and the health workers respectively indicated not to have the information necessary to use the ICT-based innovations adopted properly. Without the right information on how an ICT-based innovation works, there is no way it can be put to productive use. From Table, 6, about half (42.4%) of the health workers have the information necessary to use the ICT-based innovation adopted properly, the other half (42.4%) did not have the requisite knowledge. This can cause redundancy of the workforce as some workers will have to wait for those with the knowledge to use the adopted ICT-based innovation. The findings above corroborated those of Indeje and Zheng (2010) who, while interviewing users of the Integrated Financial Management Information System (IFMIS), observed that the fact that the system was centralized caused "disquietedness" in its use by other departments. In the primary healthcare centres, it is noted that some ICT-based innovation adopted were doomed to fail because there was no collaboration. Some health workers in some sections did not want to share their knowledge.

Thirteen percent of the heads of health centres and 27.6% of the health workers in Table 6 possess information dealing with the functioning principles underlying how the ICT-based innovation works while majority (58.2%) of the health workers and 1.5% of the head of health centres indicated not to have the "principle knowledge" of the adopted ICT-based innovation. This informs the reason why some health workers are not interested in the continuous use of ICT-based innovation in some health centres. Gelb, *et al.* (2009) noted that insufficient ICT proficiency to match application complexities is one of the common challenges in ICT-based innovation adoption. Klein *et al.* (2001) noted that innovation complexity is negatively related to user satisfaction levels and thus affects the speed at which users come to understand the ICT-based innovation. More generally, a successful adoption of ICT-based innovations calls for cooperation of all health workers (Trachtenberg *et al.*, 2014).

Factors that Led to the Adoption of ICT-Based Innovations

The respondent indicated, as reported in in Table 7 that among the factors that led to the adoption of ICT-based innovation in Primary Healthcare Centres, staff training was identified to be the highest (98%) while government policy, leadership decision, installation of well-modified software and compliance to Global standards were other factors.

About 84.3% of the respondent identified Leadership Decision as among the factors that led to the adoption of ICT-based innovation, while 51% and 56% of the respondents identified Government Policy and Compliance to Global Standards respectively were among the factors that led to the adoption of ICT-based innovation. The lowest among the factors identified was the need to Improve efficiency (13.1) while Need by the Patient were identified by 16.7% of the respondents. Interviews revealed that the head of health centres attend training regularly which exposed them to new ICT-based innovations.

Table 7: Factors that Led to the Adoption of ICT-based Innovation

Factors	Frequency	Percentage
Leadership Decision	167	84.3
Government Policy	100	50.5
Staff Training	193	97.5
Installation of well-modified Software	30	15.2
Compliance to Global Standard	111	56.1
Need to Improve Efficiency	26	13.1
Need by the Patient	33	16.7

These trained heads of healthcare centres returned back to their primary healthcare centres to train the health workers. This contradicts the study of Indeje and Zheng (2010) that noted in their findings that senior managers were always too busy with managerial activities to attend training. Although the senior managers were required to attend initial training, especially for purposes of familiarization with the ICT-based innovation, however, this did not happen. Rather, the senior managers would send lower-ranked officers. Furthermore, the study showed that those sent for training by these senior managers were considered unreliable and dispensable by their bosses. This, according to the study, affected the adoption and implementation of ICT-based innovations. The current study findings show that continuous training is one of the effective determinant/factors for the adopted and implementing ICT-based innovations in the primary healthcare centres.

Type of Implementation Strategy by Respondents across States

Table 8 shows the type of implementation strategy adopted by the respondents for the implementation of the adopted ICT-based innovation in the primary healthcare centres across the states in Southwestern Nigeria. About 39% of the heads of health centres in Lagos and Ogun, as well as 22.2% of heads of health centres in Oyo, used parallel implementation strategy to implement the adopted ICT-based innovations. Majority (38.5%) of the health workers in Oyo, as well as 37.6% and 23.9% of the health workers in Ogun and Lagos, respectively adopted the parallel strategy to implement the ICT-based innovation adopted in the primary healthcare centres. This means that the respondents implemented the adopted ICT-based innovations side by side with the old system for a period of time to ensure there were no errors or problems with the ICT-based innovation adopted.

Table 8: Type of Implementation Strategy used by Respondents across States

State	TYPE OF IMPLEMENTATION STRATEGY							
	Head of Health Centres				Health Workers			
	Parallel	Pilot	phased	plunge	Parallel	Pilot	Phased	plunge
Lagos	7(38.9)	0(0)	2(100)	1(25)	26(23.9)	19(33.9)	1(100)	2(100)
Ogun	7(38.9)	2(33.3)	0(0)	1(25)	41(37.6)	19(33.9)	0(0)	0(0)
Oyo	4(22.2)	4(66.7)	0(0)	2(50)	42(38.5)	18(32.1)	0(0)	0(0)

Note: *Figures in parentheses are column percentages.*

This has the advantage of reducing the risk of the new system failing thereby causing redundancy and stagnation of operations in the primary healthcare centres. Thirty three percent and 66.7% heads of health centres in Ogun and Oyo states used pilot strategy for the implementation of the adopted ICT-based innovation. Majority (33.9%) of health workers in Lagos and Ogun, as well as 32.1% of health workers in Oyo, adopted pilot strategy to implement the adopted ICT-based innovation in the primary healthcare centres. This means that the adopted ICT-based innovation was deployed first to a subset of the primary healthcare centre to see how it works before introducing it to be used at the primary healthcare centre upon satisfaction of its usage.

This is to reduce the risk by first confirming the ICT-based innovation to a smaller target group and allowing the debugging of the innovation without creating too much upheaval in the primary healthcare centres. It is important to choose the pilot site carefully and understand its characteristics to be able to learn what problem, if any, may occur when disseminating the ICT-based innovation from the pilot site to the primary healthcare centres.

All (100%) of head of health centres in Lagos and all (100%) of the health workers in Lagos implemented the adopted ICT-based innovation piecemeal using phase strategy by allowing the primary healthcare centres to assimilate the innovation little by little. Although this type of implementation strategy helps to adjust to the need of the innovation and it is less overwhelming for the users of the innovation, the realization of the whole benefit is delayed.

Twenty four percent of the health centres in Lagos and all (100%) of the health workers in Lagos use the plunge strategy to implement ICT-based innovation adopted in the primary healthcare centres. This means that the respondent stops the old system immediately the ICT-based innovation is adopted. Although this type of strategy creates a sense of urgency and an attitude of commitment, since there is no way back, it can create severe problems if the adopted ICT-based innovation does not work as planned. Regardless of the type of implementation strategy adopted, the users of the ICT-based innovation would need to be trained on how to effectively use the innovation.

Extent of Use of Adopted ICT-Based Innovation

The results in Table 9 indicate that the DBs fax result printer was rarely used (2.4) in primary healthcare centres. About 2% of the respondents indicated to moderately use DBs fax result printer ICT-based innovation in the primary healthcare centres while 1% of the respondents indicated to rarely use the DBs fax result printer. Half a percent of the respondents indicated not to use the adopted ICT-based innovation. Interviews revealed that not all primary centres have access to internet connection which is required for the ICT-innovation. This might inform the reason for the low usage.

Microscope and Contraceptives was moderately used (2.80) in primary healthcare centres as revealed in table 9. About 2.5% of the respondents rarely use the adopted ICT-based innovation while 1.5 % of the respondents moderately use the adopted ICT-based innovation, 0.5% of the respondents indicated to always use the innovation. Interviews revealed that not all primary healthcare centres have laboratories that will require the use of adopted ICT-based innovation, hence the reason why only those who have it usually use it and those who don't have it don't use it. Interviews also revealed that the primary healthcare centres that have laboratories have low patronage of the laboratories. This may be the reason why some primary healthcare moderately and rarely uses the adopted ICT-based innovations.

Table 9 further shows that the Centrifuge and Nebulizer Machine was rarely used (2.4) in primary healthcare centres. About 3% of the respondents indicated to rarely use the adopted ICT-based innovation. While 2% indicated that they do not use the adopted ICT-based innovation, 1.5% indicated that they frequently use the adopted ICT-based innovation. Half a percent indicated to moderately use the adopted ICT-innovation in the primary healthcare centres. Interviews revealed that the Centrifuge and Nebulizer Machine requires electricity to work and due to the epileptic supply of electricity, primary healthcare centres with Centrifuge and Nebulizer Machines cannot use the ICT-innovation as expected. This might inform the reason for the high rate of respondents not using the adopted ICT-based innovation.

Table 9: Extent of use of Adopted ICT-Based Innovation in Primary Healthcare Delivery

ICT-based Innovation	Ratings						
	5	**4**	**3**	**2**	**1**	**Mean**	**SD**
Dbs Fax Result Printer	0(0)	0(0)	4(2.0)	2(1.0)	1(0.5)	2.4286	.78680
Microscope and Contraceptives	1(0.5)	1(0.5)	3(1.5)	5(2.5)	1(0.5)	2.8000	1.03280
Centrifuge and Nebulizer Machine	0(0.0)	3(1.5)	1(0.5)	6(3.0)	4(2.0)	2.4286	1.50457
Blood Pressure Apparatus	6(3.0)	14(7.1)	5(2.5)	8(4.0)	0(0.0)	3.5455	1.06334
Solar Refrigerator and Oxygen Concentractor	0(0.0)	3(1.5)	2(1.0)	0(0.0)	3(1.5)	2.0000	.92582
Digital Weight Scale	30(15.2)	21(10.6)	15(7.6)	2(1.0)	2(1.0)	4.0714	1.01183
Digital Thermometer	17(8.6)	3(1.5)	1(0.5)	3(1.5)	1(0.5)	4.2800	1.24231
Computer, Phone and Tracker	12(6.1)	15(7.6)	2(1.0)	0(0.0)	1(0.5)	4.1667	.98553

5 – Always Used, 4 – Frequently Used, 3 – Moderately Used, 2 – Rarely Used, 1 – Not Used
Note: *Figures in parentheses are row percentages.*

Blood Pressure Apparatus was indicated by respondent to be frequently used (3.5) in primary healthcare centres. About 7% of the respondents in Table 4.10 indicated to frequently use the adopted ICT-based innovation. While 4% indicated to rarely use the adopted ICT-based innovation, 3% and 2.5% indicated to always use and to moderately use the adopted ICT-based innovation respectively. Interviews revealed that the major visitors to the primary healthcare centres are pregnant and nursing mothers who regularly need to check their blood pressure. Interviews further revealed that the adopted ICT-based innovation does not require electricity. Rather it requires batteries which can be found everywhere. This might suggest why there is a high number of primary healthcare centers using the innovation.

There was a mean rating of 4.07 in the use of Digital Weight Scales as the latest ICT-based innovation in primary healthcare centres as revealed in Table 9. Majority (30%) of the respondents indicated that they always used the adopted ICT-based innovation. While 10.6% of the respondents indicated that they frequently used the adopted ICT-based innovation, 7.6% of the respondents indicated that they moderately used the ICT-based innovation. One percent of the respondents indicated that they rarely used the adopted ICT-based innovation. This high rate of always using the adopted ICT-based innovation is because there is a high rate of visitations to the primary healthcare centre. The findings were similar to those of De Veer, Fleuren, Bekkema, and Francke (2011), who found that if a new technology was relevant to users' application area, it was easy to implement.

Digital Weight Scale was indicated by the respondents to be always used (4.1) in the primary healthcare centres. While 10.6% of the respondents indicated to frequently use the adopted ICT-based innovation, 7.6% of the respondents indicated to moderately use the ICT-based innovation. One percent of the respondents indicated to rarely use the adopted ICT-based innovation. This high rate of using the adopted ICT-based innovation always could be due to the high rate of visitors to the primary healthcare centre. The findings were similar to those of Limthongchai and Speece (2003) and De Veer, Fleuren, Bekkema, and Francke (2011), who revealed that if a new technology was relevant to users' application area, it was easy to implement.

The respondents indicated that Digital thermometer was always used (4.3) in primary healthcare centres in the study area. About 8.6% of the respondents indicated to always use the adopted ICT-based innovation. While 1.5% and 1.5% of the respondents indicated to frequently and rarely use the adopted ICT-based innovation respectively, 0.5% and 0.5% respondents indicated to moderately use the adopted ICT-based innovation. Half a percent indicated not to use the adopted ICT-based innovation. Interviews

further revealed that the thermometer is one of the important tools in the primary healthcare centres because it is used to first check the temperature of the nursing mothers, pregnant females as well as other visitors to the primary healthcare centre. This suggests the reason for the adopted ICT-based innovation to be always used at the primary healthcare centre in the study area.

Computer, Phone and Tracker was indicated by the respondents to be always used (4.2) in the primary healthcare centres. About 8% of the respondents indicated to frequently use the adopted ICT-based innovation. While 6.1% indicated to always use the adopted ICT-based innovation, 0.5% indicated not to use it. This might be due to the need to effectively communicate with one another within and outside the primary healthcare centres in the study area.

Decision on the Adopted ICT-based Innovation

In Table 10, Majority (93.4%) of the respondents agreed that they will continue to use the adopted ICT-based innovation while few (6.6%) indicated that they will not continue using the innovation. This contradicts the study of Anderson (2006) and Jha *et al*. (2009) supported by HIMSS Analytics (2015) that reports that ICT-based innovation adoption in healthcare is still low.

Interviews revealed that due to power supply challenges in some locations, some ICT-based innovations that require electricity will not work and will not be useful. Interviews further revealed that the health workers not trained on the technical use of the ICT-based innovations won't be able to use it until a superior worker with the capability to use the innovation arrives, thus causing redundancy and delays in attending to those who the innovation is to be used for. This suggests why few respondents indicated that they will not continue to use some ICT-based innovations

Table 10: Decision on the Adopted ICT-based Innovation

ICT-based Innovations	**Decision**	
	to use	**not to use**
1. Computer, phone and tracker	42(21.2)	2(1.0)
2. Digital thermometer	29(14.6)	2(1.0)
3. Digital weight scale	41(20.7)	4(2.0)
4.Solar refrigerator and oxygen concentractor	14(7.1)	1(0.5)
5. Blood pressure apparatus	28(14.1)	1(0.5)
6. Centrifuge and nebulizer machine	21(10.6)	1(0.5)
7. dbs fax result printer	1(0.5)	1(0.5)
8. Microscope and Contraceptives	8(4.0)	1(0.5)
All	1(0.5)	0(0)
Total	185(93,4)	13(6.6)

Note: *Figures in parentheses are row percentages.*

Factors Influencing the Decision of the Respondents on the Adopted ICT-based Innovation

Analysis was conducted to identify factors that may influence the decision of the respondents in Table 10. Since the dependent variable is dichotomous (yes or No) in nature, a binary Logistic regression was used to predict the relationship between predictors (independent variables) and a predicted variable (dependent variable) where the dependent variable is binary (yes or No). The predictor variables were respondents' state, age, gender, marital status, highest academic qualification, professional qualification, and years of work experience.

Table 11 shows the logistic regression coefficient, Wald test, and odds ratio for each of the predictors. Employing a 0.05 criterion of statistical significance, academic qualification and professional qualification had significant effects with significant probability of 0.032 and 0.044 respectively. The odds ratio for academic qualification indicates that when holding all other variables constant, academic qualification is 10.113 times more likely to influence the decision to continue to the use the adopted ICT-based innovation in healthcare centres. Also, professional qualification is 0.698 times more likely to influence the decision to continue to the use the adopted ICT-based innovation in healthcare centres. However, the odds ratio of years of work experience and age were almost the same at 1.055 and 1.769 respectively though not significant. Marital status has the least effect with an odd ratio of 0.138.

This means that only academic qualification and professional qualification with significant values of 0.032 and 0.044 respectively is statistically significant on the decision to continue to use the adopted ICT-based innovation because the significant values are greater than the conventional significance level of 0.05. It is therefore concluded that the addition of state, age, sex, marital status, and years of work experience to the model is not statistically significant. In other words, these variables do not explain the variations in the decision to continue to use or not use the adopted ICT-based innovation. The higher the academic qualification of the respondent, the greater the decision to continue to use the adopted ICT-based innovation because the academic training they undergo exposes the respondent to different ICT-based innovation.

Table 11: Binary Logistic Regression Predicting Decision

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1[a]	State	-.494	.377	1.724	1	.189	.610
	Age	.054	.628	.007	1	.932	1.055
	Sex	1.273	1.140	1.248	1	.264	3.573
	Marital Status	-1.980	1.297	2.332	1	.127	.138
	Academic Qualification	2.314	1.284	3.245	1	.032	10.113
	Professional Qualification	-.359	.667	.291	1	.044	.698
	Years of Work Experience	.570	.561	1.035	1	.309	1.769
	Constant	-1.103	3.089	.127	1	.721	.332

CONCLUSION

The study has shown that academic qualification and professional training by healthcare professionals influences the decision to continue to use adopted ICT-based innovation. Academic training and other training they undergo exposes healthcare professionals to different ICT-based innovations which may further enhance healthcare delivery in Southwestern Nigeria.

POLICY RECOMMENDATIONS

i. The healthcare professionals should be encouraged to acquire higher academic and professional qualifications so as to get exposed to the tenets of emerging ICT-based innovation.
ii. The Primary Healthcare Boards of different States should continue to organize regular workshops and refresher courses to equip healthcare professionals with the necessary basic skills needed in operating new ICT-based innovation.

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