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UNDERSTANDING THE PRESENT TO PREPARE FOR THE FUTURE: A REVIEW OF HEALTH INFORMATION SYSTEMS RESEARCH IN NIGERIA

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Abstract

Health Information Systems (HIS) present many opportunities to address health challenges in developing countries such as Nigeria. However, in order to leverage the potential of HIS, the opportunities and challenges facing implementation must be explored and understood. This paper conducts an archival analysis of the existing literature on HIS in Nigeria published in premier Information Systems (IS) and Health Informatics outlets; in an effort to provide a comprehensive picture of existing literature by identifying trends, discussing findings, and proposing new research opportunities. The 18 articles meeting the inclusion criteria are reviewed. Current trends are discussed using the framework developed by McLeon et al. (2013) for understanding the factors influencing health IS implementation in developing countries. At present, several challenges face IS implementation in Nigeria such as the lack of policy guidance, resistance among end users, and cultural barriers. In addition, existing studies are limited in scope, theory, and level of analysis applied. The paper contributes to the literature by investigating the status quo, presenting new areas ripe for future investigation including the organisational, financial, and technological issues at play, and illuminating important issues which can guide pilot testing and implementation of new health IS initiatives in Nigeria.

Keywords: health information systems, mobile health, mHealth literature review, future research.

1.0   Introduction

Many international and humanitarian agencies are investing vast amounts of money to improve Health Information Systems (HIS) in developing countries (Tilahun and Fritz 2015). This stems from the expectation that successfully implemented HIS have the ability to transform healthcare delivery. Indeed, this potentially transformative power is exacerbated in developing nations such as Nigeria, where IS are heralded as solutions to significant challenges such as inequitable access to healthcare (Ayeni and Misra, 2014), high infant mortality rates, the prevalence of diseases such as HIV

(Akinfaderin-Agarau et al., 2012), and low life expectancies (Ezenwa and Brooks, 2013). The potential of HIS in Nigeria has been explored in a small number of studies to date (Benson, 2011b). Recent calls have been made for research which empirically investigates the challenges and opportunities for HIS implementation (Hossain, 2016) and the impact of HIS on healthcare delivery, health outcomes, and healthcare access (Al Dahdah et al., 2015). This paper seeks to investigate the existing literature focused on HIS in the Nigerian context in order to understand what work has been done, the implications of this work, and to elucidate the enduring gaps in this context. Nigeria was chosen as the country of focus for three reasons. First, Nigeria provides an interesting context to conduct health IS research due to several health challenges (Ayveni and Misra, 2014), worrying infant mortality rates, low life expectancy rates (Brooks and Enewza, 2013), and the current low adoption rates of health information systems in Nigerian health facilities (Benson, 2011). Second, existing IS literature acknowledges the value of reviewing existing literature in order to advance theory and knowledge (Webster and Watson, 2002). Third, the authors are currently conducting a feasibility study which explores the potential of a mobile health application to aid in delivering healthcare services to young children in Nigeria. It is thus, imperative to ascertain the existing knowledge in this context. Such insights will enable the research team to better design and carry out the planned feasibility testing. The paper seeks to make two contributions. First, the paper reviews existing literature in order to advance theory and knowledge in the Nigerian context (Webster and Watson, 2002). The paper will provide recommendations for future research to address gaps in our understanding of the role of HIS in Nigeria. Second, the paper aims to provide practical insights which can guide future health IS implementations in Nigeria and indeed in other Sub-Saharan countries; as findings in Nigeria can be considered 'an antecedent' for the rest of Sub-Saharan Africa (Mursu et al., 2003; Daini et al., 1992) excluding South Africa.

The paper proceeds with an overview of the healthcare system in Nigeria. The methodology used to conduct the literature review is described, followed by presentation of the main insights gleaned from this review. The paper concludes with a summary of the important findings to guide the next steps for research in this area.

2.0 Context of the Review: Healthcare in Nigeria

Nigeria is a developing country with a population of approximately 182 million (NPC, 2017) with 120 million of the population living just above or below the poverty line (House of Commons, 2016). The health system in Nigeria is decentralised into a three-tier structure comprised of federal, state, and local government levels (WaterAid, 2016). Healthcare delivery is also delineated into three levels: the primary, secondary and tertiary levels (Ezenwa and Brooks, 2013; Ademiluyi and Aluko-Arowolo, 2009). Currently, all three levels of government are involved in the major health functions including service provision and financing (Asangansi and Braa, 2010). The federal government level is responsible for providing policy and technical support to the health system as well as the provision of health services in tertiary and teaching hospitals and national laboratories. At the state government level, ministries of health (MoH) provide regulation and technical support to primary health care services. The local government level is responsible for primary health care.

A number of conditions provide cause for concern in Nigeria. Malaria is the leading cause of death in Nigeria, followed by acute respiratory infections (WHO, 2015; CDC 2013). Low life expectancy rates of 54 years for both genders (WHO, 2015) also represent cause for concern. Infant mortality rates were 109 per 1000 in 2015 which represents a significant improvement from 213 in 1990 (WHO, 2015) 187 in 2000 (WorldBank, 2016). While this is a noteworthy improvement, this rate is still high when compared with the global average and fell short of achieving Millennium Development Goals (MDG4) (UN, 2015). This high mortality rate and other health challenges may be partly attributable to service delivery gaps which hinder access to health in rural and hard-to-reach areas where many vulnerable people reside (Federal Ministry of Health, 2013).

HIS can impact the delivery of healthcare services (Asangansi and Braa, 2010). It is often argued that developing countries lack the necessary organisational structures and resources to implement sustainable HIS (Asangansi and Braa 2010; Braa et al., 2007). While Nigeria can be considered a latecomer to the digital age (Ezenwa and Brooks, 2013), it is now described as one of the fastest growing nations for telecommunication in Africa (Aderonke, 2010). In the healthcare context, there exists

a breadth of opportunities for leveraging information technology in Nigeria. In acknowledgement of the potential of IS, the federal government has engaged in efforts to enable electronic health data exchange via the Mobile-Application Data Exchange System (MADEX) (Ezenwa and Brooks, 2013). Nigeria has been described as one of the leading developing countries in the implementation of mobile health solutions (Thompson et al., 2010). However, much work remains to be done. For example, the implementation of HIS in Nigerian hospitals remains at an extraordinarily low level (Benson, 2011b). This paper explores existing research in a bid to understand the different HIS implementations underway in Nigeria and the dominant challenges and opportunities.

3.0 Methodology: Conducting the Review

This section briefly outlines the process followed in conducting the literature review. The type of review conducted in this paper was an archival analysis which aims to review existing literature to identify trends and opportunities for future research (Eden et al., 2012). As a nascent research area (Hossain, 2016), this type of review will illuminate many areas for empirical exploration while also providing practical insights to guide future HIS projects. The scope of the review includes empirical studies focused on HIS implementation in Nigeria. Based on WHO (2008), we adopt a broad definition of HIS encompassing any use of information technology to capture, store, and disseminate information related to patients' conditions, health challenges and trends. In order to capture as many relevant studies as possible, the archival analysis targeted publications in Information Systems (IS), Health Informatics (HI) and Medical (MED) outlets and included the following databases; the American Medical Association (MED), BioMed Central (MED), British Medical Journal (MED), IEEE Explore (IS), Journal of Medical Internet Research (HI), Journal of the American Medical Informatics Association (HI), the full AIS electronic library (AISeL), the Senior Scholars' Basket of Eight top IS journals, as well as two general databases of Sage and Scopus. This may be expanded at a later stage. The search process is illustrated in Figure 1.
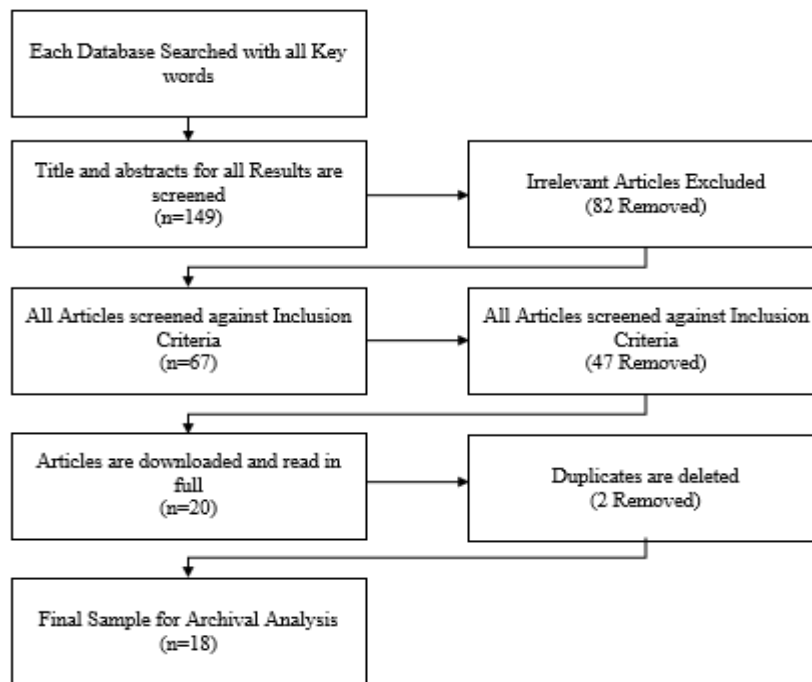
Figure 1. **Literature Search Process**

Each database was searched with the following terms: (1) 'health ICT' AND 'Nigeria', (2) 'health technology' AND 'Nigeria', (3) 'mobile health' AND 'Nigeria', (4) 'health information systems' AND 'Nigeria'. The broader term 'Health' AND 'Nigeria' was also used in IS and Health Informatics Databases. All resulting articles were screened for the keywords in the title and abstract. Articles were then subjected to the Inclusion criteria which were as follows:

- Studies conducted between 1990 and 2017
- Written in English
- Conducted in Nigeria
- Focused on health information systems
- Individual, Group, and Multilevel Studies
- Empirical Studies (Quantitative, Qualitative and Mixed Methods)
- Studies published in peer review Journals or Conferences in the Health Informatics and Information Systems disciplines

Articles which failed to meet all of these inclusion criteria were excluded including literature reviews and conceptual papers. Articles which focused on other developing countries were also excluded. All articles were downloaded and read in full. Following the deletion of two duplicates, the review consisted of 18 articles.

4.0 Overview of Findings

The trends among existing studies are briefly outlined in this section. Firstly, the distribution of studies published between IS, Health Informatics, and Medical outlets is noted in Table 1 below.

Category	# of Papers	Publication Titles
IS	2	UKAIS Electronics, Computer and Computation (ICECCO)
Health Informatics	6	JMIR mHealth uHealth, JMIR, Connected Health Symposium 2015 (JMIR), Journal of Telemedicine and Telecare, International Journal of Medical Informatics, Studies in Health Technology and Informatics
Medical	10	Malaria Journal, Journal of Global Health Care Systems, African Journal of Reproductive Health, Psycho-Oncology, Maternal & Child Nutrition, Global Public Health: An International Journal for Research, Policy and Practice, BMJ Open, Reproductive Health, Human Resources for Health

Table 1. **Distribution of Articles According to Discipline**

As illustrated above, the majority of studies in the review were published in Medical or Health journals. As expected, many of these studies focus on health outcomes with the technology artefact rarely forming the focus of the study. For example, Modrek et al. (2014) found that SMS reminders increase adherence to recommended treatments for Malaria. In this study, technology (SMS) merely provides a mechanism for testing the efficacy of treatment reminders on adherence. Six of the studies in the review were published in Health Informatics journals. In several of these studies, technology plays a minor role with some studies exploring views towards information technology, experience using technology in healthcare (Bello et al., 2014), and technology ownership (Jennings et al., 2015). However, in a small number of studies, the emphasis is on the IT artefacts. Thompson and colleagues (2010) introduce an electronic medical record system to digitise data collection in a family clinic, while Odetola (2015) describe a mobile health nursing intervention as a means of improving maternal care services. Only one study was published in an IS conference and another in an IEEE Computer Science conference. In both papers, the IT artefact is at the centre of the study. For example, Ezenwa and Brooks (2013) found that the MADEX system improves data management and decision making in maternal care thus supporting the potential of HIS in Nigeria, while also harnessing Actor Network Theory to discuss the factors surrounding acceptance of an IS among different stakeholders. This approach is described as explanatory theorising. It must be

acknowledged that many studies in the review fail to leverage any pre-existing theory or engage in new theorising. Given the significant investment in eHealth and mHealth initiatives in developing countries such as Nigeria (Al Dahdah et al., 2015; GSMA, 2013), the lack of attention paid to theory development is problematic. Although theorising within eHealth research was briefly explored by Cockcroft (2015), there is a real need to move beyond using generalisable theories, in the form of descriptive or explanatory studies. The existing work in Nigeria echoes HIS research in other contexts, where studies engage in explanatory theorising with little research going beyond this to predictive theorising. As a result, we echo recent calls for studies which engage in deeper theorising to build a greater depth of theoretical and practical understanding in the HIS research area (O'Connor et al. 2016).

The second trend of interest relates to the publication dates of prior studies. Table 2 below illustrates the number of papers in the review published every year from 2004-2017. This table shows the growing interest in the area, a trend which is promising for researchers engaged in this area.

Year	2004	2005-2009	2010	2011	2012	2013	2014	2015	2016	2017
# Papers	1	0	1	2	2	1	3	4	3	2

Table 2. **Years of Publication for Papers in the Review**

The methodologies followed by prior studies is also of interest. A broad scope of methodologies (i.e. surveys, interviews, and some form of experimental intervention) were followed in the existing studies as shown in Table 3 below. The majority of studies collected data using two or more methods. For example, Thompson et al. (2010) use surveys to explore computer knowledge levels. This data was complemented with observations and in-context interviews. A number of studies employ either a multi-method approach using several qualitative or quantitative methods of data collection (e.g. Flax et al., 2017) or a mixed-method approach (e.g. Chukwu et al., 2016; McKenzie et al., 2016; Modrek et al., 2014), supplementing interview and survey data with data from other sources such as ethnographic observations, phone calls made by patients, and health data from patient files. However, there are a number of weaknesses inherent in current studies one of which is the lack of detail in which the study methodology is described. These mixed

methods studies fail to adhere to respected reporting methodologies such as GRAMMS (Good Reporting of a Mixed Methods Study) which was developed by O'Cathain, Murphy and Nicholl (2008). Without such a structure, existing studies do not report on why mixed methods was appropriate, sampling strategy, and do not provide detailed analyses procedure overviews. Furthermore, existing studies do not provide detailed descriptions of how data validity, reliability and trustworthiness was attained (Venkatesh, Brown and Bala, 2013). This is a fundamental weakness of existing research as without transparency on validity testing, readers cannot evaluate the robustness of existing studies. Another issues inherent in existing studies relates to methods of analysis. Of the existing studies employing quantitative methods do not apply sophisticated analysis techniques, with many merely utilizing descriptive statistics. Qualitative studies provide little detail on how conclusions and inferences were reached, and mixed methods studies fail to integrate quantitative and qualitative findings to provide the comprehensive insights that mixed methods of inquiry should bring (Venkatesh et al., 2013). In summary, while the array of methods utilised suggest a richness in methodology, existing studies fail to adequately describe their methodologies or engage in the analysis needed to derive robust findings.

Methodology	# of Papers
Structured Interview	8
Survey	7
Focus Groups	1
Experiments with Interventions	6
Subjective Data (e.g. patient files)	2
Observations	1

Table 3.   **Methodologies followed**

The samples captured by existing research are also noteworthy. Table 4 below outlines the groups sampled by existing studies. As illustrated in this table, existing studies capture several groups of health professionals, patients and other stakeholders. Many studies also collected data from both health professionals and patients.

| Sample Group	Sub Groups
Health Professionals	Doctors (2), Nurses (3), Midwifes (2), Pharmacists (1), Other (1), Lab Technicians (1), CHEWs (1), healthcare professionals (3), medical students (1), health facility workers (2).
Patients	Girls aged 12-30 (1), Pregnant Women (2), Breast Cancer Patients (1), Health facility clients (1), Women of all ages (1), Oncology Patients (1), Pregnant HIV Positive Women (1)
Other	ICT Personnel (1), Management (1), Project Coordinators (1), Health Policy Makers (1), Technology experts (1).

Table 4.   Samples and Data Collection Sites

Some further observations can be made on the approach taken in the existing studies. A broad range of health issues have been covered in existing studies including sexual and reproductive health, maternal care (Odetola et al., 2015; Ezenwa and Brooks, 2013), antenatal care (Jennings et al., 2015), Ebola (Otu et al., 2016), and cancer (Mac Kenzie et al., 2016; Odigie et al., 2012). Several studies focus on educating both health professionals and patients on important health issues such as sexual and reproductive health (Akinfaderin-Agarau et al., 2012), Ebola (Otu et al., 2016), and antenatal care (Jennings et al., 2015), while others explore the barriers facing health technology implementation (Benson, 2011a, Ayeni and Misra, 2014). This breadth of HIS are reflective of the immediate healthcare in needs in Nigeria. Mostly, these are identified by agencies such the World Health Organization (WHO) and UNICEF. Up to very recently, health concerns in sub-Saharan Africa have focused on maternal health and communicable diseases such as malaria, HIV and Ebola. As life expectancy continues to increase and communicable diseases become more controlled (INCTR, 2010), it seems there is an epidemiological shift towards increased instances of non-communicable disease such as cancer (INCTR, 2010), diabetes (Prentice, 2006) and hypertension (Ibrahim and Damasceno, 2012) in developing countries. This shift may broaden the application scenarios for HIS in countries such as Nigeria.

5.0 Discussion of Findings

This review explores the existing literature focused on HIS in Nigeria as a means of ascertaining current understanding on the opportunities and challenges facing

implementation. The framework developed by Leon et al. (2013) to understand the various health system factors facing technology implementation in South Africa is leveraged as a tool for understanding the current literature in the Nigerian context. This framework was chosen due to its broad approach to understanding the opportunities and challenges facing HIS in the developing country context. This framework is comprised of four dimensions and is depicted below in Figure 2.
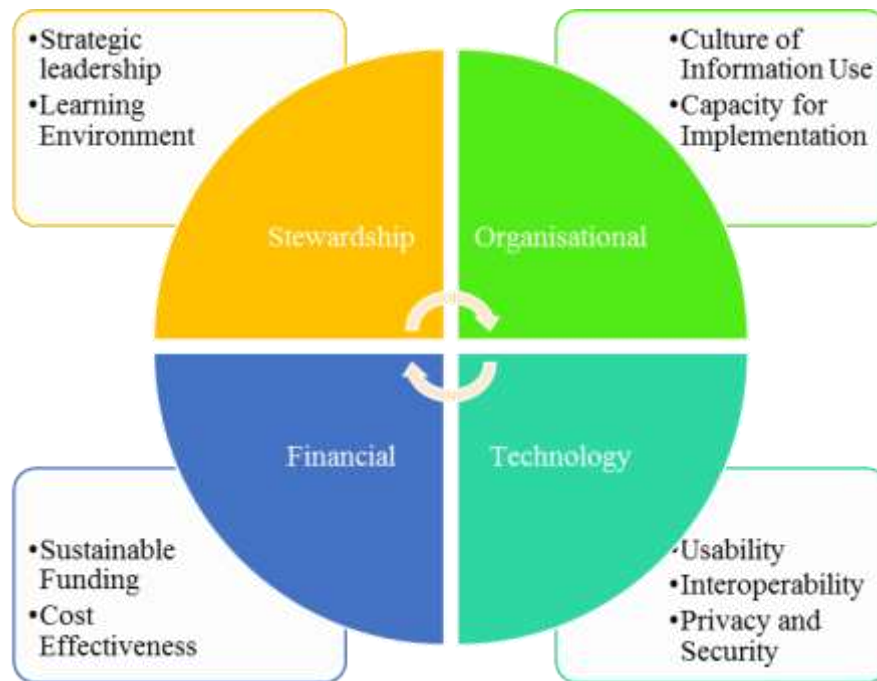
Figure 2. **Framework of Factors Facing HIS Implementation**

Stewardship: The stewardship dimension explores whether the government has created a policy to support health technology implementation and includes factors related to strategic leadership and the learning environment (Leon et al., 2013). The existing literature provides some interesting views on the current situation in Nigeria. The lack of existing policy to guide HIS implementation is noted in the literature (Benson, 2011b). Empirical findings from our literature review also support the current lack of policy. For instance, policymakers, health professionals, and Internet service providers all view current unclear policy on health information as a barrier to HIS implementation in Nigeria (Benson, 2011a). The need for improved policy is also apparent in both findings and the conclusions of authors. For example, Odetola (2015) highlight the need for policymakers to explore the potential of mobile health to improve maternal health services. Furthermore, in Benson (2011a) a large majority

(77-90%) of policy makers, health professionals, and Internet service providers believe that health policy is imperative to guiding systems implementation. In summary, existing work indicates that the lack of clear policy is a practical issue hindering the potential of HIS in Nigeria at present.

In terms of the present learning environment, a small number of studies investigated the current abilities of health professionals and patients to leverage health technologies. In 2004, Bello et al. found that a mere 26% of health professionals and medical students had access to a computer and a smaller number possessed good computer knowledge. This evidences the need to invest in computer accessibility and learning. In the patient context, Flax et al. (2016) found that many women lacked access to a mobile phone and thus could not take part in mhealth programmes. A gap between phone access and use for health purposes is also apparent. Akinfaderin-Agarau et al. (2012) noted that while the large majority of women in their study owned or had access to a mobile phone, very few had used their phone to seek health information in the past. Research also provides some support on the ability of technology to support learning in the health environment. For example, Otu et al. (2016) found that their mobile health application improved health workers' understanding of Ebola. To date, learning has been explored in a number of studies. However, no studies have conducted robust analysis to exploring how current knowledge levels impact usage or attitudes towards HIS. Gaps also persist in terms of studies which provide and evaluate the efficacy of learning interventions in improving technology self-efficacy or use.

Organisational: The current information collection processes in place in Nigeria are noted by several studies which highlight the inefficiencies in current paper based practices (Ewenza and Brooks, 2013). Health IS present the potential to overcome these inefficiencies. These studies provide some evidence for same. For example, Mc Nabb et al. (2015) developed a mobile application to collect patient antenatal data and provide primary healthcare workers with assisted guidance when treating patients, which resulted in improvements in the service provided by workers. Other organisational challenges include corruption in the Nigerian government, resistance to adoption among end users (Benson 2011a), and the role of culture. For instance,

women noted that it was viewed as shameful for them to seek sexual health information and discussed fear of isolation (Akinfaderin-Agarau et al. 2012). The current body of literature suggests that there are many organisational challenges facing HIS implementation in Nigeria, however existing research does not close the gap between identifying perceived organisational challenges and determining whether such factors actually impact implementation.

Financial: Many of the studies note that their projects were funded by research funding bodies and NGOs or that the period of data collection was constrained based on the length of their funding period (e.g. McKenzie et al., 2016). One study explicitly explores views on financing, finding that policy makers, health professionals, and Internet service providers all believe that lack of funding is a significant barrier to health system implementation in Nigeria (Benson, 2011a). The importance of funding is apparent; it enables research in this area to take place, and sustainable financing represents an issue facing future IS implementations in Nigeria. The cost effectiveness of m-health solutions and mobile phones as a means of sharing health information was highlighted by many researchers in this review. For example, Thompson et al. (2010) argue that electronic medical records have the potential to transform health data collection in Nigeria at a low cost. Mc Nabb et al. (2015) also argue that their mobile health intervention provides a low cost means of collecting patient data and assisting primary health workers in delivering high quality care. Financing remains a key issue on a practical level in Nigeria. While several studies highlight finance as an issue or barrier, little depth of understanding exists on how this concern influences views towards HIS projects, or engages with policymakers to derive insights on potential solutions for the finance problem.

Technology: The studies in the review leverage technology in a variety of ways. Many studies utilised technology in a simple manner using mobile devices merely as a mechanism for communication with oncologists via phone (Odigie et al., 2012), or with patients via SMS (Modrek et al., 2014) and video messages (Biruklia et al., 2017). For these studies, the emphasis was not on the technology but the health service or the message in question. Some studies developed and tested new HIS interventions. For example, one study tested the effectiveness of mobile health

interventions for improving antenatal care services (Mc Nabb et al., 2015) and another explored the potential of electronic medical records for collecting data in a family clinic (Thompson et al., 2010). This illustrates the variety of applications of technology within healthcare in Nigeria. There are also many gaps in our understanding on the impacts and potential of HIS. A small number of studies focused on HIS on a broad level exploring opportunities and challenges, while others included detailed descriptions of a specific health intervention. The issue of usability was not explicitly explored in many studies, however a small number noted that the sample were trained in the use of the intervention (e.g. Odetola, 2015). Interoperability was highlighted as an issue facing health systems implementation in Nigeria. In terms of privacy and security, one study noted that the priority in Nigeria was not to focus on privacy but rather to understand how to leverage technology to reduce mortality rates (Ayeni and Misra, 2014). This contradicts assertions made by researchers in other developing countries (Al-Dahdah et al., 2015) and indeed the findings of Akinfaderin-Agarau et al. (2012), who found that young girls expressed fears regarding the privacy of using mobile phones to seek sexual health information. Many gaps in our understanding persist around the potential of different health technologies, interoperability, and privacy/security barriers.

6.0 Future Research: Directions and Recommendations

This section leverages the findings in the previous two sections to identify areas for future research and detail practical implications for future HIS implementations in Nigeria and other developing countries.

6.1 Future Research Directions

As noted, there have been repeated calls for further research on the role of IS in developing countries (Al Dahadah et al., 2015; Hossain, 2016). This literature review identified a bounty of opportunities for future research. A number of broad recommendations can be noted prior to discussing more targeted research streams.

Firstly, the need for more research in the IS domain is highlighted. This review identified one paper which was published at an IS affiliated conference. We acknowledge the existence of IS studies conducted in other developing countries such

as Bangladesh and Ethiopia, which have been published at major IS conferences such as ECIS (e.g. Mengesha et al., 2014) and in IS journals (e.g. Hossain, 2016). We argue that there is a need for further IS research in the context of healthcare delivery in developing countries such as Nigeria, to understand this phenomenon further and to better shape research and practice going forward (Scott et al., 2015). The appetite for IS studies is evidenced in the recent call for papers in a special issue of the Information Systems Journal seeking studies which demonstrate the positive impact of IS in developing countries across all domains including health. The majority of studies in this review published in Health Informatics and Medical outlets pay minor attention to the technology in question. These studies contribute to knowledge in other ways and offer support for the vital role of IS such as the importance of phone ownership in the facilitation of mHealth interventions (Jennings et al., 2015) and the efficacy of SMS reminders on treatment adherence (Modrek et al., 2014). However, there is a need for IS studies which can assess the strengths and contributions of new HIS implementations, while also leveraging theory to explain the sociomaterial, sociotechnical, and organisational challenges and factors to be addressed. Such research is imperative in the advancement of IS research in the health context, to test theories among new cultures and to provide recommendations which can aid developing countries such as Nigeria in achieving the promised benefits of HIS.

Secondly, the context dimension must be explored further. This review focuses on Nigeria. Similar reviews could be conducted to ascertain the existing knowledge and prevailing gaps in research in other Sub-Saharan countries as well as other developing countries. Empirical studies could also be conducted in these countries based on the findings of studies in Nigeria to explore whether similar challenges in implementation are experienced. As noted, few studies in the review utilised existing theories or engaged in deep theorising based on their findings. The HIS research domain attracts a lot of research in the developed world context. It would be useful to leverage existing theories from this domain and test their efficacy in the developing world context. This could both strengthen existing theories and led to the generation of new theories.

The remaining recommendations are organised in line with components of the framework presented by Mc Leon and colleagues (2015).

Stewardship: Researchers could explore the views of policymakers on the potential of HIS and the challenges they foresee in its implementation and adoption. There is a need for research which can offer detailed policy recommendations to health policy makers in terms of leveraging HIS. Regardless of whether future research is focused on the policy issue, it is imperative for researchers to connect with policymakers where possible to inform them of their study and its potential contribution to the health system of the developing country in question. The findings regarding the current learning environment present many opportunities for future research. Firstly, health professionals' current HIS knowledge and attitudes should be explored to revisit the findings of Bello et al. (2004). This is important both to ascertain learning and training needs and to explore potential resistance among doctors which is viewed as a barrier to HIS implementation in Nigeria (Benson et al., 2011a). Future research should also focus on the efficacy of training programmes in informing health professionals' and patients' confidence and skills in leveraging health interventions (Hersh et al, 2010). In addition, the use of technology as a platform for educating healthcare workers and patients on important health issues was explored in several studies (Otu et al., 2016; Birukila et al., 2017) with positive results. The effectiveness of mobile interventions in improving education on emerging health issues, healthcare practices, and long term engagement in healthy behaviours should be explored. Findings on accessibility of mobile devices were mixed. For example, Akinfaderin-Agarau et al. (2012) found that the large majority of women owned or had access to a mobile phone, while Flax et al. (2017) found that many women lacked access. There is a need to investigate access among women in Nigeria further, as lack of access could impede citizens' ability to partake in mHealth programmes.

Organisational: Research shows that IS can be used to improve the delivery of antenatal care. To further strengthen the case for implementing IS, there is a distinct need for research which establishes the impact of IS interventions in Nigeria and other developing countries. This follows the assertions of Chib et al. (2015) who call for the evaluation of new IS implementations. It is important to ascertain what benefits can be achieved from these implementations. The views of stakeholders such as patients,

healthcare workers and policymakers regarding these benefits should also be investigated to explore the needs of different groups but also to identify training needs. Training interventions which highlight the benefits to different stakeholders can then be designed in an effort to improve acceptance and adoption of new health IS initiatives. Gaps remain in terms of understanding of capacity for HIS implementation, this challenge is not specific to Nigeria but is perceived as a barrier to successful HIS implementation across the developing world (Mars, 2012). Future research could explore the capacity of Nigerian health leaders to implement large scale HIS, the ability to integrate different systems at community, state, and federal level and other barriers to implementation should as resistance among end users. Reasons beyond resistance must be explored and addressed prior to the implementation of new systems. There is also a need for research which can articulate the data collection practices in place at the three levels of the Nigerian health system and identify where HIS could improve these processes.

Financing: Finance represents an issue of concern, as most of the HIS initiatives in developing countries such as Nigeria are funded by external benefactors and are not independently self-sustaining. We need to explore ways to support the transition of donor supported HIS development and maintenance to alternative sustaining funding mechanisms which might include government contracts, insurance or direct payment from consumers (Lewis et al., 2012). Future research will involve fully investigating the cost of developing and maintaining HIS infrastructure and regulatory structures that support the delivery of healthcare services at the different levels of the health delivery system (Schweitzer and Synowiec, 2012). Further, detailed cost benefit analysis is required to measure the outcomes of successful HIS utilisation as well as reporting on the anticipated return on investment.

Technology: There are a bounty of possible technology interventions that researchers could explore in the Nigerian health system. There is a need for research which explores the interoperability issues facing new implementation and provides solutions for these issues. Future research which follows implementation of a new HIS in a longitudinal manner could be of great benefit in understanding scalability and interoperability issues. There is a need for usability research for any new intervention

regardless of size or end user; usability testing should be conducted on new technologies supported by adequate training for end users. The review yielded mixed findings of the issue of privacy and security. There is a need to further explore this issue to clarify these findings and determine if privacy is a concern in Nigeria and if so, does concern for privacy impede patients' willingness to use mobile devices for health purposes as suggested by Akinfaderin-Agarau et al. (2012). The effectiveness of communicating the security measures in place to preserve the privacy of patient data could also be examined.

6.2 Practical Implications

The practical implications from this review are discussed in accordance with the dimensions provided by Mc Leon et al. (2015).

Policy: The lack of policy to guide and incentivise HIS implementation in Nigeria was evidenced in the review (Benson, 2011a). There is an apparent need for policymakers to review the opportunities for HIS and offer support on the federal, state, and community levels of healthcare delivery. The Sustainable Development Goals (SDG) have been recently introduced to build and expand on the recently expired Millennium Development Goals (MDG), no doubt this will result in new HIS initiatives in eHealth and mHealth. However, little advice is offered in terms of operationalising and maintaining these initiatives. Policymakers and aid organisations need to collaborate to overcome some of the issues facing HIS implementations such as financing, training for healthcare professionals and building project sustainability post pilot stage. IS Researchers and developers also have a responsibility to engage with policymakers and health leaders when exploring the potential of HIS in Nigeria and other developing countries to ensure they are focused on developing the right HIS that is fit for purpose in the developing country context, namely Nigeria.

Learning: Akinfaderin-Agarau et al. (2012) found that the majority of women in their study had never previously utilised their mobile phone to seek health information. This finding coupled with the effectiveness of the tablet application developed by Otu et al. (2016), on improving understanding of Ebola, supports the role of mobile devices as a conduit to educating patients and healthcare workers. In the practical sense, it is imperative to communicate such uses and benefits of mobile devices.

Financing: Full health economic evaluations need to be conducted to understand the economic viability of HIS implementation and scalability in Nigeria. Financing is directly linked to policy development, existing studies recommend the need for robust policies that support standardised monitoring of government health expenditures and government spending in health-related sectors in developing countries (Lu et al., 2010; Leach-Kemon et al. 2012), as well as policies for monitoring international funding to improve healthcare delivery in these jurisdictions (Leach-Kemon et al. 2012).

Technology: Developers needs to look beyond the small scale feasibility analysis and aspire to design, build and implement scalable, extensible HIS solutions that can integrate with existing technologies. To ensure the development of a HIS that is fit for purpose within the Nigerian context, end users need to be involved with the early design and development activities. The success of most HIS is dependent on the accessibility and usability of the technology. An iterative approach to user experience design and testing will ensure early user engagement resulting in high levels of user satisfaction and an increased commitment to using the technology. Designing, building and implementing robust scalable HIS solutions will act to underpin the "big health data" opportunity. High quality "small patient data" and analytics tools will support the generation of actionable insights for improved disease surveillance, resource allocation, the development of new public health policies and healthcare infrastructure in Nigeria. Recent epidemiological shifts in the presence of non-communicable diseases in Nigeria also present opportunities for new HIS which should improve the treatment of patients with such diseases while also enabling the monitoring and analysis of trends.

7.0 Conclusion

This paper conducts an archival review of HIS research in Nigeria. Of the 18 papers identified, only 2 papers were published in the IS domain. The current body of knowledge provides many insights into the challenges facing IS implementation in Nigeria such as the lack of policy guidance, resistance among end users, and cultural barriers. As is the case with any study, this paper is not without its limitations. The

focus on Nigeria could be deemed limiting, however this focus enabled the inclusion of a breadth of databases and the findings in the Nigerian context can act as antecedents to other Sub-Saharan countries. The omission of conceptual papers and those published in other languages may also be seen as weaknesses. Furthermore, the paper could have included some other relevant publication outlets and search terms. It was deemed necessary to focus on top-tier publications initially with the view to expand this review in the near future. At present, this paper serves as a starting point and makes two important contributions. Firstly, the paper provides practical insights for navigating these challenges when implementing new HIS in Nigeria. The paper also identifies many avenues for future research in this area and issues the call for IS researchers to conduct empirical investigations which can strengthen existing theory, foster new theory and provide important insights which aid in advancing the area of health information systems research and enabling the realisation of the proposed benefits of IS in healthcare in developing countries.

Acknowledgement

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