
Ikechukwu Celestine Maduka

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A PATIENT-GENERATED HEALTH DATA ADOPTION FRAMEWORK FOR DIABETES MANAGEMENT: A CASE STUDY OF GENERAL HOSPITAL ODAN, LAGOS STATE, NIGERIA.

Ikechukwu Celestine Maduka

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Abstract
Currently, the Nigeria health sector is saddled with a poor health information management system (HIMS), and amongst the numerous deleterious effects of this is the impediment to proper management of chronic diseases in the country. Consequently, there is a need to rethink health interventions that do not rely solely on the government or the hospitals before patients can self-manage their chronic conditions or communicate with their health care provider outside the hospital environment. This research believes patient-generated health data (PGHD) can help mitigate against some of the health information exchange problems associated with the poor HIMS in Nigeria and demonstrates this by first; investigating (termed PGHD Study-1) patient-generated health data technology readiness (PGHD-TR) in Lagos State, in order to ascertain the propensity of Lagosians and medical doctors in the State to adopt PGHD. Furthermore, this research investigated the actual use of PGHD by 53 consenting diabetic patients in General Hospital Odan, Lagos. This second investigation was carried out in order to establish the patients’ PGHD acceptance model (PGHD-AM) through a structural equation modelling (termed PGHD Study-2).

From PGHD Study-1, the 1,443 randomly surveyed Lagosians and 47 medical doctors across the 20-local government areas in Lagos State shared technology readiness attribute similar to explorers (technology readiness segmentation). This implied that they were positively predisposed towards accepting PGHD, but with certain degree of concerns. Also, the correlational analysis carried out on the surveyed population showed that age and level of education were the most likely influencers of their propensity to accept PGHD, while gender wasn’t. At the end of the 3-months duration of PGHD Study-2, there was an observed difference of 1.45% reduction on the 53 diabetic participants HbA1c level. Also, the structural equation model (SEM) analysis carried out revealed that PGHD perceived usefulness, social influence, self-efficacy and patient data security were positive influencers of the participants’ PGHD usage behaviour. Overall, their PGHD usage behaviour positively influenced their intention to adopt PGHD. The findings from the two interdependent studies (Study-1 and Study-2) informed on the conceptualisation and development of the PGHD adoption framework for diabetes management before its external validation by 35 domain experts. Finally, the research concludes by identifying areas with significant scope for further research and investigation.
Dedication

This thesis is dedicated to my Family (and especially to the memory of my father), who all have inspired and believed in me:

Late Engr. Peter and Mrs. Mary-Juliet Maduka – Parents
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This research would not have been possible without the grace and wisdom bestowed upon me by God almighty. Also, my deepest gratitude to the Lagos State Health Service Commission and General Hospital Odan Lagos, for approving the research ethics and as well, collaborating with me.

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CHAPTER 1: INTRODUCTION

This chapter presents an overview of the research, starting with the aim and objectives of the research (detailed in Section 1.1 and 1.2, respectively). Section 1.3 introduces Nigeria’s geography as the country case study and as well presents the Nigeria Health Management Information System (NHMIS). Section 1.4 introduces public health informatics, the Patient-generated Health Data (PGHD) concept, its evidence-based potential in healthcare delivery, and the merits it could offer the Nigeria government health care delivery as well as Nigerian patient-provider concern of PGHD when investigated. Section 1.5 highlights diabetes mellitus in Nigeria, challenges faced by the Nigerian healthcare system in dealing with the burden and how PGHD could contribute towards improving the self-management of the disease. Section 1.6 presents an overview of the thesis. Section 1.7 concludes the chapter with a short summary.

1.1 Research Aim

Patient-generated health data (PGHD) are health-related data such as symptoms, biometric data, lifestyle choices, treatment history, health history and other information created, recorded, gathered from patients or their designees (i.e., care partners or those who assist them) to help address a health concern (Deering 2013: 13). PGHD are different from data generated within clinical settings and through meetings with care providers in two important ways. Firstly, patients, not providers, are chiefly responsible for capturing or recording these data and secondly, patients direct the sharing or distributing of these data to health care providers and other stakeholders.

Deering (2013: 3) argues that although PGHD concept is not new as information from patient-reported outcomes is already valued and integrated into the physician’s record, there are no generally recognised policies and practices to define the optimum use of PGHD much less to support its growth as a practical health care tool. This underscores the need for a location applicable framework of policies and good practices that can help to engage physicians and patients successfully and ensure the privacy, security, and appropriate use of PGHD.

Extant literature has shown that the introduction of PGHD cannot be approached using a one-design fits all framework, given the context-specific nature of PGHD within each locality, but should be evidence-based driven (Foreit, Moreland and LaFond 2006 and National eHealth Collaborative 2013). As social determinants of health are unique to each population (Marmot
2004 and Sen 1999), so does the methods to capture, store, review, document, and respond to PGHD are context-specific and vary even among individual providers and patients (Shapiro et al. 2012). These variables are amongst the factors that make PGHD unique to each region, thus, the need for empirical investigation to understand the implications of PGHD on these factors.

To understand the PGHD concept within the Nigeria context, a case study of PGHD was carried out in Lagos State Nigeria in collaboration with the Lagos State Health Commission (LSHSC). This investigation has attempted to address the knowledge gap on Nigerian patients’ health information technology (HIT) interaction and healthcare providers’ disposition towards supporting and integrating patient-generated information into formal care as evidenced by an actual PGHD practise of consenting diabetic patients in Lagos State Nigeria.

The case study research commenced after ethics approvals were given by LSHSC, General Hospital Odan, Lagos administration and Coventry University, UK. In order to achieve the research aim, the study applied two well tested and validated information system theories to investigate firstly, the Lagos State population propensity towards PGHD (Study-1) and secondly, an actual use of PGHD by diabetic patients in General Hospital Odan, Lagos - in order to model their beliefs and attitudes to use PGHD, which in turn could determine their intention to use and adopt PGHD (Study-2).

The overall aim of this research was to investigate how PGHD can contribute towards improving Nigerian patients’ diabetes mellitus management and subsequently develop a validated PGHD adoption framework for Patients and healthcare providers within the Nigeria health care sector.

**Study-1 Aim:** to undertake a preliminary feasibility study in order to establish Lagosians’ and medical doctors’ propensity in Lagos State to accept the PGHD concept.

This involved two separate surveys PGHD-TR1 and PGHD-TR2 (See chapter 4 for Study-1 PGHD-TR1 hypotheses and overall findings). The underpinning information system theory adapted for Study-1 was the Technology Readiness (TR). According to (Parasuraman 2000:
technology readiness refers to people’s propensity to embrace and use new technologies for accomplishing goals in home life and at work.

**Study-2 Aim:** The aim of Study-2 was to develop a PGHD acceptance model via an actual PGHD usage exercise of consenting diabetic patients in General Hospital Odan, Lagos State Nigeria.

The underpinning information system theory adopted for this study was the Technology Acceptance Model (TAM). (See chapter 5 for Study-2 hypotheses and overall findings).

**1.2 Research Objectives**

To actualise the overall research aim, the following objectives set include:

1. Review concepts central to the definition and usage of PGHD.

2. Undertake a preliminary feasibility study in Lagos State in order to establish the Lagosians’ and medical doctors’ propensity to the PGHD concept.

3. Undertake a cross-sectional study of PGHD use by consenting diabetic patients in General Hospital Odan, Lagos State Nigeria.

4. Propose, from the studied consenting diabetic patients, a PGHD acceptance model for the implementation, adoption and use of PGHD in Lagos State.

5. Propose a validated framework for the adoption and usage of PGHD in Lagos State health sector.

In order to achieve the set aim and objectives of this research, the research questions addressed through secondary and primary collected data include:

1. How can the present health information management system (HIMS) structure in Lagos State support health information exchange (HIE) from patients?

2. How enlightened are the involved stakeholders to the potentials of PGHD?

3. What policies and resources would be most useful to help Nigerian patients adopt and effectively use eHealth tools that generate PGHD?
4. If PGHD is to be considered, how can an all-inclusive solution be created to provide guidance to all stakeholders?

The research aim(s), objectives and questions informed on the entirety of the scope of this research and are illustrated in Figure 1.1.

![Figure 1.1 Research Scope](image)

1.3 Overview of Nigeria

With a population of over 174 million people, Nigeria, located in Sub-Saharan Africa, is the most populous black nation in the world and accounts for about half of West Africa’s population (The World Bank 2014a). Nigeria is made up of 36 states and the Federal Capital Territory (Abuja). These states are further divided into 744 local government areas (LGA), with each state having a range of 10 to 44 LGAs, averaging 20 LGAs per state. Nevertheless, 71% of the country’s citizens live below the international poverty line, and the average per capita income is US$2,760 (The World Bank 2014b). Health care provision has remained poor in the country; with challenging effects as represented in the nation’s health indices (Asangansi and Shaguy 2009: 2). The issue of quality, equal and equitable health for all remains a major concern for the democratic government and its partners. This decline in health care provision and condition in the country could be attributed to being responsible for an average life expectancy of only 52 years (The World Bank 2014c).

Nigeria is dedicated to the long-term United Nations (UN) sponsored Millennium Development Goals (MDGs) (United Nations 2008). Under the MDGs Programs that span from 2000 to 2015, Nigeria is committed to realising a broad range of ambitious objectives such as providing education for all, poverty reduction, gender equality, provision of quality health and ensuring
equality and equity in health care delivery, improving the environment, and expanding international development cooperation (Asangansi and Shaguy 2009). Although progress has been made towards realising some of these goals according to a UN update released in 2014, such as the improvement in provision of primary education, improvement in the environment and growth in the development of global partnership, other goals are still far from being realised (United Nations 2014). Nigeria still struggles in attaining the goals of eradicating extreme hunger and poverty, reducing child and maternal mortality, combating diseases like human immunodeficiency virus/acquired immune deficiency syndrome (HIV/AIDS), malaria, diabetes and other diseases. This suggests a lag behind in the attainment of the listed MDGs centred on population health. Therefore, the development of human capital through provision of quality health services is central to the present democratic government’s programme (Federal Ministry of Information n.d.).

According to the Federal Ministry of Health (2009), Nigerian health facts showed that there were 39,210 registered medical doctors in the country in 2006. This implied that the ratio of a doctor to patients in Nigeria was 39 per 100,000 or 1:2,564 as against the WHO standard of 1:600 (doctor to patient ratio). This dearth in manpower remains a huge challenge for the Nigerian government. The factors responsible for this include poor human resources planning and structure, poor remuneration, unsatisfactory working conditions and few professional development opportunities (BusinessDay 2013). These challenges highlight the need for the country to investigate other ways to attain the MDGs centred on population health and this is epitomised in the public health informatics discipline that entails improving population health outcome through the application of information science technology. Through the use of health information technology (HIT), this research will attempt to address these challenges from a patient-centric view using PGHD.

1.3.1 Nigerian Health Management Information System

According to Asuzu (2004), a weak colonial health system was inherited by Nigeria from the UK at independence in 1960; afterwards, the country’s health care system went through a series of three unsuccessful National Development Plans that lacked comprehensive strategy for the health care system. This lasted till the Alma Ata declaration in 1978, bringing with it the need for a comprehensive health care reform in Nigeria (WHO 1978). Nigeria committed officially to
the Alma Ata declaration and this declaration called for a primary healthcare approach that demands health care provision for all citizens. From 1988, the country worked towards a National Health Policy. This was realised ten years later in 1988 with primary health care as its main thrust (Asangansi and Shaguy 2009) and illustrated in Figure 1.2. This National Health Policy, for the first time, provided for the formation of an organised and robust national Health Management Information System (HMIS).

![Figure 1.2 Development of the Nigerian Health Management Information System Timeline (Asangansi and Shaguy 2009: 3)](image)

As illustrated in Figure 1.2, 1992 saw the HMIS framework design in Nigeria and through 1996 to 1997, a work plan was formulated for the commencement of the implementation in some states, driven by support from the UK Department for International Development and World Bank (PATHS Project Report 2006). Donor support ran out in 2000 leading to the project’s collapse. However, this was short-lived as the successful transition from military to democratic rule in 1999 saw the ban on funding from the United States Government lifted later in 2000 (Asangansi and Shaguy 2009). The NHMIS is the data component of Nigeria’s health information system and comprises a manual that holds forms and instructions for data collection and reporting (FMOH 1997). The manual details how to manually calculate indicators and provides protocols for data reporting at each level of the health system: Federal Ministry of Health (FMOH), State Ministry of Health (SMOH), Local Government Area level (LGA) and other health facilities.
Akpan, Searing and Adetunji (2004: 4) noted that from 2000, the HMIS project was funded through VISION, a partnership between the US-based Johns Hopkins University, Engender Health and other partners. These partners collaborated with the Federal Ministry of Health in implementing the country’s first computer-based national health information system in 2001 with pilots in Bauchi, Oyo and Enugu states. This system named Health Information for Action (HIFA) was proprietary and DOS-based. It operated on EpiInfo 6 and EpiMap 2 software applications (CDC n.d.) and was network capable (Akpan, Searing and Adetunji 2004). Nevertheless, this implementation ran into several challenges such as poor supervision at the facility level, poor interconnectivity, multiple parallel systems and the complications from the use of large dataset (Akpan, Searing and Adetunji 2004: 5). At the completion of the VISION partnership, HMIS activities were again underfunded for some years.

As the VISION pilot projects were ending in 2003, the United Kingdom funded Partnership for Transforming Health Systems (PATHS) project commenced and borrowed from lessons gained from past implementations and principles from similar HMIS projects in South Africa and other countries in the Health Information System Programme (HISP) network. This programme addressed the challenges encountered in the VISION pilot projects by introducing the minimum dataset approach, improved on connectivity and developed local capacity to deploy and maintain these systems (Asangansi and Shaguy 2009: 3). District Health Information Software (DHIS) which is a free and open-source HMIS and data warehouse was also introduced.

HISP (2014) describes DHIS as a customisable free and open-source software tool used for data collection, aggregation, management and analysis. It functions by incorporating data hierarchy in collecting health data from primary sources up to and including well-structured, decision-supporting information. The introduction of DHIS and the minimum dataset approach made the PATHS project a success and this continued beyond the end of the project in June 2008 (Asangansi and Shaguy 2009: 3). Based on an open tender process in 2006, the DHIS supported by the PATHS project was implemented in six states (Benue, Enugu, Jigawa, Ekiti, Kano and Kaduna states) and has been adopted by the Federal Ministry of Health as a national standard for HMIS and nationwide implementation was planned (PATHS 2008). Currently, the system is being scaled up in phases in all the states.
1.3.2 Structure and Components of the NHMIS

The NHMIS is the data component of Nigeria health information system and it consists of a manual that contains forms and instructions for data collection and reporting at each level of the health system structure; Federal Ministry of Health (FMOH), State Ministry of Health (SMOH), Local Government Area (LGA) and health facility (Akpan, Searing and Adetunji 2004: 2 and FMOH 1997). Akpan, Searing and Adetunji (2004: 2) highlighted other components of the NHMIS which include a vital events registry, a disease registry, a national population and household census, epidemiological surveillance surveys, community surveys and a financial reporting system. The NHMIS contains the 13 components which are listed as follow:

1. Antenatal care and pregnancy outcome (ANC)
2. Immunization (NPI)
3. Family Planning (FP)
4. Outpatient Attendance (OPA)
5. Immediate Disease Notification (DSN-A)
6. Disease Notification (DSN)
7. Pharmaceutical Services (DRU)
8. Drug Inventory and Utilization (DRU)
9. Laboratory (LAB)
10. Family planning commodities (FPC)
11. Growth Monitoring and Promotion (GMP)
12. In-Patient Cases (IPC)
13. Out-Patient Deaths (IPD)

These components also include the people, tools, data and processes that occur at various levels of hierarchy as specified by the national health policy (Asangansi and Shaguy 2009: 5).

1. The people working in the system: As illustrated in Table 1.1, the people involved in the NHMIS are the human actors whose responsibility stretches across administration, operation and utilisation of the Nigeria health care system as structured within the national health policy.
Table 1.1 Human actors in the Nigerian HMIS (Asangansi and Shaguy 2009: 5)

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2. *The tools they use*: - Currently, the tools they use include the traditional paper-based system for handling health information and the computer-based system called District Health Information System (DHIS) software for health information collection. The DHIS database engine can integrate and aggregate data across levels of the Organisational Unit hierarchy, and its warehousing components include ETL (Extract/Transform/Load) data transformation (HISP 2014).
3. The data involved: - The data demanded and collected within the NHMIS is based on the minimum dataset approach and thus requires the collection of only appropriate data elements at each level of reporting – appropriateness being defined by the need for information to inform and drive action at that level (Asangansi and Shaguy 2009: 6). Figure 1.3 from Alpan, Searing and Adetunji (2004: 3) illustrates the NHMIS data collection process.

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Figure 1.3 NHMIS data collection process (Alpan, Searing and Adetunji 2004: 3)

*LGA; State Ministry of Health (SMOH); Federal Ministry of Health (FMoH)

4. The processes: - Lindsay Downs and Lunn (2003) define a process as a series of actions performed in order to achieve a goal. The processes involved within the NHMIS include actions taken in order to create information for decision-making and action. These processes guide the day-to-day running of the Nigerian HMIS and they include data collection, processing, analysis, presentation, interpretation, use and feedback. For the NHMIS to make sense of the data collected, this process must complete its cycle and is illustrated in the information cycle in Figure 1.4.
1.3.3 Challenges facing the NHMIS

The presence of a well functional health information system is pertinent towards achieving success in this modern healthcare era (O'Carroll et al. 2003). From evidence-based scenarios as noted by Strasbourg (2006); Ludwick and Doucette (2009: 23), the application of health information technology (HIT) has been shown to improve health equality and equity (enhances population accessibility of healthcare service, enhances physicians and health workers office efficiency, is cost saving and alleviates shortages in healthcare human resources). Yet the continuous effort made by the Federal Government of Nigeria to implement a nationwide health management information system has been impacted by several challenges stemming from poor system architecture, inadequate supporting infrastructure (poor electricity supply and high cost of internet connectivity), resistance to change in adopting new health information technology practices and tools by some health workers and patients, the financial cost of procuring and deploying health information technology systems across Nigeria (HITS), poor maintenance culture and finally, the Nigerian government’s attitude to HITS (Idowu, Cornford and Bastin 2008 and Asangansi and Shaguy 2009).

Osain (2011) argued that the Nigerian health care system has been on a steady decline over the years, and amongst the causal factors for this decline is poor development of adequate and functional surveillance systems. Asangansi and Shaguy (2009) further implied that among the
many challenges hindering the development of the Nigerian health care system is the lack of an information system to guide planning and decision making. Figure 1.5 from Asangansi and Shaguy (2009: 8) is an illustration of the various factors that have shaped the health management information system (HMIS) in Nigeria. The inner circle comprises actors very specific to the HMIS while the outer circle contains those specific to the health system. Other factors outside the outer circle are amongst the few important ‘external’ factors also impacting on the Nigerian HMIS.

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1.3.4 The Research Problem

Akpan, Searing and Adetunji (2004: 3) argued that although the NHMIS covers a broad list of components, it is still yet to meet the current data management needs of the nation’s health

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Figure 1.5 Factors Impacting the Nigerian Health Management Information System (NHMIS) (Asangansi and Shaguy 2009: 8)
information management system. They highlighted that in most scenarios, the system collects quantitative data on a number of patients needing a particular medication but not qualitatively on the types of medication as these vary based on each patient’s needs. This limitation in reporting precisely what the patient needs from his or her local health facility means that the facility fails to report to the LGA so that they (LGA) can provide supplies to meet patients’ demand. It also highlights the need to investigate the role of the patient in contributing useful data towards the HIMS available within his or her locality.

Another mistake made in the past was concentrating so much on the mainstream health sector at the expense of other sectors. This top to bottom approach has denied the primary benefactors (the Nigerian patients) the benefits of the NHMIS. Such benefits like reduction in health cost, access to health information, an improved patient-provider communication and flexibility in accessing health care facilities are still lacking in the NHMIS (WHO 2008: 664) within their locality.

Nosa Orobaton, a manager with the WHO-hosted partnership, Health Metrics Network, suggested that subsequent implementation of strategies like the NHMIS that aims to achieve aspects of the MDGs (primary health care in Nigeria) will need to address extensively, the decentralised political system in the country, a much more dominant private sector, increasing demand for a reliable health information system and expanded roles for non-health sectors (WHO 2008: 664). Asangansi and Shaguy (2009: 10) opine that “a successful system would be one based on practical, scientifically sound, socio-politically acceptable and economically sustainable methods and technologies that make information on health-related activities accessible at the different levels and/or aspects of care with the necessary level of relevance at every stage of the systems development”.

1.4 Public Health Informatics

The case for PGHD in contributing towards Nigerian the Health Management Information System.
Continuous technology evolution has influenced the way we live, interact, think, learn and respond to life challenges as individuals and as a society. This technology evolution has also affected the traditional approach institutions and business organisations use in interacting with their respective customers, patients, students, employees and stakeholders (Edquist 1997: 1). As a result of system of innovation, the inclusion of information communication technology (ICT) in healthcare delivery has evolved to the point where healthcare intervention designs have become more patient-centric (Conway et al. 2006: 4). As opined by Strasbourg (2006), the adoption of health information systems is seen globally as one method to bridge the widening healthcare demand and supply gap such as improving patients’ inclusiveness in their health outcomes through ICT.

Asangansi and Shaguy (2009: 2) opine that health is a matter of fundamental concern to all nations, their societies and people as it is an essential foundation for socio-economic development. This fundamental fight to deliver good health care to all in the society is characterised by the Alma Ata declaration of 1978 which states that health ‘is a fundamental human right’ and its attainment is a “most important world-wide social goal whose realisation requires the action of many other social and economic sectors in addition to the health sector” (WHO 1978: 1). The Alma Ata declaration to which Nigeria is a member recommends that primary healthcare is the key to achieving equal and equitable healthcare delivery to all and that government bears the responsibility. Unfortunately, this goal of universal primary healthcare, as stated in the Alma Ata declaration has not been achieved in Nigeria and amongst the barriers to this is the lack of an information system to guide planning and decision-making (Stansfield et al. 2006).

Over the years, the issues surrounding the lack of information systems in guiding decision-making and planning healthcare delivery has been addressed using health information technology (HIT) (Chaudhry et al. 2006). HIT has played a significant role towards improving healthcare delivery and its introduction has given birth to the public health informatics discipline, which is similar to other informatics fields, but differs from them in so many aspects. O'Carroll et al. (2003: 3) distinguished the uniqueness of public health informatics from other informatics specialty areas by suggesting that public health informatics focuses on the
application of information science and technology in promoting the health of populations, rather than that of an individual.

From a global healthcare service perspective, relating public health informatics to healthcare delivery, Abd Ghani (2010: 11) noted that “the emphasis of the developing world is on basic survival (such as providing better access to healthcare and increasing the quality of health) whilst in the developed world, the emphasis is on reducing the financial cost of public funding for healthcare”. Lippeveld, Sauerborn and Bodart (2000) opined that the implementation of health information systems in developing countries is significant for improving the quality and equity of health services. Regardless of this notion, most healthcare systems in the developing world are yet to fully tap into the potentials available from adopting health information technology (HIT) as a medium for improving healthcare service and delivery, reducing cost and improving their populations’ health outcomes (Asangansi and Shaguy 2009). Idowu, Cornford, and Bastin (2008) argued that the Nigerian healthcare system which falls under the umbrella of a developing world healthcare system is inundated with many challenges that could be solved with the right application of HIT.

In an effort to investigate empirically, other methods that could contribute towards the improvement of the NHMIS and the population health outcome in general, this research has proposed a novel approach within the Nigerian healthcare sector that could contribute to the much-needed data for making decisions by the healthcare providers in Nigeria through a case study of Patient-generated Health Data (PGHD) in the country’s context. Relating the justification for the need for a different approach to the present challenges faced by the NHMIS, this research has demonstrated the potentials of PGHD within the study area by developing a validated PGHD adoption framework that could contribute towards improving the Nigerian patients’ management of diabetes mellitus.

1.5 Diabetes Mellitus in Nigeria

Data from the International Diabetes Federation (IDF) published in the World Diabetes Atlas shows that Africa has the highest population of undiagnosed diabetes, which is about 78%, and
more than 20 million of the 382 million people living with diabetes in the world are in Sub-Saharan Africa (IDF 2014a). Nigeria being situated within the Sub-Saharan Africa region has over 6 million people estimated to have diabetes and this makes Nigeria the country with the highest number the people living with diabetes in the region (IDF 2014b). The figure is in agreement with the IDF prediction stating that developing countries like Nigeria with an acute shortage of health facilities and medical personnel, would record higher statistics of people living with this disease in the nearest future (IDF-Africa, WHO-AFRO2006).

According to Wild et al. (2004) and Chinenye and Young (2011), the incidence and prevalence of diabetes mellitus (DM) in Nigeria has continued to increase despite a great deal of research and resources allocated to alleviating this burden. Adebayo (2013) reports that Type-2 diabetes kills more Nigerians than the dreaded HIV/AIDS virus, as observed by medical personnel in the country, and further suggested that physicians in Nigeria have identified low awareness, lack of physical exercise and increased consumption of diets high in fats and sugars as reasons why Nigeria has a large population of people suffering from Type-2 diabetes than those living with HIV/AIDS.

Alebiosu et al. (2013: 655) suggested that the diabetes pandemic in Nigeria is driven by an increase in the adult population due to increase in longevity and changes in behaviour associated with rapidly increasing urbanization and development. These changes in behaviour include reduced physical activity, consumption of high-energy dense calorie diets, with associated increase in obesity. From the healthcare providers’ perspective, knowledge of diabetes care by healthcare workers in most Nigerian health establishments still remains generally poor and this has resulted in inadequate care for many people with diabetes in Nigeria. Previous studies showed that a large number of healthcare workers in Southwest Nigeria, in the absence of a Nigerian National guideline, were unfamiliar with the current practice guidelines of the American Diabetes Association for the management of diabetes (Alebiosu et al. 2009, Kolawole et al. 2009 and Alebiosu, Obi and Ogunsemi 2008).

Chinenye and Young (2013: 1010) suggest that the lack of supportive healthcare systems has been a major obstruction in the implementation of effective diabetes management strategies. Mensing et al. (2002) hinted that the elements of a chronic care model should include decision
support, clinical information systems, self-management education, and delivery system redesign. In supporting the need to consider a multi-sectional approach in dealing with the burden of diabetes, the American Diabetes Association recommends that a wide range of techniques and strategies should be used to provide adequate education and development of investigative skills in the various aspects of diabetes management (American Diabetes Association 2011).

1.5.1 Diabetes Management and PGHD
Several studies have shown benefits and challenges of HIT interventions both in developed and developing nations on chronic care management (O’Carroll et al. 2011; Srinivasan 2013; Swan 2009). Preliminary published studies have evidenced promising outcomes from the use of remote monitoring technologies in the treatment and management of diabetes (Adkins et al. 2006; Watson et al. 2009) as well as in heart-related ailments and other health conditions (Kulshreshtha et al. 2010 and Seto et al. 2012). As diabetes is a self-managed illness, the input of HIT into patient self-care keeps offering an avenue for both patients and their care providers to have information on patient health which usually cannot be captured during regular patient visits to the hospital. Roter (2000) argued that improved patient outcomes have been recorded in studies where patients took the initiative for obtaining their own health information. As the paradigm in healthcare continues to evolve towards an enlightening belief in personal responsibility for one’s health and away from the mind-set that physicians can use pharmaceutical therapy, advanced surgical techniques, or modern technology to fix any health problem (Calabretta 2002: 34), PGHD will keep playing a significant role in this evolution. This increase in consumers’ (patients’) involvement in their health issues as suggested in Kassirer (2000) will draw physicians into a new partnership with patients who are more responsible for their own care.

1.6 Thesis Overview
Chapter 2 presents the literature review for this research. Chapter 3 discusses the research methodology used with justifications. Chapter 4 reports the design and findings in Study-1
(PGHT-technology readiness survey of Lagosians and medical doctors in Lagos State). Chapter 5 presents the theoretical framework that underpinned Study-2 (PGHD-acceptance model). Chapter 6 presents the preliminary analysis for PGHD Study-2. Chapter 7 (PGHD-Acceptance model) presents the findings made from the structural equation modelling of the consenting diabetic patients studied and will focus on analyses of the data collected from the State’s general population, the diabetes focus group sample and all other respondents. Chapter 8 details the conceptualisation, development and validation of the PGHD adoption framework. Chapter 9 presents this research’s detailed conclusion, recommendation and contribution to knowledge.

1.7 Summary

The chapter has presented the aim(s), objectives and justification to investigate PGHD within the study area. The chapter has also addressed diabetes mellitus in Nigeria and the need to apply patient-centric approaches such as PGHD in order to help improve the health data exchange needed for the management of their chronic condition. Having justified the need for a PGHD adoption framework within the study area, this chapter also presented the overall thesis overview.
CHAPTER 2: LITERATURE REVIEW

This chapter reviewed the literature centring on the theoretical underpinnings of the overall research. The literature reviewed was guided by the key research questions on patient-driven health care delivery and patient-generated health data (PGHD) current state, electronic health information standardisation frameworks and stakeholders’ concerns as they relate to PGHD. This chapter also reviewed the literature that investigated factors that affect PGHD adoption, the current state of electronic health policy in Nigeria and the impact of the policy(ies) on patient data. Subsequent reviewed literature has been presented to support the theories that informed on the two inter-dependent studies carried out in chapter 4 and chapter 5.

2.1 A Shift towards Patient Driven Healthcare Delivery

The current shift from traditional healthcare delivery to a more consumer-driven, patient-centred health care is a good example of process overtaken innovation (Calabretta 2002). In the words of economist John C. Goodman, the consumer-driven healthcare model allows the consumer (patient) to occupy the primary decision-making role concerning the healthcare they receive (Goodman 2006). This in no small measure could be attributed to the introduction of ICT in healthcare delivery - which over the years has empowered not just medical staff but created a whole new generation of informed patients and an interactive healthcare system as a whole (Berg, Aarts, and van der Lei 2003; Goldzweig et al. 2009). Calabretta (2002: 33) further emphasised on the drive behind the growing array of informed health consumers by opining that patients can now concentrate on their individual health condition, take greater control of their health care budget and as a result gain in-depth knowledge of their health condition to the extent of even becoming “consumer specialist”. This goes with the general belief that patients possess intrinsic knowledge of their health symptoms giving their everyday experience with the health condition and such experience physicians lack. Bensing et al. (2000) suggests that regardless of how sophisticated the diagnostic tools used in healthcare are currently, medical staff function inefficiently without the input of the patient.

The ongoing buzz on consumer-driven healthcare delivery and patient-centric health care has given rise to the influx of so much input from the patient (Herzlinger 2004; Herzlinger, and
Parsa-Parsi 2004; Herzlinger and Falit 2009). One such input is patient-generated health data (PGHD). Traditionally, healthcare providers base their care decisions on information generated within a clinical setting during a patient’s visit, such as symptoms, medical allergies, vital signs, laboratory results, and a range of other types of data. Thanks to the improvement being made in patients’ involvement in decision making as it relates to their health, PGHD has come to stay and its impact on patients’ health outcome can no longer be ignored (Shapiro et al. 2012 and Spiers 2003).

2.1.1 Patient-generated Health Data (PGHD)

According to Shapiro et al. (2012: 2) “PGHD are health-related data including health history, symptoms, biometric data, treatment history, lifestyle choices, and other information created, recorded, gathered, or inferred by or from patients or their designees (i.e., care partners or those who assist them) to help address a health concern”. In simple terms, PGHD are really any health data that is not captured within the clinical environment by a healthcare provider. Shapiro et al. (2012: 2) further suggested that in two significant ways, PGHD are unique from regular data created in clinical surroundings or through consultations with providers. In the first instance, they suggested that it is the patients and not providers who are chiefly responsible for capturing or recording these data. Secondly, the patients are solely responsible to direct the dissemination of these data to their healthcare providers and other stakeholders. Further distinction to the uniqueness of PGHD from regular data created within a clinical setting is that PGHD may or may not be integrated into a patient’s electronic medical record (EMR) or a patient’s health record (PHR) (HIMSS 2013: 7) This is to say that PGHD could be seen as an additional complement to provider-directed capture and flow of health-related data across the health care system as contributed by the patient.

Although PGHD is not a new concept given that several patients already record and distribute their health information with their care providers, the proliferation of smart phones, remote monitoring devices, mobile application development platforms and ubiquitous networks has facilitated the enormous growth of PGHD (Khoumbati et al. 2010; Shapiro et al. 2012: 3). In other words, the possibility to generate different types of PGHD with the increasing enabling technologies has given rise to the number of patients contributing or willing to contribute to
sharing their health data with healthcare providers, and these keep impacting on the perceptions of the current growth of PGHD. Even most market experts predict that technology giants like Microsoft, Apple, Samsung and Google will continue to drive innovation and adoption of PGHD devices for consumers, and as a result move PGHD further into the mainstream of everyday life (HIMSS 2014). This implies more PGHD will be generated, collected and shared than ever before, and as expected, the data flow will be in an electronic format.

The PGHD data flow diagram in Figure 2.1 illustrates how current and emerging states of electronic health-data flows (i.e. health information exchange) today can be captured, transferred and reviewed. Form the left side of the diagram, a depiction of several sources of potential patient inputs is given from data captured automatically by a device to data recorded manually by patients and/or their proxies.

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**Figure 2.1 Patient-Generated Health Data Flow (Shapiro et al. 2012: 3)**

In relation to PGHD:

- *Data capture* is the creation and storage of health data by patients or their designees and these data could be in the form of:
  - video or audio data captured using a multimedia storage device
  - written data entered via keyboard or another text-input device
  - physiological and environmental data captured on a monitoring device
It is to be noted that the means of capturing PGHD and the pathways it travels from patient to reach the provider is not solely dependent on technology-driven methods, but equally possible through a compilation of manual and semi-automatic means. An illustration of this could be seen in Jane Hart’s Hypertension Scenario in Figure 2.2. Manually, Jane captures and records her blood pressure readings using a paper log and sends the information (PGHD) via e-mail weekly to her primary care provider (PCP) using a secure messaging system. Although varieties of new sensor technology have facilitated the development of monitoring devices and expanded the range of health conditions whose treatment could potentially be assisted by use of remote monitoring, collectively, these developments will eventually keep yielding many of new types of PGHD (Kulshreshtha et al. 2010 and Shapiro et al. 2012:6). This will result in increased expectations of responsibilities shared amongst patients and healthcare providers.

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Figure 2.2 PGHD Hypertension Scenarios (Shapiro et al. 2012: 6)

- *Data transfer* in PGHD which is the next step after *data capture* entails the communication of the captured data to a receiver who ideally, is a member of the care provision team. This transfer could be electronically through internet-enabled methods, secured e-mail, via telephone or in a face-to-face meeting.
Data review. After the capture and transfer, the next step involves the review of the PGHD by the patient’s healthcare provider (preferably medical doctor) or the designated recipient of the PGHD. To arrive at a clinical decision-making, the data is evaluated against its source and relevance (Foreit, Moreland and LaFond 2006). The outcome of this review determines if the PGHD will be discarded, entered in the patient’s medical record (PMR) or shared but not documented in the PMR.

PGHD capture may be in an unstructured or structured format, numeric, text, image, machine-readable or even in waveform. It includes several methods and steps as illustrated in Figure 2.3. Jack, a diabetic patient measures his blood glucose using a glucometer, then copies his result into a spreadsheet for personal use, keeping a paper logbook for his next primary care physician (PCP) visit, and uses secure e-mail to share the data with a nurse.

Some materials have been removed due to 3rd party copyright. The unabridged version can be viewed in Lancaster Library - Coventry University.

Figure 2.3 PGHD Diabetic Scenarios (Shapiro et al. 2012: 6)
Types of PGHD

1. Patient or designated patient’s helper (proxy) measured and recorded vital signs using a portable medical device. Such data could be in the form of patient’s blood pressure, body weight, and body temperature and blood glucose. These types of data can be captured manually by reading the measurement display via a mechanical or electronic device. Most of these data can as well be automatically captured using monitoring devices with sensors fitted.

2. Perceived quality of life data that are self-reported by the patient or their helpers like sleep quality, mood, level of pain and social contacts can also be captured manually based on a patient’s or a patient proxy’s observation.

3. Self-reported lifestyle data that could be recorded by a patient or a family member such as dietary intake, caloric consumption, hydration, physical exercise, ability to perform activities of daily living and medication adherence. These types of data would require the patient or a patient proxy to manually capture these data.

4. Data, other than health-related - that enable the patient to be known to the provider on a personalized individual basis. Such data include a patient’s change of location, personal profile, travel plans and other activities that could impact the patient’s life directly or indirectly.

2.1.2 The Current State of PGHD

Research on electronic personal health records (PHRs) has identified many of opportunities for sharing PGHD, regardless of the PHRs being pre-populated with PGHD by a provider or insurer organisation, or only populated with PGHD as directed by the patient (Archer et al. 2011 and Cayton 2004). Although no general established definition of an electronic personal health record (PHR) exists, it has been described as an electronic application through which patients (individuals) can access, manage and disseminate their health information (PGHD) in a secure and confidential environment (National Committee on Vital and Health Statistics 2006). Electronic PHR models for PGHD differ based on the degree to which the data content of the records is made up of, the access levels being controlled either by the patient or provider or healthcare provider, the types of health information technology (HIT) tools that support them and the setup of health information exchange (HIE) applicable to each PHR model (Pagliari, Detmer and Singleton 2007b).
Shapiro *et al* (2012: 30) opined that though some of the enabling technology that supports the projected expansion of PGHD is new, several fundamental issues relating to PGHD are not new and the discussion of these has a long history in the academics’ literature. Slack *et al.* (1966) in their paper ‘A Computer-based Medical-history System’ proposed giving direct access for patients’ interface with computer, managing their health information without restriction from physicians. Slack (1972) predicted a change in the traditional environment of a closed medical record, initially inaccessible to patients, becoming declassified at least for doctors and patients to contribute towards the patients record. He further suggested in his editorial that greater involvement should be permitted to patients by including them in the decision making relating to their health (Slack 1977).

Sands and Halamka (2004) addressed the factors facing secure electronic communication from patients to their healthcare provider as an important criterion to be addressed if PGHD’s seamless flow is to be realised. They also investigated and recommended best practices on how best to enable patients to see and communicate securely their online health records with their care provider. Kulshreshtha *et al.* (2010) investigated the use of remote monitoring to improve outcomes in patients with heart failure. Tang *et al.* (2006) reported on several PHRs issues and suggested approaching the issue educationally by proposing health IT-related education for consumers, starting from primary grade levels up till high school.

Mandl *et al.* (2007: 25) article on the Indivo system describes the idea of a personally controlled health record (PCHR). They suggested that PCHRs are designed and developed on the principle that patients own the right to manage copies of their own medical information. They further opined that PCHRs are meant to complement, and not replace existing healthcare information management systems.

Some studies have also looked at the disruptive impact of introducing PGHD into healthcare providers’ workflow; and healthcare providers’ attitudes towards PGHD. Halamka, Mandl and Tang (2008) addressed healthcare providers’ concerns and warned that the influx of e-mail communication from patients will result in an overflow of messages that adversely impact healthcare providers’ workload and workflow. Osborn *et al.* (2011) further suggested that the
growth of PGHD could portend a disruptive impact on the workflow and practice of healthcare providers.

In two contrasting studies, Wynia et al. (2011) using a large sample size, found that although the majority of physicians had never accessed data via a PHR, 42% of the sample were willing to try. In Witry et al. (2010), using a smaller sample size of family practice physicians, their study observed that these physicians only accessed the PHRs as an alternative source for patient information when the primary source cannot be accessed. Their study also showed that the physicians were not conversant with the patient features supported by the PHR.

In Germany, Wells et al. (2014) investigated the potential opportunities of electronic personal health records for patients with chronic disease. Their (2014) review could only have been realistically achieved given the practical usage of electronic patient records in the environment where their work was carried out. A typical example of an online personal record for optimizing PGHD exchange with physicians in the region where Wells et al.’s review took place is the LifeSensor product available in Germany, Switzerland, Bulgaria and Austria. LifeSensor enabled patients to store and manage their self-generated health record from a non-clinical environment (online) and also to decide who they authorise access to view, add or update their information. The LifeSensor system is not directly linked to the patient’s healthcare provider record as it is solely administered by the patient.

Currently, due to issues surrounding acceptance, the software owner InterComponent AG (ICW) has decided to withdraw from the retail business and operation of LifeSensor (IntercomponentWare 2014). This hints that acceptance and adoption of PGHD into regular care is amongst issues facing its success and needs to be empirically addressed as it affects each region. The aspect of acceptance and adoption as it relates to social determinants of health and demography formed an intrinsic basis of the investigation carried out in this research.

In UK, Pagliari, Detmer, and Singleton (2007a) considered the potential of electronic personal health records and the influencing factors that will determine their adoption. Pagliari, Detmer and Singleton (2007b) further examined the potential benefits and challenges of the emerging
patient electronic health records and their findings highlighted that in both the United States and Europe, there is an increase in the online version of personal health records systems that permit patients to manage their health data. Also, Pagliari, Detmer and Singleton (2007b) noted that the implementation of NHS HealthSpace is increasing awareness and provision of PGHD in the UK, but this comes with a number of considerable barriers such as security balance against meaningful use and integration of different data sources in the existing systems. Part of the objective of this research was to address specific concerns and barriers relating to privacy, security and meaningful use of PGHD as they relate to the study environment.

The NHS HealthSpace is an online secure personal health planner available to all patients in England. The system, launched in 2003, saves health notes generated by patients (PGHD), though its capabilities have increased to incorporate making hospital appointments, storage and charting of health indicators like blood pressure, peak flow, or weight (Pagliari, Detmer and Singleton 2007b). Also, a calendar with the option to generate email reminders, a database of NHS contacts and links to online health information are all at the patients’ disposition on HealthSpace. With the ongoing evolution of HealthSpace in the UK, patients are expected to be able to access their NHS summary care record containing a snapshot of patients’ general practice record detailing allergies, adverse reactions and drug treatment. In regard to accessibility, HealthSpace will not provide access to detailed care records and clinicians can only add data to the summary record with the patient’s consent. It could be agreed that HealthSpace is a consumer-driven and patient-centred effort made to ensure patients have greater power in shared decision-making as it relates to their health.

All the evidence presented so far hints to the shift towards a consumer-driven and patient-centred health focus. Whether this shift is to be attributed to innovations in health information technology, a growing array of informed patients willing to make more input in their health outcomes or the need to consider approaching public health interventions from a bottom-top perspective that centres more on the patient; the underlying push to this growing patient-centric trend is that data are being generated and these data bear ramifications that portend great benefit for the patient and their healthcare provider. But also, to be considered is the PGHD impact on
healthcare providers’ workflow and how these impacts can be managed to the benefit of all involved stakeholders.

2.1.3 Electronic Health Information Standardisation - Frameworks

In the quest to ensure the standardisation of PGHD integration and its interoperability within healthcare institutions, several standardisation frameworks have been developed and in some case are still under development. Established in 1987, Health Level Seven International (HL7) focuses on developing and providing an all-inclusive framework and related standards for the exchange, integration, sharing, and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services. HL7 aims to provide interoperability standards that contribute towards the improvement of care delivery, optimization of workflow, reduce uncertainty and boost knowledge transfer among all healthcare delivery stakeholders such as healthcare providers, government agencies, the vendor community and patient (Health Level Seven International 2014).

In the UK, IHE UK is a non-profit association dedicated to interoperability in health information technology (IHE UK 2014). The association does this by bringing together a broad range of stakeholders to advance the shared exchange of patient information.

In America, The Office of the National Coordinator for Health Information Technology commissioned a white paper on PGHD in April 2012 (Shapiro et al. 2012) and convened a technical expert panel in December 2013 involving numerous stakeholders on how to identify best practices that will enhance PGHD generation, its sharing and integration via established health information exchange (HIE) channels, PGHD impact on healthcare workflow and how best to deal with it as well as other issues such as: technical, operational, legal, cultural, educational, control, privacy and ownership of these PGHD (National eHealth Collaborative 2013).

All these were done in an effort to identify existing best practices from using technology in enhancing patients’ input into their care, with a focus on the important Meaningful Use Stage 3 (MU3) recommendations. A report from the technical expert panel findings implies that PGHD
is still in its early stage of development and is expected to become more common as a result of consumer, provider, and technological, organisational and societal drivers.

Even with the paucity of literature supporting a standardised adoption framework of PGHD into regular care in developing nations (Akpan, Searing, and Adetunji 2004; Asangansi and Shaguy 2009; Idowu, Cornford and Bastin 2008), PGHD as it is currently in developed nations still lacks an established policy and practice to define its optimal use (Deering 2013: 3). Different sets of data types, workflows, policies and approaches to using PGHD in daily practice as well as how it impacts all involved actors are needed to ascertain the many different examples in use (National eHealth Collaborative 2013). Thus, a framework of policies and empirically proven good practices can assist in engaging care providers and patients towards ensuring the meaningful use of PGHD while satisfying concerns relating to privacy and security of PGHD. The absence of PGHD literature and adoption framework in Nigeria (developing country) justified the need to embark on this research.

Globally, most of the evidence presented in the literature showing the influence of PGHD in healthcare delivery has been witnessed mostly in developed nations with well-developed health information management systems in their healthcare setup, be it government funded or privately owned. Unlike in developing nations with a struggling health information management system infrastructure, one of the issues surrounding patients’ generation of electronic health data mostly hinges on inadequate health information technology infrastructure and other limiting socio-economic factors that ideally should support the integration of PGHD into regular care (Foreit, Moreland and LaFond 2006; Idowu, Cornford and Bastin 2008).

This cannot be said of developed nations where issues facing electronic health interventions mostly emphasise on the need to adopt such interventions in order to reduce public funding for healthcare (AbdGhani 2010: 11). Thus, if the growth of PGHD, which is a consumer-driven approach, towards a less expensive healthcare and a more involved patients’ input towards their health decision-making is to be realised in developing nations, there is a need for a bespoke approach to realise PGHD success in these regions (Pagliari, Detmer and Singleton 2007b).
2.1.4 PGHD - The Concerns

Numerous drivers could increase PGHD’s meaningful use such as: improved patients’ engagement, new health information technology innovations, incentives for patients and healthcare providers in using and sharing the collected data, as well as evidenced-based research that demonstrates how PGHD satisfies the three-part aim of better health for populations, better care for individuals, and reduced expenditures through improvement in care delivery processes (Shapiro et al. 2012: 5). While some stakeholders with PGHD experience are confident about its potential to improve care, some providers and patients still have certain concerns about PGHD (National eHealth Collaborative 2013: 4).

Be it termed concerns, issues or challenges, certain barriers affect stakeholders involved in the capture, transfer, review and documentation of PGHD. Deering (2013) highlighted concerns facing the flow of patients’ data from outside the clinical environment and opined that these concerns have not been systematically addressed to the fullest up till date, given the associated dynamics impacting the adoption and meaningful use of PGHD. In the Issue Brief: Patient-Generated Health Data and Health IT, Deering hinted on providers’ concern, patients’ concern, technical issues, as well as issues concerning privacy and security of PGHD. Shapiro et al. (2012) further emphasised on technical, operational, legal, cultural and educational issues facing healthcare providers, patients and healthcare stakeholders in using PGHD. It is important to note that all these concerns are unique to each region and how they affect the involved PGHD stakeholders in one region may be totally different to how they affect other PGHD involved actors in another region, considering demographic factors and social determinants of health (Shapiro et al. 2012: 8). Thus, there is need for an evidence-based approach in considering how PGHD will impact patients and providers in a region PGHD is to be adopted. Figure 2.4 illustrates the listed PGHD concerns with all the stakeholders they impact on.
2.1.4.1 Provider Concerns

With the influx of PGHD into normal care settings from patients outside the clinical environment, healthcare providers are concerned of the potential workflow disruption as a result of accepting PGHD. These concerns include the belief that PGHD will add the burden of having providers review large amounts of data, leading to increased liability and unrealistic patient expectations (Deering 2013: 9). This implies that providers are wary of the unanticipated reaction from patients when they fail or refuse to use PGHD to meet patients’ healthcare expectations. In addition, providers are concerned about the impact of PGHD on their profession as its inclusion might question their authority and interfere with their ability to deliver quality care. The likelihood of being held accountable for PGHD that was never received or reviewed promptly, depending on the urgency, is also a concern shared amongst healthcare providers.

The consequences of these concerns are not just limited to the disruption of healthcare providers’ operational workflow, but as well bears with it financial and ethical implications. Safran et al. (2007) suggests that the financial impact of PGHD within the providers’
organisation includes the use of staff and physician time for reviewing, processing and analysing the data and potentially integrating it into the EHR.

2.1.4.2 Patient Concerns

Patients are concerned that after being convinced to adopt PGHD, their providers might fail to use the shared data in meeting their healthcare expectations. Just as the concern affects healthcare providers as it relates to the confirmation of PGHD receipt and the expected usage outcome of the PGHD from their patients, Deering (2013: 9) suggests that patients are also concerned about:

- their healthcare providers confirming the receipt of data sent to them,
- the extent their healthcare provider uses the information to improve their health,
- whether the information sent was securely received and saved in the patient’s chart,
- whether the provider will share the information appropriately amongst family members and any other party,
- whether the information will be used for a purpose other than what it was intended for,
- whether the patient-generated data is valued and well-received by their doctor,
- if the PGHD bears any financial implication

Although the listed patient concerns can be assuaged with good physician-patient communication practice, and given that it is not (communication) the most central issue either impeding or driving the use of PGHD, some experts are of the view that changes are needed in healthcare on issues relating to culture and education (Shapiro et al. 2012: 16). The general belief that clinicians are not trained to listen to their patients and the observation that the focus of health IT has been centred on clinicians and not on patients are amongst the major concerns patients share when considering the value attributed to their PGHD by their healthcare provider. Improving such perspective can facilitate patient-provider communication, patient-engagement and empowerment, as well as being of great value to people with chronic illness (Wynia and Dunn 2010).
2.1.4.3 Technical Issues

Technical issues in the healthcare service are of diverse facets when considering their interpretation in a developed and developing nation scenario (Abd Ghani 2010: 11). In developed nations with well-equipped care institutions, most technical issues revolve around improving the potentials of existing IT infrastructure as in the case of PGHD; the standardisation of PGHD data flow, how PGHD can be integrated into regular electronic health record (EHR), improving the adoption of the practice amongst patients and their healthcare providers and improving data provenance (data traceability) in health information exchange (HIE) are some of the examples of technical issues affecting PGHD use (National eHealth Collaborative 2013). As could be seen from the aforementioned technical issues, none of the technical issues hinge on poor health information management systems, inadequate health information technology infrastructure, or lack of funding (WHO 2008). This cannot be said of developing nation’s health institutions where the latter is the case and while most literature would not consider these to have impact on PGHD use given that their PGHD context is set in a developed nation’s healthcare institution, this research investigates how such challenges can be ameliorated in a developing nation’s context. Regardless of the discrepancy between developed and developing nation healthcare service as it relates to PGHD, technical and data standards are very important for the meaningful use of PGHD (Deering 2013: 10).

This implies that PGHD must be collected and submitted in standardised ways that guarantee the received information is understood (readable and useful) while permitting the receiver the responsibility (ability and authority) to decide whether to integrate the received PGHD into a patient EHR or remote hospital record if need be. Usability factors such as identifying consumer-friendly vocabularies when designing patient portals and eHealth tools, balancing the need for early standards to kick-start PGHD activity and the need to enable innovation that permits standards to evolve in order to help patients submit useful information is vital in assuaging technical concerns that impede the use of PGHD.

Also, given the significance of data provenance in PGHD, Deering (2013: 10) opines that the technical inadequacy that obstructs the identification of data provenance needs to be addressed if healthcare providers are to trust data received from patients or from their personal health
record (PHR). Provenance refers to the origin and information about the source of clinical information when it is first generated, and throughout the whole processes and transitions the data goes through (The Office of the National Coordinator for Health Information Technology 2013). Provenance enables a system that collates patient information via EHR, PHR and HIE to understand the genesis of any particular medication or diagnosis. Efforts are being made by some HIE platforms to address the technical concern surrounding PGHD provenance by improving provenance tracking through marking and retaining provenance as they collate PGHD from various sources and exchange records (Deering 2013: 8).

Pagliari, Detmer, and Singleton (2007b) highlighted the possibility of PGHD creating a digital divide amongst users. With most PGHD being generated electronically, the integration of PGHD into electronic personal health records has the potential to add to health inequalities through uneven internet access and disparity on patients’ level of IT literacy given the social determinants unique to each patient. Tang and Lansky (2005) suggest that while the growing ownership of mobile phones, tablets, wearable gadgets, remote sensor monitoring and digital TV might aid to limit these patient-provider inequalities, Pagliari, Detmer, and Singleton (2007b) opine that it boils down to how IT developers design these alternative media so that usability would not be an issue.

This implies that much attention needs to be paid to usability and training in order to overcome usage disparities due to poor technical skills as could be typified among elderly people. If these problems are effectively addressed, recorded evidence may mitigate healthcare exclusion for most patients through flexible access to information and services (Gustafson et al. 2005). Aside from the mentioned technical issues, there are technical issues related to the capture, transmission and integration of PGHD with overarching privacy and security issues.

2.1.4.4 Privacy and Security Issues

Foreit, Moreland and LaFond (2006) in their conceptual framework opined that health data and information lack value unless they are used to inform decision, but even with this notion and in the case of PGHD, healthcare stakeholders need to be assured that PGHD is private and secure at all times for value to be attached to the data (Deering 2013: 10). As implied by the National
eHealth Collaborative (2013), concerns surrounding identity of, and authorisation for healthcare providers and hospital staff accessing the received PGHD needs to be addressed and if need be, transmission should be encrypted in order to ensure security.

Several instances from the literature have exemplified how secured messaging, anonymity of patient identity, coding of information shared between patient and provider, password-enabled access control for shared information and encryption have all been applied in ensuring privacy, confidentiality and security in patient-provider health information exchange, as well as in the general usage of information in health care (Buckovich, Rippen and Rozen 1999; Smith and Eloff 1999; Van der Haak et al. 2003). To ensure integrity of PGHD, privacy and security are paramount and the patients willing to partake in providing PGHD reserve the authority to determine the degree of where secondary sharing of their PGHD should go. This includes informing their primary healthcare provider on whether their PGHD should be shared with other providers or for other purposes.

In summary, although several improvements in the broader field of patient engagement will have an impact on PGHD, there is a need for evidence-based policies to promote patients’ access to their data in situations where requests for corrections or additions to their health record occur. The growth and variety of consumer technologies will continue increasing the interest in consumer health data tracking, and as information becomes ever-readily available from patient-initiated analyses, new policies and approaches for extracting and incorporating valued PGHD from huge data files will be needed (Deering 2013).

2.1.5 Factors Affecting PGHD Adoption

Having highlighted and discussed several concerns shared by patients and providers in the use of PGHD and though these concerns may reduce the usefulness and availability of PGHD or a patient’s willingness and ability to participate, findings also show that these barriers are shifting. Table 2.1 presents a list of PGHD concerns, barriers and issues alongside drivers that influence the adoption and meaningful use of PGHD (Deering 2013; National eHealth Collaborative 2013; Pagliari, Detmer and Singleton 2007b; Shapiro et al. 2012).
The National eHealth Collaborative (2013: 21) technical expert panel (TEP) anticipates that several factors will impact the use of PGHD and that these factors are unique to the various contexts of PGHD use in self-management and care delivery by providers. The TEP grouped these factors into four aspects: a) consumerism and the growing empowerment of the patient, b) medical practice changes, c) societal trends and d) technology advances.

### 2.1.5.1 Consumerism and the Growing Empowerment of the Patient

As patients and their proxies (caregivers) continue to share health information substantial to their care, this presents an opportunity to enhance patient engagement in self-care and care with professionals. Considering the impact of healthcare informatics which underlines the basic principle of PGHD from a patient-centric perspective, Srinivasan (2013) suggests that PGHD can serve as an addition to clinical data generated by providers in offering a holistic view of an individual’s health. This is because PGHD can contribute to ensuring accuracy and reliability of

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**Table 2.1 PGHD use Concerns and Drivers**

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<thead>
<tr>
<th>PGHD Concerns&amp; Barriers Issues</th>
<th>PGHD Adoption Drivers</th>
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<tbody>
<tr>
<td>Financial disincentives in PGHD use by both patients and providers</td>
<td>Incentivising physicians meaningful use of PGHD by government or health policy makers</td>
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<tr>
<td>Physician concerns about liability and extra workload</td>
<td>The growing empowerment of the patient and patient engagement in their health care</td>
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<tr>
<td>Workflow disruption for healthcare providers</td>
<td>Medical practice changes such as improved physician attitude towards patients’ opinions and contribution</td>
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<tr>
<td>Incompatible technologies for patients and healthcare providers</td>
<td>Technology advance in healthcare and the adoption of health information technology for PGHD use by both physician and patient</td>
</tr>
<tr>
<td>Lack of technical standards and an underdeveloped case for change, in addition to privacy and security issues facing PGHD</td>
<td>Developing established standards for PGHD data flow, data provenance and HIE</td>
</tr>
<tr>
<td>Limited patient health literacy</td>
<td>Societal trends (the case for public health and Social determinants)</td>
</tr>
<tr>
<td>Technology access and stature in the patient-physician relationship</td>
<td>An all stakeholders inclusive Government policies and political buy-in the use of PGHD</td>
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data stored in an EHR, as well as empowering patients and their caregivers to be proactive partners in their health and healthcare (National eHealth Collaborative 2013: 21).

With the growing spate of organisations remodelling their values to meet the needs of their consumer online activities such as shopping, travel planning, entertainment, gaming and online social interactions, these consumer driven activities significantly influence changes in consumer experience and present the consumer as not just a consumer, but a co-developer that can contribute to organisational learning and innovation from outside the firm (Jeppesen and Molin 2003). Moreover, as time spent by an average person interacting with computing devices keeps increasing dramatically, exemplified by the rise in the use of social media to connect with family, friends and others with similar interests online, consumers acquire experience from these activities that portends great benefit of lowering barriers to the use of computers for health-related activities, such as collecting and using PGHD (National eHealth Collaborative 2013: 21).

Other factors affecting PGHD adoption include medical practice changes, societal trends and technology advancement. These factors may impact several PGHD usage aspects, but still portend the capacity to collectively drive the adoption and growth of PGHD. Zickmund et al. (2008) suggest that the growth of patient portals are also drivers for PGHD as they will enable millions of patients to interact electronically and securely with their healthcare providers or hospitals for clinical and administrative health services. These IT developments in healthcare are amongst the drivers that will lower barriers for patients to share symptoms and contribute to their treatment progress by making observations and asking questions about their health information through electronic conversations (National eHealth Collaborative 2013: 21)

2.2 The Current State of Electronic Health Policy in Nigeria

Health information technology (HIT) investments and expectations from health information systems towards the delivery of eHealth services continuously face issues regarding the safeguarding of data, and most especially patients’ information (Hill, Langvardt and Massey 2007; Tan and Payton 2010). While most countries keep responding to personal data safeguarding challenges by sanctioning policies and regimes that cut across multi-institutions or
sector-specific policies in order to ensure responsible use of data and accountability, the current state of personal data protection and definition in Nigeria still remains inadequate (United Nations Foundation 2015: 6). The absence of a comprehensive personal data protection framework in Nigeria has resulted in several sector-specific laws that range from industry practices and professional codes of ethics that regulate the use of personal information. In most cases, these existing personal data laws in Nigeria could best be described as rendering support to confidentiality and consent before the disclosure of personal information, but offers no support to the subjects - concerning their right to dictate access or interpret how they wish their data to be used.

This inconsistency in data law definition in Nigeria has also seen varying levels of personal data usage definitions from the communication sector which cover specific provisions on data protection while data protection remains absent in laws regulating the health sector. Since the proponents of policies governing health systems in Nigeria solely focused on universal health coverage, while paying less heed to providing policies that ensure meaningful use of patient information, the country will have to rely on the existing data policy provisions in the non-health sector as well as various professional codes of ethics (United Nations Foundation 2015).

**2.2.1 Laws Relevant to Patient Privacy and Data Security in Nigeria**

Currently, the legal framework that oversees the health sector consists of both non-health related and health related policies, statutes and rules of professional conduct that directly or indirectly legislate patients’ privacy and security as it relates to the capture, processing, storage, and transfer of personal health information (United Nations Foundation 2015: 8).

They include the following:

- *The Constitution of the Federal Republic of Nigeria* (Nigeria’s supreme law) guarantees the right to privacy to every Nigerian citizen and in the event of conflict between the Constitution and any other law, the Constitution overrules.

- *The National Health Act (NHA)*: Though recently ratified in October 13, 2014, the NHA is the principal legislation that regulates the provision of health services in Nigeria by providing a legal framework for the regulation, development and management of the national health
system and sets standards for all stakeholders (Enabulele and Enabulele 2014). The NHA does not cater to the patients’ right as it relates to how their data is used or would be used.

- **The Health Records Officers Act (HROA)** is responsible for regulating the profession of health record management by defining conditions for registration and requiring health officers to be fully documented. This act does not directly influence patients’ data but provides the definition of health record as it relates to Nigeria.

- The Code of Medical Ethics which is legislated by the Medical and Dental Practitioners’ Act ensures all physicians and medical staff adhere to absolute confidentiality of patients’ information even when a patient has died, with the exception of when the need for disclosure is justified by law overriding common good or with the patient’s consent (Code of Medical Ethics in Nigeria 2004).

- **The Dangerous drug act (DDA) and national drug formulary and essential drug list act (NDFEDLA)** offer guidelines on patient user information.

Other relevant laws and regulations which may apply to the usage of patient information in Nigeria include: The National Communications Act (NCA), the Nigerian Communications Commission (Registration of Telephone Subscribers) Regulations (RTS), the National Information Technology Development Agency Act (NITDA Act) the National Identity Management Commission Act (NIMC Act) and the Cybercrimes (Prohibition, Prevention, etc.) Act (CA).

**2.2.2 The Impact of These Laws on Patient Data in Nigeria**

It is evident that health data or patient information remains undefined under any of the laws applicable to both the health sector and the non-health sector. The National Health Act (NHA) makes sketchy reference to information relating to the patient’s health status, treatment or stay in any health establishment; the Nigerian Communications Commission (Registration of Telephone Subscribers) Regulations (RTS) offers a definition of personal information as the full name, gender, date of birth, residential address, nationality, state of origin, occupation and every
other personal information and contact details of subscribers specified in the registration requirements (United Nations Foundation 2015: 11).

The NIMC Act differentiates between personal information (as already defined by the RTS) and identification information (to include a photograph of the individual’s head and shoulders, the individual’s signature, the individual’s fingerprints and other biometric information about the individual). Yet, the NIMC Act offers no definition of biometric information. According to the RTS, biometric information is defined as information relating to subscribers’ fingerprints and facial image in accordance with the Registration Specifications (as might be continuously edited) provided by the Commission for the registration of subscribers (United Nations Foundation 2015: 11).

All these gaps in definition of patient information in Nigeria have given rise to uncertainties such as:

- vague definition of patient information including what constitutes a “health record”
- unclear designated stakeholders and organisations that should be responsible for defining and enforcing compliance of patient data usage requirements due to duplicity of definitions
- the ideal conditions for the lawful usage of data, e.g., as in the case for obtaining consent from the patient before the disclosure of their information remains unclear
- the lack of provisions of clear guidelines as they relate to patient data ownership and right of data access, data quality, data provenance, length of withholding patient’s data and notification requirements
- finally, the lack of provisions for third-party responsibilities and both intra- and inter-institution usage and transfer of patients’ data

It could be clearly deduced that there is no clear definition of what patient information entails and it will be difficult to define what rights the Nigerian patient wields over his or her personal information (electronically). This in no small measure would impact on the introduction of PGHD within the study area, thus the need to empirically investigate how every stakeholder in this study responds to PGHD capture, share and usage.
2.3 CHAPTER SUMMARY

This chapter has presented the definition of PGHD by discussing some central concepts and concerns central to its definition. This chapter also highlighted factors such as challenges facing electronic health standardisation, consumerism and the growing empowerment of the patient, medical practice change, societal trends and technological advancement that play significant roles in the adoption of PGHD and in the electronic health information in general. Further reviews on the information system theories that informed the theoretical concepts underpinning this research are carried out in Chapter 4 and 5.
CHAPTER 3: RESEARCH METHODOLOGY

This research methodology chapter presents all the research methods used in this research. To clarify the usual misinterpretation of research methodology and research methods, Kothari (2004) suggested that research methods are all methods or techniques used in conducting a research, while research methodology refers to the science of systematically studying how research is done. This chapter starts by detailing the research design adopted in delivering the two interdependent studies (PGHD Study-1 and Study-2) that informed on the validated PGHD adoption framework for diabetes management in Lagos State Nigeria in section 3.1. In section 3.2, the entire study population involved in the research is discussed. Explanation with justifications of the data collection methods used in this research is presented in Section 3.3. At the completion of the data collection stage, all the processes involved in the analysis of collected data are presented in Section 3.4. In addition, all ethical issues regarding this research are discussed in Section 3.5, followed by the chapter summary in Section 3.6.

3.1 Research Design

Awang (2012) and Cresswell (2012) described research as a systematic process of reaching an empirical conclusion based on investigative steps that entail identifying a problem, defining the problem, collecting and analysing evidence (data) in order to gain better understanding of the problem. A successful research depends on good research design and a good research design requires a good research strategy and tactics. Saunders, Lewis and Thornhill (2003) suggest that research strategy entails good planning that meets all the demands within the research scope while tactics offer a comprehensive process for the collection of data and analysis. Putting it simply, a good research built on a well thought design and strategy should be able to develop knowledge, ideas and innovation from its findings.

Based on activities involved within a research, Awang (2012) classified research into two types; applied research and basic research. Applied research, also referred to as action research, involves embarking on inquisition in order to solve an existing problem. On the other hand, basic research, also known as pure research or fundamental research, is carried out to develop and evaluate concepts and theories. Kothari (2004) further highlighted other categories of research. Kothari (2004) suggested that besides applied research and fundamental research as
classified by Awang (2012), other types of research include analytical research, descriptive research, qualitative research, quantitative research, empirical research, conceptual research, and derivatives or combinations of other types of research such as longitudinal research, field-setting research, laboratory research, one-time research, simulation research, historical research, conclusion-oriented research and decision-oriented research and evidence-based research mostly used in clinical research and diagnostic research.

Creswell (2012) proposed six research process steps that systematically entail identifying a research problem, reviewing the literature, specifying a purpose for research, collecting data, analysing and interpreting the data and finally reporting and evaluating the research. Similarly, Awang (2012) presented a general research flowchart that illustrates Creswell’s proposed six research process steps in Figure 3.1. The first step of every research process, which involves identifying and defining the research question (problem), is mostly influenced by the researcher’s adopted research philosophy and approach. A research question enables the researcher to examine the appropriate research strategy, the preference of techniques and measures for data collection and analysis, as well as the timeframe required to achieve the research scope of the project (Saunders, Lewis and Thornhill 2009). Awang (2012) further hinted that research questions help researchers stay focused on the aim and objectives of the research project.

Creswell (2012) opines that the nature of the research problem and research questions influences the researcher’s decision whether to adopt a quantitative or qualitative research method and this determines the outcome of the research design used and other procedures involved in executing the project. In quantitative research, a research problem is identified and investigated based on statistical trends of the phenomenon majorly, but in contrast, qualitative research seeks to address research problems where certain variables are unknown, thus the need for a holistic exploration that is independent of statistical trends (Creswell 2012). Creswell (2012) further intimates that adopting either or both quantitative or qualitative research methods influences the research design data collection technique and tools. In quantitative data collection, the research instrument usually involves the use of survey questionnaires comprising of standardized tests and checklists to measure the variables in the study, data is analysed using
mathematical procedures called Statistics. In the case of qualitative research, data collected from the participants will develop into forms called protocols, such as an interview protocol or observational protocol. Regardless of these differences, a similarity shared by quantitative and qualitative research is that they conform to the six research process steps.

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Figure 3.1 Research Process Flowchart (Creswell 2012:8 and Awang 2012: 9)

The distinctive difference between the quantitative and qualitative research methods is underlined in the summary by Creswell (2012) in Table 3.1.
<table>
<thead>
<tr>
<th>Quantitative Research Characteristics</th>
<th>Qualitative Research Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Highly depends on defining a research problem based on account of trends or relationship among variables.</td>
<td>Focuses on exploring a problem in order to develop detailed understanding of phenomenon central to the problem.</td>
</tr>
<tr>
<td>Trends in existing literature plays significant role in suggesting the research question and providing justification for the research problem. There is need to seek for direction based on general opinions in the subject area.</td>
<td>Literature review plays a minor role in the justification of the problem as the phenomenon is mostly unique to the research area or population. As a result, the research can only be addressed from studying the subjects directly.</td>
</tr>
<tr>
<td>Creates purpose statements, research questions, and hypotheses that are observable measurable, specific and narrow.</td>
<td>A bit of vagueness in the statement of purpose and research questions which leaves room for justification and solution of the problem to be reached only after a thorough inclusiveness and consideration of all participant’s view.</td>
</tr>
<tr>
<td>Relies on sampling the research population in order to collect data that are expressed in numerical form. The instrument used contains already pre-set questions and suggested responses.</td>
<td>Samples the population and collects data from a population that is independent of numerical size.</td>
</tr>
<tr>
<td>Analyses trends by comparing groups or relating variables using statistical analysis. Interpretation of results is usually done by evaluating them with prior finding from and past research.</td>
<td>Considers all aspect of the response and analyses data for description and themes using text analysis for data interpretation.</td>
</tr>
<tr>
<td>The research report is normally written using standard, fixed structures and evaluation criteria. This form of report takes an objective and unbiased approach.</td>
<td>Report is written flexibly using evidence from findings made by the researcher, although the interpretation offered by the researcher might be subjective and biased.</td>
</tr>
</tbody>
</table>
Awang (2012), proposed two types of research design when conducting non-experimental research as exploratory research design and descriptive research design and in the case of experimental research design, he proposed causal research design and quasi-experimental research design.

1. Exploratory research: Also known as formative research, this kind of research as opined by Shields and Rangarajan (2013) focuses on investigating a problem that is yet to be clearly defined. It usually occurs before enough can be known of a particular problem in order to be able to make conceptual distinctions or posit an explanatory relationship. Exploratory research often entails investigating secondary research from existing data or literature, or it could be conducted using qualitative approaches such as informal discussions with consumers (patients), employees, management or competitors, and more formal approaches such as engaging in an in-depth interview, projective methods, use of focus group, pilot studies, feasibility studies or case studies. Stuart et al. (2002:419) defines case-study research as “a scientific approach that attempts to ground theoretical concepts with reality”. In Yin’s (2009) opinion, the use of case study and survey research method is generally useful to the researcher when investigating recent phenomena that possess variables that cannot be manipulated. Yin (2009) further stated that case study research is also a useful means of carrying out an explanatory, exploratory or descriptive investigation.

2. Descriptive Research: Kotler and Armstrong (2013: 122) opined that the objective of descriptive research, just as the word implies, is mainly to explain, narrate or describe phenomena, trends, events or things, such as the market potential for a brand or the demographics and attitudes of consumers who patronise the brand. Shields and Rangarajan (2013) suggest that descriptive research is adopted when describing characteristics of a population or the phenomenon being studied. They opined that it is not an in-depth form of enquiry as it does not answer the how, when and why questions regarding the occurrence of the phenomenon; rather it focuses on addressing the ‘what’ question. Like, what are the characteristics of the population or phenomenon being studied?
3. *Causal Research:* This research design is employed when testing hypotheses concerning cause-and-effect relationships (Shields and Rangarajan 2013). It is adopted when the aim of the research is to investigate which variable is responsible for a certain attribute within a population or a system. Causal research seeks to find out the cause behind an action and this is done by holding the variable that is suspected to be influencing other variable(s) constant and then evaluating the changes in the other variable(s). One of the complexities of this research includes the difficulty for the researcher to ascertain the absence of other influencing factors on the causal relationship. This is often observed in cases that deal with peoples’ motivations and attitudes. Such factors hinge on respondents’ psychology which they might not even be fully aware of. Simulation and experimentation are the two research methods used in exploring the cause and effect relationship between variables (Miller and Salkind 2002).

In choosing a fitting research design, Saunders *et al.* (2009) suggest that researchers should ensure the selected research design must justify the research question and objectives. They argued that the research design must always agree with the research philosophy and should as well be in sync with existing knowledge and feasible within the research scope. Exploratory research design that explores the phenomenon under study using a case study technique and survey research technique was employed in this research. This is because exploratory research design could permit an in-depth investigation of PGHD within the study area, both quantitatively and qualitatively; through the survey of Lagosians (general populace and medical practitioners in the State) as part of PGHD feasibility (technology readiness) study that aimed to ascertain their propensity to accept PGHD, and a further case study of a consenting group of diabetic patients and their healthcare providers in order to establish their disposition to adopt PGHD for the management of diabetes in the State.

**3.1.1 Triangulation Methodology**

For this research, a combination of both *quantitative* and *qualitative* research methods known as triangulation was used. This is because the triangulation method captures all the actions needed in justifying the research aim, objectives and research questions, as well as offering flexibility and vigour to research (Carpenter and Suto 2008). Also, the triangulation of both methods as proposed by Greener (2008) helped to enhance the depth of data that can be collected and
interpreted. Figure 3.2 presents a clearer picture of triangulation research methodology, while in Figure 3.3, a summary of how the research process flows via the use of quantitative and qualitative research (triangulation) is illustrated.

The use of this method enabled the researcher to collect both qualitative and quantitative data from the general population in Lagos State Nigerian in order to ascertain their predisposition and disposition towards PGHD before narrowing down on a consenting group of diabetic patients within the study area - by investigating the unique challenges and drivers impacting on their PGHD adoption and integration into formal care through a 3-month actual PGHD exercise.

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Figure 3.2 Concept of Triangulation Methodology (Carpenter and Suto 2008).

This approach required that the research be partitioned into two interdependent studies in order to be able to deliver a comprehensive investigation of PGHD in the study area. For the PGHD Study-1 that investigated the Lagos State population PGHD-technology readiness (PGHD-TR): the general State populace (PGHD-TR1 survey) and the medical doctors (PGHD-TR2 survey) in the State were surveyed, respectively. Further information on when, how, where, what, why and the theoretical concept underpinning this study is detailed in Chapter 4. For PGHD Study-2, a consenting group of diabetic patients, with their collaborating medical doctors were engaged in carrying out an actual PGHD exercise for 3 months. Findings made from PGHD Study-2 and
the theoretical concepts underpinning this study are presented in Chapters 5, 6 and 7 of this thesis.

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Figure 3.3 Flow of the Research Process via Triangulation (Creswell 2012:12)
3.1.2 Triangulation Methodology - Strategy

The use of mixed methods which permits the collection of both quantitative and qualitative data could be carried out sequentially or concurrently (Creswell 2003). The distinction in these two types of implementations relies on their application, as either qualitative or quantitative data could be collected individually in phases or at the same time. Creswell (2003) identified six major strategies under these two types of implementation. Sequential strategy is of two types, namely, sequential transformative design and sequential exploratory design, while concurrent strategies’ types include concurrent nested strategy, concurrent transformative strategy and concurrent triangulation strategy.

This research used concurrent triangulation strategy as it depicts most the mixed research methods employed in it. According to Creswell (2003), the concurrent triangulation strategy normally uses separate quantitative and qualitative methods in combination and as a way to overcome limitations inherent within the use of one method which is compensated by the other method. Creswell (2003) stresses that the concurrent triangulation strategy is common amongst most researchers and argued that the advantages of this method rely on its ability to contribute towards validating findings made, as well enabling room for collecting series of data within a short time frame. Creswell (2003) also emphasized the limitation of this strategy by suggesting that significant effort and expertise are needed to study a phenomenon with two separate methods, complexity of comparing results of two different strategies and reaching a conclusion from its findings. Figure 3.4 illustrates the concurrent triangulation strategy. Figure 3.5 depicts the research methodology deployed in actualising this research aim and objectives.

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Figure 3.4 Concurrent Triangulation Strategy (Creswell 2003:214)
Figure 3.5 The Research Methodology
3.2 The Study Population

Eisenhardt (1989: 537) suggested that case selection is an essential step in case-study research, as the selected population establishes the sample set from which research data is collected and also determines the extent to which the findings can be generalised. It was therefore important that in the selection of this research case, careful consideration was placed on the population-inclusive criteria in order to develop an accurate theory. The study samplings done for the two studies are presented in their respective Chapters (See Chapter 4 for PGHD Study-1 sampling and Chapter 6 for PGHD Study-2 sampling). As shown in Table 3.2, the entire study population was reached on the basis of the two interdependent studies carried out, and the external validation carried out through domain expert evaluators.

Table 3.2 Table 3.2 PGHD Study-1, Study-2 and Domain Experts Population

<table>
<thead>
<tr>
<th>PGHD Study-1 population</th>
<th>PGHD Study-2 population</th>
</tr>
</thead>
<tbody>
<tr>
<td>For PGHD-TR1 survey, the population included residents of Lagos State as their investigation would enable the researcher to gain insight on the predisposition towards PGHD. Population sampling was carried out on the basis of the local government area (LGA) distribution in the State. Within each LGA, 100 random Lagosians were approached (See Chapter 4 for more details of PGHD-TR1 sampling).</td>
<td>Consent ing type 1 and type 2 diabetic patients were engaged in a 3-month PGHD acceptance model study. This was done in order to help the researcher develop evidence-based knowledge on the actual use and impact of PGHD on the Nigerian patients given that the dynamics of social determinants impact on the sample population. Population sampling was purposive with participants selected within one LGA secondary healthcare centre in the State. (See Chapter 6 for more details on PGHD Study-2 sampling)</td>
</tr>
<tr>
<td>For PGHD-TR2 survey, the population included medical doctors practicing in Lagos State secondary healthcare centres (government owned public general hospitals) as their investigation would enable the researcher to gain</td>
<td>The collaborating medical doctors involved in Study-2 were responsible for the treatment of the consenting diabetic patients’ population. Population sampling for this group was carried out after ethical approvals were given by Lagos</td>
</tr>
</tbody>
</table>
insight in the predisposition of these medical doctors towards PGHD.
Just as in PGHD-TR1, sampling was carried out on the basis of LGA in the State. Within each LGA, 20 random Lagosians were approached (See Chapter 4 for more details on PGHD-TR2 sampling).

State Health Service Commission (LSHSC) and the medical director in charge of the hospital where the study took place.

### External Validation: Domain expert population
This population was engaged after Study-1, Study-2 and the framework had been conceptualised and developed. The inclusion criteria for this population have been extensively discussed in Chapter 8 part 2.

#### 3.3 Data Collection Methods
Having defined and identified the research design, data collection begins. Based on the various selected mixed methods, this research employed both primary and secondary data in answering the research question.

##### 3.3.1 Primary Data
As defined by Glass (1976), primary data are generated and collected directly from respondents in an original study by administering data collection tools such as interview, questionnaire surveys or focus group observation of the sample population. Malhotra and Birks (2006) suggested that primary data are sourced with the intention to address specific issues or information needed that is not present in existing sources. While developing the validated PGHD adoption framework, this research collected primary data via a series of questionnaires, and first-hand observation of consenting diabetic patients and medical doctors. The questionnaire method is designed with the intent of getting and collating information from respondents through structured, unstructured or semi-structured questions. Several research questions relating to the research problem are asked to a consenting random or non-random selected population. Its advantages include sourcing vast information from a large number of respondents, while the disadvantages include: having some questionnaires not returned, incomplete answering, uncooperative respondents and the likelihood of some respondents not understanding the asked questions due to poor question structuring.
3.3.2 Secondary Data

Dolowitz, Buckler and Sweeney (2008) defined secondary data as data collected from already-made literature, established by other researchers and/or from academics. Sources of secondary data include library based research, internet-based research, from journal articles, textbooks and public records. Saunders et al. (2009) highlighted some advantages and disadvantages of using secondary data in research by stating that:

Advantages of Secondary Data

• most times, it is readily available
• it provides evidence on extent of research done and the existing knowledge available on a particular topic
• it could be feasible for longitudinal studies
• it can provide comparative and contextual data for systematic reviews
• it can result in unforeseen discoveries by identifying research gaps and trends
• it affords permanence of data and used in supporting, evolving and new ideas

Disadvantages of Secondary Data

• although they are free most times, some secondary data due to their exclusivity are expensive to obtain
• most collected secondary data are not significant to the problem they aim to address
• the sources of data might add bias to the authenticity of the data, and findings made with such data might be disputed
• there is no real researcher control over data quality

Literature from the library, internet, textbooks and journal papers were all mined for relevant data. All the data collected contributed towards defining the problem, analysing the findings made and developing the proposed PGHD adoption framework in Lagos State Nigeria.

3.4 Data Management and Analysis

Data analysis in research entails the phase when collected data is examined, classified, catalogued and correlated to meet the original project aim and objectives (Yin 2003). As the research adopts a concurrent triangulation method, this was also reflected in the data analysis
done in this research. By using concurrent mixed data analysis as suggested by Tashakkori and Teddlie (1998), both qualitative and quantitative data collected via various questionnaires administered during different phases of the research were analysed concurrently. Also, the concurrent technique permits qualitative data to be transformed into numerical information, which is referred to as quantising the qualitative data (Tashakkori and Teddlie 1998).

For both PGHD Study-1 and Study-2, the quantitative data analysis entailed data cleaning (editing questionnaires collected from the sampled population and inspecting for omissions and incorrect or inconsistent entries). This was then followed by data coding of the collected data where necessary. Data was analysed for both PGHD Study-1 and Study-2 with IBM SPSS 24 and IBM Amos 24 for the structural equation modelling (SEM) done in Chapter 7. All the analysis (descriptive, thematic, inferential, correlational and SEM) carried out have been defined and justified in the Chapters where they were applied.

Mann (1995) defined descriptive statistics as the discipline of quantitatively expressing the major characteristics of collected data or the quantitative description itself. Mann (1995) distinguished descriptive statistics from inferential statistics (or inductive statistics), by suggesting that descriptive statistics focuses on summarizing a sample, instead of using the data to investigate the sample the data represents. This implies that descriptive statistics are not developed on the premise of probability theory, unlike inferential statistics (Dodge 2008). Combining the two statistical techniques was justified by Dodge (2008) who argued that even if conclusion is reached on analysed data using inferential statistics, descriptive statistics are as well presented.

Upton and Cook (2014) defined inferential statistics as the process of reaching a conclusion from data subject to random variation, such as sampling variation or observational error. They opined that inferential statistics are used alongside the research sample data in testing hypotheses, making estimations and inferring predictions about a larger population that the sample represents, whereas descriptive statistics basically describe a sample. Outcomes from statistical inference usually suggests what should be done next, such as suggestions about making further experiments or surveys, drawing conclusion before implementing certain organisational or governmental policy, and in the case of this study, suggestion of an adoptable
PGHD framework for the area under study. To ensure the quality of this research work, extensive validity and reliability tests were performed on the collected data (See Chapter 4 for Study-1 reliability and validity results, see Chapter 6 for Study-2 reliability and validity results and see Chapter 7 for PGHD-acceptance modelling reliability and validity results).

### 3.5 Legal & Ethical Considerations

Given that undertaking research entails the use of respondents (people), specific issues concerning ethics must be carefully considered (Kapp 2006). Legal and ethical issues consist of respondents’ autonomy, privacy and dignity and this should always be reflected in the research process as it guides the researcher in ensuring the study meets all ethical requirements. In respect of this, all the data collection tools and techniques were designed to meet the approved ethics criteria in accordance with Coventry University’s ethics and the research collaborating organisation. For copies of the letters detailing the study ethics approval see Appendix 1, 2 and 3.

The following ethical issues were considered:

- **Legal implications of this research**: - This was highly considered and the researcher assured all participants that all data obtained will be used solely for research purposes, as stipulated in the Data Protection Act 1998 implications for health care researchers (Redsell and Cheater 2001).

- **Consent approval**: - This was a prerequisite for the participation of each and every participant in all the studies and data collected in this research. The researcher briefed all participants on what their willing participation entailed. Polit and Hungler (1991) state that respondents should be given enough information and time so as to enable them to consider if they should participate in the study or not.

- **Anonymity and Confidentiality**: - Data generated from this research were treated with the utmost anonymity and confidentiality. All collected data remained anonymised all through the analysis and reporting stages. This research has also wiped clean all electronic versions
of anonymised data stored in all repository devices used during the various study stages (with exception made for data either published in papers or presented in this thesis).

- **Benefit to Risk Ratio:** - Behi and Nolan (2004) argued that respondents’ involvement in any research might be hindered if their involvement risks are higher than the benefit. Communicating the risks and benefits of this research to respondents was essential in ensuring proper ethical conduct and reassuring the participants of how safe this research was.

- **Right to Withdraw:** - At any given point where any respondent becomes confused or uninterested during their participation, he or she has the right to withdraw (Behi and Nolan 2004). Whilst undertaking this research, the respondents were not coerced to continue partaking in this research against their will.

**3.6 Chapter Summary**

This chapter has identified, discussed and justified all the phases adopted in this research, with further emphasis presented in the respective chapters reporting the two interdependent studies carried out. This was done so as to avoid repetition or mixing up of terms, while allowing the reader to have a clear understanding of how each study was approached. The study area and research population have been discussed, and a mixed method of both qualitative and quantitative approaches (triangulation) was employed in order for data collection and analysis to be more flexible and comprehensive in representation. These approaches have guided the study and enabled the actualisation of the research aim. Implications of the legal and ethical issues were also considered in this chapter.
CHAPTER 4: STUDY-1 PATIENT-GENERATED HEALTH DATA - TECHNOLOGY READINESS (PGHD-TR) SURVEY

As a necessary step needed to be carried out in order to realize this research aim - to investigate if Patient-generated Health Data (PGHD) can contribute towards improving Nigerian patients’ diabetes mellitus management and subsequently develop a validated PGHD adoption framework for patients and care providers within the Nigerian health care sector, this chapter reports in detail, the patient-generated health data (PGHD) feasibility study carried out in Lagos State, Nigeria. Designed as a two-part cross-sectional study that was conducted concurrently, it lasted for 6 weeks starting from 5th of March to 10th of April 2015. The study was carried out in collaboration with the Lagos State Health Service Commission.

In justifying the need for this feasibility study, Justis and Kreigsmann (1979) argue that the concept of studying the feasibility of a project is to learn objectively the strengths and weaknesses of the proposed venture, to uncover opportunities and threats existing within the project environment, to identify the resources and personnel needed, to establish the relationships and degree of impact of each personnel and ultimately the prospects for success. Within the context of this research, the idea of this feasibility study was to ascertain the Lagos State residents’ and the State’s medical practitioners’ predisposition and readiness to adopt PGHD. This was done in order to empirically highlight the concerns, if any, that they (Lagosians and the State medical doctors) share regarding PGHD adoption.

As proposed in chapter three (Research methodology), this chapter details the research design (with justification) used in this study. The sampling method adopted a stratified sampling technique in order to reach a representative sample of the State’s population and medical doctors practicing in the State. It is to be noted that all aspects of this study abided fully by both ethics requirements of Coventry University UK and that of Lagos State Health Service Commission. Being a two-part survey, the first survey focused on the general State residents while the second survey targeted medical doctors working in the secondary healthcare centres (State’s General Hospitals) within each Local Government Area (LGA). In three LGAs where no secondary healthcare centres could be located, the primary healthcare centres were used. The
only exception was in Ikeja LGA, where the tertiary healthcare Centre for the State is located, and was used to supplement the General Hospital in the LGA.

The final data for the first survey – Patient-generated Health Data-Technology Readiness 1 (PGHD-TR1) was collected from 1,443 respondents, while that of the second survey (PGHD-TR2) was collected from 47 medical doctors across the 20 Local Government Areas or 37 Local Council Development Areas (LCDAs) that constitute Lagos State. Questionnaires were used for data collection and distributed through various channels (online and paper versions). Items in the two-part PGHD-TR1 and PGHD-TR2 questionnaires were modelled around the four dimensions of technology readiness index (TRI) framework. Based on the aforementioned, the theoretical background from which the patient-generated health data-technology readiness (PGHD-TR) multiple-item scale was developed is being discussed in this chapter. Other key concepts investigating the populations PGHD disposition were included in the questionnaire and findings made from the surveyed population and are being presented, analysed and discussed in this chapter.

4.1 Lagosians’ PGHD Technology Readiness (PGHD-TR)

As already defined, PGHD are health related data and other information created, recorded, gathered from patients or their designees to assist towards addressing the patient health concern and are unique from other types of health data as they are solely generated and distributed by the patient outside clinical environment (Shapiro et al. 2012). Although the practice or technology involved is not novel, the uniqueness of this study is justified by the fact that PGHD practice at the moment is not evident in Lagos State, based on initial literature searches (and as reaffirmed from the data collected in this Study-1), thus the need for this preliminary study to establish Lagos State residents’ (Lagosians) and medical practitioners’ predisposition towards PGHD in the State. Given that primary users of PGHD within this research will be Lagosians, and taking into consideration all the dynamics involved when it comes to technology adoption, it was necessary to ascertain their predisposition and that of the medical personnel in the State before actual implementation of the technology and practice in the state.

Still in support of the justification to investigate Lagosians’ PGHD readiness prior to adoption, is the need to adopt an out of the box approach to address the changing and challenging
dynamics in today’s healthcare delivery. Such changing and challenging dynamics include but are not limited to inadequate funding for healthcare delivery that is most times not accessible or affordable to an increasing population with an even increasing healthcare demand (Levitt 2008; Osain 2011; Pew Health Professions Commission 1995; Viseltear 1982). These recurring healthcare delivery challenges, which Lagos State and Nigeria, as a developing nation are familiar with, beg for alternatives and interventions that are technology driven, but most importantly, should be patient-centred in nature. Several studies have shown the impact on quality of life and additional improvement in healthcare delivery as a result of patients’ empowerment and inclusiveness (Anderson and Funnell 2005; Maizes, Rakel, and Niemiec 2009; McCabe 2004; Ueckert et al. 2003). Underlying the technology and patient-centred nature of these health delivery alternatives and interventions are the users (patients), and establishing their predisposition to technology adoption is a prerequisite to the successful implementation (Massey, Khatri and Montoya-Weiss 2007; Parasuraman and Colby 2015). In other words, the success of these technology-driven patient-centred alternatives is dependent on the readiness of the patient and healthcare providers contemplating to adopt them, thus the need to ascertain Lagosians’ patient-generated health data-technology readiness (PGHD-TR).

Pagani (2004) and Venkatesh et al. (2003) opined that the significance of understanding a population’s technology readiness as a foundation for establishing their predisposition towards adoption and use of new technology has attracted substantial attention from researchers and practitioners, and till present, continues setting precedents to technology adoption in various fields. Lanseng and Andreassen (2007: 397) suggest that the introduction of self-service technology (SST) as in this case of PGHD in healthcare may prove to have a significant impact for users (e.g. increased satisfaction) and care-providers (e.g. reduced cost and improved capability). Yet, independent of how promising PGHD appears in theory, its introduction does not guarantee success - as its adoption and utilisation will likely vary on the premises of individual psychographic features like technology readiness (Dabholkar and Bagozzi 2002; Lin and Hsieh 2006; Parasuraman 2000). To assuage this problem, several studies have examined the part played by individual differences towards the adoption of new technologies (Beaudry and Pinsonneault 2005; Harrison and Rainer 1992; Majchrzak and Cotton 1988; Zinkhan, Joachimsthaler, and Kinnear 1987).
Amongst the several factors and variables influencing or determining individual adoption of new technologies studied so far, Zmud (1979) investigated the role of demographics on individual differences and how it determines management of information system success. Agarwal and Prasad (1999) studied the usefulness of identifying individual differences towards the acceptance of new information technologies. Harrison and Rainer (1992) investigated the influence of gender, age, experience and personality variables in determining end-user computer skills. Nelson (1990) carried out a systematic review of related studies on the effects of various individual variables within the context of new technology implementation. All these studies, though different within the context of the environment and variables investigated, have one commonality: they aim to understand the user’s or population’s readiness prior to the adoption of new technology. This commonality is strongly hinged on the need to identify and understand various user attributes and how services or technology could be modelled or designed to meet their needs, based on their uniqueness.

The Technology Readiness Index (TRI) as proposed by Parasuraman (2000), aims to investigate and, to a large extent, predict a user’s or a population’s readiness towards a new technology based on their predisposition. In other words, the idea underlying technology readiness is to ascertain people’s propensity to embrace and adopt technology-based products and services for everyday use both at work and at home (Parasuraman 2000). Lanseng and Andreassen (2007: 398) is of the opinion that establishing a population’s readiness to accept a new technology is the foundation for adoption, and this was the main objective for this PGHD’s feasibility study in Lagos State. Bitner, Ostrom, and Meuter (2002: 102) and Meuter et al. (2003) suggested that often, the limitation with self-service technology (SST) like PGHD is not the sophistication of the technology, but getting users on board, while making sure that the platform is reliable, affordable and available.

In addition to all the aforementioned studies and several theories underpinning user acceptance of new technology, as in this case electronic healthcare (PGHD) adoption by users (patients), research and development investments in health information technology to a large extent will always rely on the number of users contemplating to adopt the technology and the more specific attitudes towards the technological application eventually provided (Lanseng and Andreassen
The former is a question of user's readiness to adopt technology at large or the diffusion of a new technology within a population (Rogers 2010), while the latter is a question of investigating the set of beliefs and expectations potential users share about the technological provision of the service, and how these beliefs will influence attitude and use (Lanseng and Andreassen 2007: 395). To address the former, this feasibility study adopts the four dimensions constituting the main construct (Innovativeness, Optimism, Insecurity and Discomfort) of TRI, which measures people’s propensity to embrace and use new technology to realise their goals (Parasuraman 2000: 308). The TRI Construct was adopted with measured items restated to suit this study. This was specifically as a result of its already established reliability and validity from a wide-range usage over the years across several institutions and most importantly in similar studies investigating users (both patients and care providers) adoption of technologies supporting e-healthcare delivery (Godoe and Johansen 2012; Lanseng and Andreassen 2007; Rockbridge 2015).

4.1.1 The Technology Readiness (TR) Construct

The TR construct represents a gestalt of mental motivators and inhibitors that could collectively define a person’s predisposition towards using new technologies (Parasuraman 2000: 308). Since TR is an individual-level characteristic that does not change within a short while nor alter unexpectedly in response to a stimulus (Parasuraman and Colby 2015: 3), the application of the four dimension of TRI framework in this study is as a result of its reliability and adaptability to measure requirements and identify factors that users hold high when evaluating technology readiness and expected service quality. Parasuraman and Colby (2015: 3) opine that TRI application has crossed a variety of services and this has attested to the proliferation influence of technology within the service domain. To buttress the wide adaptability and reliability of the TRI construct, Parasuraman and Colby (2015) carried out a longitudinal analysis of the academic license requests of TRI, and their result suggests that it has been applied to sectors that were early adopters of technology-based service delivery models, such as financial services, online retailing, various government institutions, non-profit services and more recently to health care. Within the health care sector, Lanseng and Andreassen (2007: 397) argue that the significance of TRI application is related to the novelty of e-health aspects during introduction to a population or an environment with little or no experience of e-health.
A high TR score implies that the population must have arrived at a definite level of comfort with technology through usage in other areas. Also, a high TR level is in correlation with higher adoption rates of cutting-edge technology and greater perceived ease of use (Fisk et al. 2011; Kuo 2011; Massey, Khatri and Montoya-Weiss 2007).

4.1.1.1 The Four Dimensions of Technology Readiness

The TR construct is multifaceted and consists of four dimensions (two dimensions are motivators and two are inhibitors) that were the key concepts adopted for this preliminary feasibility study. According to Rockbridge (2015), TR is a mind-set and not a measure of competence.

Describing the four dimensions based on Parasuraman’s (2000: 311) definition;

1. Optimism – is “a positive view of technology and a belief that it offers people increased control, flexibility, and efficiency in their lives.” Lin and Hsieh (2012: 48) suggest that optimism aims to capture a user’s general disposition toward technology. In other words, that technology is a positive thing.

2. Innovativeness - is “a tendency to be a technologically pioneering and a thought leader.” It signifies the length to which a user believes that he/she is a pioneer in trying new technology-based products/services and is an opinion leader on matters relating to technology.

3. Discomfort – is “a perceived lack of control over technology and a feeling of being overwhelmed by it.” Lin and Hsieh (2012: 48) hint that discomfort as a component of the TRI construct measures the degree to which people have a general bias about technology-based products/services, believing that they are exclusionary rather than inclusive of all kinds of people.

4. Insecurity – is “distrust of technology and scepticism about its ability to work properly.” It emphasises people’s trust and assurance of technology-based transactions.

Of these four dimensions, Parasuraman (2000: 311) opined that optimism and innovativeness are the positive drivers/contributors/motivators of TR, encouraging new users to adopt
technological products/services and to hold a positive attitude toward technology, while discomfort and insecurity are negative drivers/inhibitors, making customers reluctant to use technology and this is seen illustrated in Figure 4.1. Parasuraman and Colby (2015: 2) argue that the four dimensions are somewhat distinct, suggesting that an individual can have different combinations of technology-related traits, sometimes leading to a paradoxical state that entails of strong motivations tampered by strong inhibitions.

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Figure 4.1 The Four Dimensions of Technology Readiness Construct (Rockbridge 2015)

4.1.1.2 The Technology Readiness Segment

The TR-segmentation is a formal segmentation typology that captures different combinations of beliefs and as well offers researchers a robust tool for describing research subjects (Rockbridge 2015). The TR segmentation depends on the outcome of each subject’s TR-dimensions when reaching a conclusion. According to Parasuraman and Colby (2001), segmenting new technology adopters based on their TR scores can be insightful. The segmentations as illustrated in Table 4.1 include the highly tech-oriented “Explorers”, the strongly-engaged “Pioneers”, the dispassionate “Skeptics”, the cautious “Hesitators”, and the tech-resistant “Avoiders” (Rockbridge 2015).
4.1.2 Study-1 Research Hypotheses (PGHD-TR1 Survey)

Having reviewed literature surrounding the Technology Readiness (TR), and how its dimensions, segmentation and application could assist in ascertaining Lagosians’ PGHD readiness, Study-1 further investigates how the TR-dimensions will impact on Lagosians’ demographical attributes such as age, gender and level of education. This was informed by various studies that have examined the significance of individual differences and demography towards the adoption of new technologies (Dwivedi and Williams 2008; Lee et al. 2010). These studies though different within the context of the environment and variables investigated had one commonality that hinged on the need to investigate user’s demography and how technology could be modelled to meet their needs based on their demography.

Within the demography of Lagos State and Nigeria in general, self-medication is a common habit across the population and this study also investigated the relationship between studied population and self-medication (Omolase et al. 2007; Afolabi 2008; Arikpo, Eja and Enyi-Idoh 2010). Having shown that there is some evidence in the literature regarding the impact of demographics on acceptance of technology, and reviewed literature suggest that readiness precedes acceptance and adoption, Study-1 for PGHD-TR1 hypothesises that age, gender and
education are key determinants of Lagosians’ propensity to adopt PGHD and also have an influence on their attitude to self-medicate. On this basis, the following hypotheses are proposed:

H$_{1a}$. Age is positively related to Lagosians’ TR-optimism towards PGHD adoption.

H$_{1b}$. Age is positively related to Lagosians’ TR-innovativeness towards PGHD adoption.

H$_{1c}$. Age is positively related to Lagosians’ TR-discomfort towards PGHD adoption.

H$_{1d}$. Age is positively related to Lagosians’ TR-insecurity towards PGHD adoption.

H$_{1e}$. Age is positively related to Lagosians’ attitude towards self-medication

H$_{2a}$. Gender is positively related to TR-optimism towards PGHD adoption.

H$_{2b}$. Gender is positively related to TR-innovativeness towards PGHD adoption.

H$_{2c}$. Gender is positively related to TR-discomfort towards PGHD adoption.

H$_{2d}$. Gender is positively related to TR-insecurity towards PGHD adoption.

H$_{2e}$. Gender is positively related to Lagosians attitude towards self-medication

H$_{3a}$. Level of education is positively related to TR-optimism towards PGHD adoption.

H$_{3b}$. Level of education is positively related to TR-innovativeness towards PGHD adoption.

H$_{3c}$. Level of education is positively related to TR-discomfort towards PGHD adoption.

H$_{3d}$. Level of education is positively related to TR-insecurity towards PGHD adoption.

H$_{3e}$. Level of education is positively related to Lagosians attitude towards self-medication

Figure 4.2 illustrates the hypotheses model, in which Technology Readiness is conceptualised as a joint process whereby patient age, gender and level of education are exogenous variables that could influence Lagosians’ propensity to adopt PGHD.
4.2 The PGHD-TR Preliminary Feasibility Study Design

According to Trochim and Donnelly (2001), research design offers the glue that holds the research project together. With the aim of fulfilling this research’s second objective - undertake a feasibility study in order to establish Lagosians’ and medical doctors’ propensity to the PGHD concept, the study design mirrored a cross-sectional study of the State’s residents and medical doctors. Mann (2003) opined that in social science and medical research, a cross-sectional study, also referred to as cross-sectional analysis or prevalence study, is a type of observational study that entails the analysis of data collected from a population or a representative subset at a particular point in time. Aiken et al. (2012) suggest that this type of research design is highly descriptive in nature as it provides a one-off picture of the variables under investigation. Data collected from this type of study is known as cross-sectional data, and usually, it is obtained via various survey techniques. Sapsford (1999) defines survey as a thorough and quantified description of a population. It involves the systematic collection of data, be it by interview, questionnaire or observation methods (Gray 2004: 99). As with any other study design, a cross-
sectional study design has its advantages and disadvantages as highlighted by Trochim and Donnelly (2001);

Table 4.2 Advantages and Disadvantages of Cross-Sectional Designs

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enables capturing data on many variables and from a large number of dispersed subjects</td>
<td>This increases likelihood of error and as well increase in cost due to dealing with large subjects in several locations</td>
</tr>
<tr>
<td>Mostly measures data on attitudes and behaviours</td>
<td>But cannot measure change</td>
</tr>
<tr>
<td>Focuses on answering questions on who, what, when and where</td>
<td>But cannot establish cause and effect</td>
</tr>
<tr>
<td>It is good for exploratory research</td>
<td>Leaves no control of independent variable</td>
</tr>
<tr>
<td>It generates hypotheses for future research</td>
<td>But difficult to rule out rival hypotheses</td>
</tr>
<tr>
<td>Data generated is useful to various different researchers</td>
<td>Data generated is static, time bound</td>
</tr>
</tbody>
</table>

Having carefully discussed the philosophy underpinning cross-sectional study design, it was chosen in order to offer first-hand information on the present state of PGHD within the Nigerian environment – (the general population’s and medical doctors’ predisposition and readiness to adopt PGHD). Secondly, the need for this study centres on the fact that there is paucity of empirical data on PGHD readiness or usage in Nigeria at the moment, and most studies available in the country show little or no evidence of PGHD, either from patients’, medical practitioners’ or related stakeholders’ perspective.

The PGHD-TR1 and PGHD-TR2 State surveys were conducted across 20 Local Government Areas (LGAs) or 37 Local Council Development Areas (LCDAs) in Lagos State with details of each LGA’s composition and response rate listed in Tables 4.7 and 4.8. Given the cosmopolitan makeup of Lagos State and how its diversified attributes depict a microcosm of Nigeria, it was ideal to base the study in the State as the survey response could give an insight into the average Nigerian’s predisposition and readiness to adopt PGHD. A further justification why the State was ideal for this study can be seen from the study area section. The sampling approach - stratified sampling technique adopted in conducting the survey ensured that data collected was
representative of the State’s residents. The sample population was stratified on the basis of the 20 LGAs in Lagos State. In selecting the sample size for the two surveys that were conducted (PGHD-TR1 and PGHD-TR2), the researcher took into consideration the huge population size of the State and weighed it against time, cost (travelling to Nigeria from the UK and mobilizing the needed resources for data collection) and the practicality of covering all 20 LGAs in Lagos State.

- **PGHD-TR1 Study Sample:** After considering all these factors, the sample size for the first survey on Lagosians (PGHD-TR1), which was chiefly the main set of data needed to realize this preliminary feasibility study objective, was selected based on a statistical sample size calculation model (precision-based sample size calculation). This sample size calculation applies the formula:

\[
SS = \frac{Z^2 \cdot pq}{c^2}
\]

where \(SS = \text{sample size}\), \(Z\) is a constant value of 1.96 for 95% confidence level, \(p\) is the standard deviation that is unknown but usually set at 0.5 for the sample size needed, \(q\) is \(1 - p\) and \(c = \text{confidence interval or margin of error selected to be at 0.05 (±5) with a 95% confidence interval.}\)

To get the finite population, the formula used was:

\[
SSadj = \frac{SS}{1 + (SS-1/Population)}
\]

where \(SSadj\) is the adjusted new sample size and the population value was that of Lagos State which is estimated at over 21,000,000 (Lagos State Government 2015).

Based on this calculation, a sample size of 384 respondents was deemed appropriate to give sufficient power to meet the research objective. Dividing this between the 20 sub-groups (20 LGAs in Lagos State) amounted to 19 respondents per sub-group and this was deemed insufficient as each of the sub-groups needed to be treated as a distinct population (Freedman, Pisani, and Purves 2007). In response to this, instead of the initial 19 respondents, 50 respondents were randomly picked within each sub-group (LGA). The justification behind this was to ensure that each of the 20 sub-groups would be large enough for valid estimation of the measured parameters. With this done, a total of 1,000 respondents from the 20 LGAs in Lagos
State were arrived at, and this was set as the baseline before setting a final sample size of 2,000 Lagosians. This adjustment to 2,000 PGHD-TR1 survey respondents was done so as to give room for likely dropouts from the study due to unforeseen reasons. As expected, with a huge population such as that of Lagos State, devising a representative sample could be tricky. However, Freedman, Pisani, and Purves (2007) have shown that the size of the population does not matter much given that a sample of 1,000 is equally sufficient for a population of 10,000,000 citizens. Secondly, in justifying the final sample size reached for the PGHD-TR1 survey, a similar study investigating ownership and usage of mobile phones in African countries titled ‘Cell Phones in Africa: Communication Lifeline’ used a sample size of 1,014 persons with a ±4.3% margin of error for Nigeria (Pew Research Centre 2015). This study’s final sample size is well above the range of the sample size used in study by the Pew Research Centre, though this study’s margin of error was set at ±5%.

**PGHD-TR2 Study Sample:** For the PGHD-TR2 survey that solely focused on medical doctors practicing in Lagos secondary healthcare centres (State General Hospitals), a stratified sampling method was also used. The sample frame centred on randomly picking at least 5 medical doctors from General Hospitals in each of the 20 LGAs in Lagos State. This was to corroborate their response with that from the PGHD-TR1 survey, as well as have a first-hand professional opinion on PGHD practice in Lagos State if it is in existence and if not, to ascertain their disposition towards PGHD adoption in the State. Also, the PGHD-TR2 survey measured items under the TR dimensions - *innovativeness, optimism, insecurity and discomfort*, in order to establish the State medical doctors’ readiness to adopt PGHD. Having selected 5 medical doctors per LGA, the overall sample size was 100 medical doctors. As customary with good sampling practice, the final sample size for PGHD-TR2 was set at 10 per LGA, and this now gave an overall sample size of 200 respondents in order to give room for any sudden participants withdrawal. Amongst the justification for deeming this sample size sufficient for this study was the doctor to patients’ ratio in Nigeria. At present, the doctor to patients’ ratio in Nigeria stands at 1:3,500 against the World Health Organisation (WHO) standard of 1:600 (Nigerian Health Journal 2011; Osun Defender 2015; The World Bank 2015). Based on this logic, weighing the sample size of medical doctor ratio of 200:2,000 → 1:10 Lagosians against the present ratio of 1:3,500 in Nigeria is deemed sufficient for this study.
**Figure 4.3 PGHD-TR Feasibility Study Design**

PGHD-TR1/Stratified sampling

- Lagosians, Lagos State Nigeria, English; 5th March – 10th April 2015
- Questionnaire: mostly closed ended questions with yes/no, multiple choice answers and 5-point Likert scale. Open ended answer only for ‘other’ answer choice (±5% margin of error).
- 2,000 – Adult population; 18 and above
  - For the Study: Lagosians to doctor ratio is 2,000:80 = 10:1
- Self-administered paper & online versions; distributed across public institutions and locations within each 20 LGAs (e.g. hospitals, schools, banks, markets, sports centres, churches, mosque, bus stations, streets, local government offices and traditional ruler palace etc.)
- Demographic attributes: = 4 items
  - PGHD-TR items: Optimism = 8; Innovativeness = 9; Discomfort = 3; Insecurity = 3
  - Self-medication habit: = 4 items
  - Health check-up habit: = 3 items
  - Opinion on Hospital appointment: = 5 items
- Out of 2,000 questionnaires, 1443 responded (72.15% response rate)
  - Male population; 743 (51.5%) and Female population; 700 (48.5%)
- Paper version answered = 128, online version answered = 1315

PGHD-TR2/Stratified sampling

- Medical Doctors practicing in Lagos State General Hospital Nigeria, English; 5th March – 10th April 2015
- Questionnaire; both closed ended (yes/no, multiple choice answers and 5-point Likert scale) and open ended questions (±5% margin of error).
- 200 – Medical doctors; For the Study; doctor to Lagosians ratio is 200:2,000 = 1:10
- Self-administered paper & online versions; distributed across Secondary Healthcare Centres within the 20 LGAs
- Demographic attributes: = 5 items
  - PGHD-TR items: Optimism = 12; Innovativeness = 6; Discomfort = 2; Insecurity = 3
  - PGHD disposition: 12 items
- Out of 200 questionnaires, 47 responded (23.50% response rate)
  - Male population; 28 (59.6%) and Female population; 19 (40.4%)
- Paper version answered = 6, online version answered = 41
4.2.1 The Study Area for PGHD-TR

Lagos State is one of the 36 States in Nigeria and consists of twenty local government areas (LGAs). Lagos State is usually referred to as a microcosmic representation of Nigeria due to her unique diversity. As illustrated in Figures 4.4, it is located in south-west Nigeria and shares boundaries with the Republic of Benin in the West; Ogun state in both the North and East, while in the South of the State lies the Atlantic Ocean stretching up to 180 kilometres along the coast. On land mass, it is the smallest State as shown on the map of Nigeria in Figure 4.4 with an area of 356,861 hectares of which 75,755 hectares are wetlands, yet it is the most populous with a population of over 21 million out of over 170 million citizens of Nigeria (Lagos State Government 2011). The socio-demographic profile of Lagos State is highly diverse and representative of numerous ethnicities, religions, socioeconomic divides, as well as sociocultural practices in Nigeria. Therefore, the State is very ideal for this research. At present, Lagos State generates up to 25% of Nigeria’s total gross domestic product and is the second-fastest growing city in Africa with a predicted population growth of more than 25 million people as of 2015, making the State the 3rd largest city in the world (World Population Review (2015).

With the population doubling over the last 15 years, living standards and social infrastructure across the country and the State remain poor (The World Bank 2015). Amongst the impact of this continuous population explosion in the State is the pressure it puts on the State’s overstretched poor health information management system, and as a result, its impediment in managing her population’s chronic care diseases (Asuzu 2005; Asangansi and Shaguy 2009). In addition, social determinants of health such as means of livelihood, economic disparity and education keep contributing to a population shift within the State. Chinenye et al. (2012: 558) suggests that the aforementioned are amongst the factors that contribute to the incidence of diabetes mellitus, of which Lagos State has the highest diabetes prevalence in Nigeria. This further reaffirms the study’s suitability in the State.

Focusing on patient’s diabetes management in the State, some studies in Nigeria have systematically reviewed how application of health information technology can help
improve the management of this chronic condition and health in general within the country’s health sector. These studies mostly conclude by stating the challenges limiting their interventions such as: inadequate health information technology support system, epileptic power supply, inadequate human resources, government attitude towards the underfunded health sector, resistance to new technology and lack of maintenance culture (Idowu, Cornford, and Bastin 2008: 20). Another commonality within these studies is that they adopt a top-down approach that is of little significance and with less inclusivity to the primary benefactor - the chronic care patient. Also, an exhaustive literature search has shown no study at the moment with information on technology readiness of Nigerians to adopt health information technology for a PGHD purpose. As a result of this existing gap, it was deemed necessary to embark on studying first, the population’s and healthcare provider’s predisposition to PGHD and their PGHD-TR (technology readiness). Secondly, how the introduction of PGHD which has the patient at the centre can contribute towards improving Lagosians’ diabetes management.

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Table 4.3 Lagos State Population Distribution (Lagos State Government 2011)

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4.2.2 Study Sample - Strategy and Scope

PGHD-TR1 Survey (Lagosians): The inclusion criteria for selecting the sample for PGHD-TR1 was based on each respondent being above 18 years, and a resident of Lagos State. The age limit reflects the defined legal age in Nigeria. Having earlier justified the sample size and why the State was deemed appropriate for the study – both in diversity
(socio-economic and cultural) and having the highest prevalence of diabetes in Nigeria, the stratified sampling technique adopted ensured all corners of the State were represented on the basis of equal representation of each of the 20 LGAs in the State, see Table 4.3. 100 participants in each of the 20 LGAs were picked randomly from different parts of each LGA, and in total, 2,000 Lagosians were randomly targeted. The sample stratification strategy employed is illustrated in Figure 4.5.

*Figure 4.5 PHGD-TR1 Stratified Sampling Strategy*

With stratified sampling, an equal chance is given to every element in the overall population to be represented (Särndal, Swensson and Wretman 2003; Moore and McCabe 1989). This often improves the representative on of the overall population by reducing the sampling error and ensures that at least one observation is picked from each of the stratum (Shahrokh and Dougherty 2014). As much as this sampling technique enhances representativeness by ensuring that the respondents reflect the diversity across the population, it is as well expensive, time consuming and produces a large number of respondents with unique attributes, thus a greater need to be very analytical (Shahrokh and Dougherty 2014).
**PGHD-TR2 Survey (Medical Doctors):** For this part of the survey, the sample frame centred on Lagos State Health Service Commission (LSHSC) distribution of healthcare centres in the State. LSHSC oversees healthcare delivery and regulation in the State via the various facilities and agencies under its watch (Lagos State Ministry of Health 2015).

The facilities for healthcare provision in Lagos State, just like in other States in Nigeria are designed with the aim of being accessible and affordable to the masses and includes;

1. **Primary Healthcare Centres (PHCs):** Totalling about 238 PHCs and distributed within each LGAs or LCDA across Lagos State.
2. **Secondary Healthcare Centres:** Also known as General Hospitals or Health Centres. There are about 25 secondary healthcare centres in the State.
3. **Tertiary Healthcare Centres:** The Lagos State University Teaching Hospital is the only State owned tertiary healthcare centre in the State. It is responsible for the training of doctors and other health care professionals, as well as providing high quality clinical services for the State populace (LASUTH 2015).

In order to balance the available resources (time, cost and an achievable scope) to the environment under study, the PGHD-TR2 survey sampling only picked medical doctors across the State secondary healthcare tier (General Hospitals). The questionnaire administration was done by picking randomly within each LGA, 10 medical doctors from the already stratified 20 LGAs, and in LGAs where secondary healthcare centres couldn’t be located, the primary healthcare centres sufficed, except in Ikeja LGA where the tertiary healthcare Centre for the State - Lagos State University Teaching Hospital (LASUTH) was used to supplement the secondary health centre in the LGA. It is also to be noted that the sample frame did not consider private healthcare hospitals, as the scope of the PGHD-TR2 study focused on investigating the public healthcare institution in the State. A further justification for limiting the sample frame to only secondary healthcare centres in the State was to be able to gain information on how medical practitioners in the State-sponsored hospitals view the PGHD concept as well as enable findings made to be representative as much as possible at the State and National levels. The Survey respondents had the option of either responding to the online or paper version of the PGHD-TR2 questionnaire. Table 4.4 details the sample frame for the PGHD-TR2 survey.
### Table 4.4 PGHD-TR2 Sample Frame

<table>
<thead>
<tr>
<th>Local Government</th>
<th>Secondary Healthcare Centre</th>
<th>Target Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agege</td>
<td>Orile-Agege General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Ajeromi-Ifelodun</td>
<td>Ajeromi General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Alimosho</td>
<td>Alimosho General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Amuwo Odofin</td>
<td>Questionnaire sent to 2 separate primary healthcare centres (given the absence of secondary health care centres in the LGA)*.</td>
<td>10</td>
</tr>
<tr>
<td>Apapa</td>
<td>Apapa General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Badagry</td>
<td>Badagry General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Epe</td>
<td>Epe General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Eti-Osa</td>
<td>Questionnaire sent to 2 primary healthcare centres*.</td>
<td>10</td>
</tr>
<tr>
<td>Ibeju-Lekki</td>
<td>General Hospital, Akodo</td>
<td>10</td>
</tr>
<tr>
<td>Ifako-Ijaiye</td>
<td>Ifako Ijaiye General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Ikeja</td>
<td>Lagos State Teaching Hospital (Tertiary Healthcare Centre was used)</td>
<td>10</td>
</tr>
<tr>
<td>Ikorodu</td>
<td>Ikorodu General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Kosofe</td>
<td>Gbagada General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Lagos-Island</td>
<td>General Hospital Lagos</td>
<td>10</td>
</tr>
<tr>
<td>Lagos-Mainland</td>
<td>Mainland Hospital, Yaba</td>
<td>10</td>
</tr>
<tr>
<td>Mushin</td>
<td>Mushin General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Ojo</td>
<td>Questionnaire sent to 2 primary healthcare centres*.</td>
<td>10</td>
</tr>
<tr>
<td>Oshodi-Isolo</td>
<td>Isolo General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Somolu</td>
<td>Somolu General Hospital</td>
<td>10</td>
</tr>
<tr>
<td>Surulere</td>
<td>Surulere General Hospital</td>
<td>10</td>
</tr>
<tr>
<td><strong>Totalling: 20 LGAs</strong></td>
<td><strong>Sample size: 200</strong></td>
<td></td>
</tr>
</tbody>
</table>
4.3 The PGHD-TR Research Method

In order to categorically state the findings made from the collected data for this PGHD-TR survey, it was important to establish the theory underlying the research method, choice of data collection instrument and justification for use in this study. As stated in Chapter 3, this PGHD-TR survey adopts a mixed research method approach as seen from the item construct in the data collection instrument. The mixed method is desirable as it provides a more holistic view of the concept under investigation and because requirements during different phases of the research make very specific demands on a general methodology (Johnson and Onwuegbuzie 2004; Brannen 2005).

Further emphasizing on the desirability of mixed research method, Johnson, Onwuegbuzie and Turner (2007) argue that narrow interpretations of the world are often misleading and to avert this limitation to interpretation, approaching a subject from different perspectives may help gain a more holistic perspective.

4.3.1 The PGHD-TR Data Collection Instrument – Questionnaire

Data collection involves a systematic process of collecting and measuring information on variables of interest so as to enable one answer to the stated research questions, test hypotheses, and evaluate outcomes (Cresswell and Clark 2007). Selecting an appropriate data collection instrument - whether existing, adapted, or novel must be done with clear instructions in order to ensure correct use, which in turn helps in reducing the likelihood of errors occurring. Jupp (2006) suggests that the need for formalising the data collection process is to ensure the collected data can be accurately defined and ensuing decisions based on arguments embodied in the findings are valid. In other words, the data collection process offers the researcher a model from which a measured phenomenon could be improved upon. In the absence of a proper data collection process, there is a high likelihood of not being able to answer the research questions accurately and this limits the possibility to repeat or validate the study.

For this survey, a questionnaire was deemed most appropriate. Bradburn, Sudman and Wansink (2004) defined a questionnaire as a pre-formulated written set of questions administered to respondents and to which they input or record their answers, customarily
with a closely defined alternatives or in an open-ended form. Amongst the rationales behind the use of a questionnaire as the instrument of choice for both PGHD-TR surveys are:

1. The questionnaire is an efficient data collection instrument that is often employed when the researcher knows exactly what is being investigated, the resources required and how to measure the variables under investigation. Investigations carried out in field studies, comparative surveys and experimental designs usually use questionnaires to measure the variables of interest (Sekaran 2003).

2. It was used because both quantitative and qualitative information were required from quite a huge number of Lagos State residents and medical doctors in the State.

Brace (2008) suggests that amongst preferences for using a questionnaire as a data collection instrument is the ability it avails to the researcher to reach a large number of respondents concurrently while being less expensive, less time consuming and posing a wider reach than an interview or other forms of data collection. Ordinarily, it does not require much skill to administer a questionnaire as to conduct interview and even more, it can be administered by a proxy or answered at a comfortable time by the respondent without fear of losing the question intent.

Nevertheless, the issue of convincing participants to partake in the survey and confidentiality are big limitations to questionnaire administration (Hussey and Hussey 1997). This was resolved by getting ethical approval from the necessary bodies, attaching a covering letter and a consent approval form. Also, assurance was laid on the fact that all data collected would be strictly handled with the utmost confidentiality. In addition, the questionnaire design emphasised on anonymising all personal data by not asking for details that could reveal a participant’s true identity.

4.3.2 Questionnaire Design - Development of the PGHD-TR Survey Instrument
The questionnaires for the two surveys – PGHD-TR1 and PGHD-TR2 were conceived and developed after preliminary information gathering through reviewed literature on
Patient-generated Health Data (PGHD), IT adoption models with a core focus on the Technology Readiness Index (TRI) and discussions with experts such as medical doctors and academic persons in the field under study. Considerations were also made during this development stage on how environmental factors will impact on the distribution of the questionnaires and this in part has been discussed in the research sampling subsection. Primarily, English is the major spoken language in the study area and this was the language used in administering both questionnaires. During this development stage, emphasis was also laid on how best to construct the questionnaire items and ensure that their readability wasn’t lost.

Amongst the strategies to enhance the response rate from the respondents considered were:

1. Starting the questionnaire with a non-revealing detail on each participant’s gender, age, LGA, education level and occupation. This was done in order to avert unforeseen fatigue or loss of interest setting and resulting in vital information on the participant being unanswered.
2. After anonymising the demographic question items that could be possible correlates of PGHD technology readiness, the PGHD-TR1 questionnaire started with questions regarding mobile device ownership and usage before getting to questions that required more reflective thinking from the respondents. By designing the questionnaire to go from an easy to a gradual complex progression, the researcher’s intent was to capture and engage the participant’s curiosity throughout the questionnaire answering phase (Brace 2008).
3. The readability of the questionnaire was ensured by pre-testing the wordings of each question during the questionnaire development phase. Secondly, open-ended questions mostly used in the PGHD-TR2 survey were generally minimised as much as possible for reasons of coding and to avoid instances whereby respondents lose interest to participate due to a lengthy questionnaire or fatigue. Thirdly, answer options with no suitable option were afforded the “other” function for any additional answer provision or comments.
4. Finally, as the time-length of completing the questionnaire might be a hindrance to getting a good response rate, the estimated time-length to complete the questionnaire was communicated in the covering letter so as to avoid a participant’s fear of engaging in a lengthy task.

4.3.3 PGHD-TR1 and PGHD-TR2 Questionnaire Construct

An intrinsic challenge with scales that measure user’s technology attitudes is the fact that technology keeps evolving over time and even at a faster speed in fields where service delivery technologies are much relied on as in healthcare delivery field. All the items measured were modified to suit the context of the study and most especially the technology readiness (TR) items in both questionnaires. With this adaptation came the need to reword the measured items in order to be relevant to the study environment. Several studies investigating patient adoption of mobile tracking technology and another study investigating people’s readiness and attitude toward performing self-diagnosis have had measured items restated while keeping the main questionnaire construct (Abu-Dalbouh 2013; Lanseng and Andreassen 2007). The former study adopted the technology acceptance model (TAM) with item statement under each construct modified to fit the study environment, while the latter study adopted both TRI and TAM with modifications made under item statements measuring TAM.

It is to be noted that the adaptation of the TRI as a measurement scale for this study was formerly approved with a written consent from Parasuraman to use the four-dimensional TRI framework for this study (See Appendix 4). As shown in Table 4.5, PGHD-TR1 consisted of 2 sections of 13 questions with sub-questions under each question, while PGHD-TR2 consisted of 8 questions with sub-questions under each question likewise (See appendix 4.2 and 4.3 for Study-1 questionnaires).
Table 4.5 PGHD-TR1 and PGHD-TR2 Questionnaire Construct

<table>
<thead>
<tr>
<th>Key Concepts</th>
<th>PGHD-TR1 Measured by</th>
<th>PGHD-TR2 Measured by</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic characteristics:</td>
<td>4 items</td>
<td>5 items</td>
</tr>
<tr>
<td>Self-medication habit</td>
<td>4 items</td>
<td>-</td>
</tr>
<tr>
<td>Health check-up habit</td>
<td>3 items</td>
<td>-</td>
</tr>
<tr>
<td>Opinion on Hospital appointment</td>
<td>5 items</td>
<td>-</td>
</tr>
<tr>
<td>PGHD disposition</td>
<td>-</td>
<td>12 items</td>
</tr>
<tr>
<td>PGHD-TR items: Optimism</td>
<td>8 items</td>
<td>12 items</td>
</tr>
<tr>
<td>PGHD-TR items: Innovativeness</td>
<td>9 items</td>
<td>6 items</td>
</tr>
<tr>
<td>PGHD-TR items: Discomfort</td>
<td>3 items</td>
<td>2 items</td>
</tr>
<tr>
<td>PGHD-TR items: Insecurity</td>
<td>3 items</td>
<td>3 items</td>
</tr>
</tbody>
</table>

4.3.4 Pretesting the Questionnaire and Pilot Survey

Sekaran (2003) opines that questionnaire pretesting is an experimental run with a set of respondents for the purpose of discovering if there are any readability or design problems with the questionnaire. Two phases of pretesting were carried out during the questionnaire development phase. The first questionnaire pretesting was carried out with the researcher’s supervisory team and research colleagues from 9th January – 30th January 2015. Observations made included: rearranging the flow and sequence of the questionnaire progress from an easy-to-complex form and removal of questions that seemed repetitive or ambiguous with no connection to the research objective. Also, emphasis was laid on making the questionnaire concise, comprehensive and measurable. This first pretesting phase enlightened the researcher on the need to have a theoretical backing to the concepts under investigation and as a result, the TRI (Technology Readiness Index) framework, which is copyrighted, by A. Parasuraman and Rockbridge Associates, Inc. (1999) was adapted with written permission from Parasuraman (2000).

After putting into effect all corrections made from the first pretesting phase, the second questionnaire pretesting phase, which also served as a pilot survey was carried out from 2nd February – 20th February 2015 with a population of Nigerian students in Coventry University UK. Cooper, Schindler and Sun (2006) suggest that a pilot study is carried out to discover flaws in design and to provide an alternative to achieving the aim of the
project while drawing participants from the target population to simulate methods put in place for data collection. van Teijlingen and Hundley (2001) highlighted the importance of pilot study by stating that it:
1. improves clarity and testing of question sequencing
2. enables testing questionnaire layout and meaningfulness in the answer options
3. allows the researcher to gain familiarity with potential participants
4. enables pretesting fieldwork arrangements such as the training and testing of fieldworkers if required
5. enables estimation of response rate completion time
6. allows for pretesting the practicability of the chosen analysis procedures on the generated data

Having designed the questionnaire using the Bristol Online Survey which is a web-based survey design, distribution, retrieval and analytical tool licensed to Coventry University, a link to the PGHD-TR1 survey was sent to 30 Nigerian students in Coventry University. An additional set of questions surrounding questionnaire readability was also asked in order to gauge from the respondents’ view, how clear the questionnaire was. The rationale for using this set of participants was to have, as much as possible, a real-world response from respondents who share similar characteristics with respondents in the actual study area. Out of the 30 contacted participants, 23 responded and this meant a good response rate of 76%. Based on response to completion time from the 23 respondents, the average completion time to respond to the PGHD-TR1 questionnaire was 15 minutes.

For the PGHD-TR2 survey that focused on medical doctors in the State, the second pretesting phase, which as well sufficed as a pilot survey entailed sending a copy of the questionnaire via E-mail to the Medical Director at General Hospital Lagos, Odan. After perusing through the questionnaire, he gave his opinion on the readability of the questionnaire and corrections identified were effected. There was no emphasis laid on completion time in the PGHD-TR2 questionnaire as some of the questions asked required great reflection and were open-ended questions.
4.3.5 Reliability Analysis of the Instrument

Tice and Veal (2000) argue that reliability is the degree to which research findings would remain unchanged if the research were carried out with a different sample in the same population or repeated at a later date. In other words, testing reliability and validity of measures is done to ensure goodness of data as this indicates the degree to which the measure is free of bias (Litwin 1995). Kimberlin and Winterstein (2008) suggest that the significance of testing reliability of a scale used in research is to offer consistency to the measurement instrument over time and across the various items it measures. This is important because in the absence of reliability, it is impossible to have any validity associated with the score (Carmines and Zeller 1979).

To ensure that this was attained with the measurement instrument used in this survey, Cronbach’s alpha coefficient, which is an estimate of internal consistency associated with a score derived from a scale, was used for this purpose (Cronbach 1951; Nunnally 1979). According to Sekaran (2003), reliabilities below 0.6 are considered poor while those at 0.7 are deemed acceptable, and those above 0.8 are termed good. The closer the reliability coefficient is to 1.0 the better. Based on this, the general agreed lower limit for Cronbach’s alpha is 0.70 (Nunnally 1979; Lanseng and Andreassen 2007: 406). Though in exploratory research which this is, it may decrease to 0.60 (Robinson, Shaver and Wrightsman 1991).

This reliability test was carried out only on the 23 retrieved PGHD-TR1 questionnaires for the pilot phase while it was carried out after the main survey again on both surveys (PGHD-TR1 and PGHD-TR2), see Table 4.6.

Table 4.6 Summaries of Cronbach’s Alphas Values in PGHD-TR1 Pilot Survey

<table>
<thead>
<tr>
<th>PGHD-TR1 Measured Items</th>
<th>Items</th>
<th>Cronbach’s Alpha</th>
<th>Reliability Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimism</td>
<td>8</td>
<td>0.718</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Innovativeness</td>
<td>9</td>
<td>0.849</td>
<td>Good</td>
</tr>
<tr>
<td>Discomfort</td>
<td>3</td>
<td>0.756</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Insecurity</td>
<td>3</td>
<td>0.771</td>
<td>Acceptable</td>
</tr>
</tbody>
</table>
4.3.6 Validity of the Instrument

Johnson and Turner (2003) opine that validity is the degree to which data collected truly embodies the phenomenon under study. A common issue faced with most IT adoption research surrounds the difficulties about validity, especially when it comes to measuring attitudes and behaviour as a result of various users’ bias to technology acceptance (Lanseng and Andreassen 2007: 410). Sekaran (2003) proposed several types of validity tests for testing the goodness of measures such as content validity, criterion-related validity, and construct validity - for this study, both face and content as well as construct validity were undertaken.

4.3.6.1 Face and Content Validity

Holden (2010) defines face validity as the degree to which a test is subjectively seen as covering the concept it claims to measure. It is carried out in order to assess how relevant a test measures the participants it aims to test (Gravetter, and Forzano 2015). This implies that a test has face validity if it appears it will measure what it is supposed to measure and this was undertaken during the development phase of both PGHD-TR1 and PGHD-TR2 questionnaire. During this phase, repeated consultations were made with the statistical department at the University library to discuss the relevance of the items to the construct they aim to measure, and how relevant these items will be able to elicit unbiased response from the respondents. After this, a further validity called content validity was done.

Content validity, also known as logical validity, is the degree to which a measure represents all features of an assumed knowledge construct (Fraenkel, Wallen, and Hyun 1993). It requires expert opinion in evaluating whether test items measure defined content and it is more thorough than assessment made with face validity (Hair et al. 2006). Given the thoroughness required, content validity is often addressed through academic and vocational testing, where test items need to reflect the knowledge essential for a given subject area.

For the purpose of this study, the researcher had the PGHD-TR1 questionnaire assessed in order to establish how relevant the items cover the subject area. Four experts in the
subject area (IT adoption and PGHD) were asked to offer a critical appraisal of the questionnaire, especially on the items under each key-concept in order to ascertain if individual items corresponded with the key-concept. Based on their suggestion, the instrument was further revised.

As regards construct validity for PGHD-TR2, the questionnaire was assessed by a medical practitioner within the study area and based on the suggestions made, some changes were made to some of the items.

4.3.6.2 Construct Validity

Brown (1996) defined Construct validity as the extent to which a test (questionnaire) measures what it intends to be measuring. In respect to this study, it was necessary to ensure that the measure reflects the construct it claims to be measuring. The PGHD-TR1 and PGHD-TR2 questionnaire construct relied on the four-dimensional TRI framework, which has been widely adopted, replicated, and having its reliability and validity empirically verified by numerous researchers (Lanseng and Andreassen 2007; Lin and Hsieh 2012; Tsikriktsis 2004; Parasuraman and Colby 2015). The validity of the questionnaires was further strengthened by the two questionnaire pre-tests carried out, as well as the face and content validity undertaken.

4.4 Data Collection

The population was limited to respondents 18 years old and above (the lower age limit being the legal age limit in Nigeria). Having stratified the sample, participants in each of the 20 LGAs were randomly picked for both PGHD-TR1 and PGHD-TR2 surveys. For both questionnaires distributions, respondents had the choice of filling out a paper version, having it communicated verbally (for not too literate, physically impaired and elderly participants) or responding online via the survey link. As already stated, the Bristol Online Survey, a web-based tool for designing and distributing surveys provided by Coventry University, UK, was used.
An intercept method was used in distributing the PGHD-TR1 questionnaires in public locations across the State, with concentration made at locations such as schools, churches, mosques, shopping centers/mall, markets, hospitals, government institutions, private locations with high human traffic and bus stations, etc. For the PGHD-TR2 survey, medical doctors in the State secondary healthcare centers were randomly picked. Based on the adjusted sample size with room for uncertainties, the final sample for PGHD-TR1 contained 1,443 usable responses with a refusal rate of 27.85%, while that of PGHD-TR2 had 47 usable responses with a refusal rate of 76.5%. The high refusal rate from PGHD-TR2 population could be attributed to the very busy schedule of most of the medical doctors contacted and the limited data collection duration. After collating the entire questionnaires (both online and paper version), the respondents’ feedback was summarised, coded and reverse scoring performed for the negatively worded items. Data analysis was done using IBM SPSS 22.

Table 4.7 Summary of PGHD-TR Questionnaire Distribution

<table>
<thead>
<tr>
<th>Survey Type</th>
<th>Target Population</th>
<th>Quest. Paper Shared</th>
<th>Quest. Paper Returned</th>
<th>Quest. Online Response</th>
<th>Overall Response (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGHD-TR1</td>
<td>2,000</td>
<td>500</td>
<td>128</td>
<td>1,315</td>
<td>1,443 (72.15%)</td>
</tr>
<tr>
<td>PGHD-TR2</td>
<td>200</td>
<td>50</td>
<td>6</td>
<td>41</td>
<td>47 (23.5%)</td>
</tr>
</tbody>
</table>

4.4.1 PGHD-TR Survey Response Rate

A total of 1,444 questionnaires were returned for PGHD-TR1 and out of this total, only 1 questionnaire was unusable. For PGHD-TR1, the response rate in each LGA is shown in Table 4.7 and the LGA with the most response rate was Alimosho LGA with 96 responses (6.7%), out of 100, while the least was Ifako-Ijaiye LGA with a total of 61 responses (4.2%) out of 100 questionnaires shared for each LGA. In each LGA, a minimum of 60% response rate was achieved. There were 743 (51.5%) male respondents and 700 (48.5%) female respondents in the PGHD-TR1 survey. For the PGHD-TR2
questionnaire, 47 questionnaires were returned and they were all usable with (gender distribution) 28 males (59.6%) and 19 females (40.4%).

For surveys with no prior relationship with potential respondents, achieving a response rate of 20-30% is considered highly successful (Sekaran 2003; Survey Monkey 2015). The response rate from both the PGHD-TR1 and PGHD-TR2 surveys was considered satisfactory based on this merit. To achieve the response rate for both surveys (most especially for PGHD-TR2 survey), a steady follow-up was ensured by the researcher through texts, calls and re-visits. Tables 4.8 and 4.9 presents a detailed response rate for the PGHD-TR1 and PGHD-TR2 surveys respectively.

**Table 4.8 PGHD-TR1 Overall Response Rate**

<table>
<thead>
<tr>
<th>20 LGA in Lagos State</th>
<th>Total Pop.</th>
<th>Target Pop.</th>
<th>Quest. Returns</th>
<th>Resp. Rate Per LGA (%)</th>
<th>Overall Reps. Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Agege</td>
<td>1,033,064</td>
<td>100</td>
<td>71</td>
<td>71%</td>
<td>4.9%</td>
</tr>
<tr>
<td>2. Ajeromi-Ifelodun</td>
<td>1,435,295</td>
<td>100</td>
<td>76</td>
<td>76%</td>
<td>5.3%</td>
</tr>
<tr>
<td>3. Alimosho</td>
<td>2,047,026</td>
<td>100</td>
<td>96</td>
<td>96%</td>
<td>6.7%</td>
</tr>
<tr>
<td>4. Amuwo Odofin</td>
<td>524,971</td>
<td>100</td>
<td>79</td>
<td>79%</td>
<td>5.5%</td>
</tr>
<tr>
<td>5. Apapa</td>
<td>522,384</td>
<td>100</td>
<td>63</td>
<td>63%</td>
<td>4.4%</td>
</tr>
<tr>
<td>6. Badagry</td>
<td>380,420</td>
<td>100</td>
<td>78</td>
<td>78%</td>
<td>5.4%</td>
</tr>
<tr>
<td>7. Epe</td>
<td>323,634</td>
<td>100</td>
<td>79</td>
<td>79%</td>
<td>5.5%</td>
</tr>
<tr>
<td>8. Eti-Osa</td>
<td>983,515</td>
<td>100</td>
<td>78</td>
<td>78%</td>
<td>5.4%</td>
</tr>
<tr>
<td>9. Ibeju-Lekki</td>
<td>99,540</td>
<td>100</td>
<td>62</td>
<td>62%</td>
<td>4.3%</td>
</tr>
<tr>
<td>10. Ifako-Ijaiye</td>
<td>744,323</td>
<td>100</td>
<td>61</td>
<td>61%</td>
<td>4.2%</td>
</tr>
<tr>
<td>11. Ikeja</td>
<td>648,720</td>
<td>100</td>
<td>71</td>
<td>71%</td>
<td>4.9%</td>
</tr>
<tr>
<td>12. Ikorodu</td>
<td>689,045</td>
<td>100</td>
<td>64</td>
<td>64%</td>
<td>4.4%</td>
</tr>
<tr>
<td>13. Kosofe</td>
<td>934,614</td>
<td>100</td>
<td>71</td>
<td>71%</td>
<td>4.9%</td>
</tr>
<tr>
<td></td>
<td>Area</td>
<td>Population</td>
<td>Total</td>
<td>Male</td>
<td>Male%</td>
</tr>
<tr>
<td>----</td>
<td>---------------</td>
<td>------------</td>
<td>-------</td>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td>14.</td>
<td>Lagos-Island</td>
<td>859,849</td>
<td>100</td>
<td>81</td>
<td>81%</td>
</tr>
<tr>
<td>15.</td>
<td>Lagos-Mainland</td>
<td>629,469</td>
<td>100</td>
<td>65</td>
<td>65%</td>
</tr>
<tr>
<td>16.</td>
<td>Mushin</td>
<td>1,321,517</td>
<td>100</td>
<td>68</td>
<td>68%</td>
</tr>
<tr>
<td>17.</td>
<td>Ojo</td>
<td>941,523</td>
<td>100</td>
<td>64</td>
<td>64%</td>
</tr>
<tr>
<td>18.</td>
<td>Oshodi-Isolo</td>
<td>1,134,548</td>
<td>100</td>
<td>76</td>
<td>76%</td>
</tr>
<tr>
<td>19.</td>
<td>Somolu</td>
<td>1,025,123</td>
<td>100</td>
<td>65</td>
<td>65%</td>
</tr>
<tr>
<td>20.</td>
<td>Surulere</td>
<td>1,274,362</td>
<td>100</td>
<td>75</td>
<td>75%</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>17,552,942</strong></td>
<td><strong>2,000</strong></td>
<td><strong>1,443</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

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### Table 4.9 PGHD-TR2 Overall Response Rate

<table>
<thead>
<tr>
<th>20 LGAs in Lagos State</th>
<th>Secondary Healthcare Centres</th>
<th>Target Pop.</th>
<th>Quest. Returns</th>
<th>Overall Response Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Agege</td>
<td>Orile-Agege General Hospital</td>
<td>10</td>
<td>2</td>
<td>4.3%</td>
</tr>
<tr>
<td>2. Ajeromi-Ifelodun</td>
<td>Ajeromi General Hospital</td>
<td>10</td>
<td>5</td>
<td>10.6%</td>
</tr>
<tr>
<td>3. Alimosho</td>
<td>Alimosho General Hospital</td>
<td>10</td>
<td>5</td>
<td>10.6%</td>
</tr>
<tr>
<td>4. Amuwo Odofin</td>
<td>Questionnaire sent to 2 separate primary healthcare centres given the absence of secondary health care centres in the LGA.</td>
<td>10</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td>5. Apapa</td>
<td>Apapa General Hospital</td>
<td>10</td>
<td>4</td>
<td>8.5%</td>
</tr>
<tr>
<td>6. Badagry</td>
<td>Badagry General Hospital</td>
<td>10</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td>7. Epe</td>
<td>Epe General Hospital</td>
<td>10</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td>8. Eti-Osa</td>
<td>Questionnaire sent to 2 separate primary healthcare centres given the absence of secondary health care centres in the LGA.</td>
<td>10</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td>9. Ibeju-Lekki</td>
<td>General Hospital, Akodo</td>
<td>10</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td>10. Ifako-Ijaiye</td>
<td>Ifako Ijaiye General Hospital</td>
<td>10</td>
<td>2</td>
<td>4.3%</td>
</tr>
<tr>
<td>11. Ikeja</td>
<td>Lagos State Teaching Hospital (Tertiary Healthcare Centre was used)</td>
<td>10</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td>12. Ikorodu</td>
<td>Ikorodu General Hospital</td>
<td>10</td>
<td>1</td>
<td>2.1%</td>
</tr>
<tr>
<td></td>
<td>Location</td>
<td>Name</td>
<td>Sample Size</td>
<td>Number of Providers</td>
</tr>
<tr>
<td>---</td>
<td>-------------------</td>
<td>-------------------------------</td>
<td>-------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>13.</td>
<td>Kosofe</td>
<td>Gbagada General Hospital</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>14.</td>
<td>Lagos-Island</td>
<td>General Hospital Lagos</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>15.</td>
<td>Lagos-Mainland</td>
<td>Mainland Hospital, Yaba</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>16.</td>
<td>Mushin</td>
<td>Mushin General Hospital</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>17.</td>
<td>Ojo</td>
<td>Questionnaire sent to 2 separate primary healthcare centres given the absence of secondary health care centres in the LGA.</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>18.</td>
<td>Oshodi-Isolo</td>
<td>Isolo General Hospital</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>19.</td>
<td>Somolu</td>
<td>Somolu General Hospital</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>20.</td>
<td>Surulere</td>
<td>Surulere General Hospital</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

**Total: 20 LGAs**

| Sample size: 200 | 47 | 100% |
4.4.2 Data Editing and Coding

All the questionnaires answered on paper were re-entered into the web-based online survey in order to make data export into SPSS straightforward, as well to reduce bulk paper handling. As already mentioned, the questionnaires primarily contained structured questions with closed multiple-choice answer options for both the PGHD-TR1 and PGHD-TR2 surveys. Also, some questions in the PGHD-TR2 questionnaires had open-ended answer options. Answer options to questions measuring PGHD-TR under the construct of the four-dimensional TRI framework were scored on the 5-point Likert scale (Strongly Agree = 5, Agree = 4, Undecided = 3, Disagree = 2 and Strongly Disagree = 1, while reverse scored scale was scored; Strongly Agree = 1, Agree = 2, Undecided = 3, Disagree = 4 and Strongly Disagree = 5). Some question items not adhering to the 5-point Likert scale were coded to reflect the values assigned to each option of the 5-point Likert scale. Other questions under other key constructs were descriptively presented and analysed.

4.4.3 Study-1 Ethical considerations

PGHD Study-1 adopted strict ethical guidelines that ensured the safety of respondents, the researcher and the collaborating organisation involved in the study. These guidelines also served to ensure that the quality of data collected remained guaranteed.

Prior to the start of the survey, Coventry University ethics panel gave ethical approval after careful consideration of the research topic and deliverables. In addition, the study sought local approval for the research and was granted by the Lagos State Government through the Lagos State Health Service Commission. For the copy of letters detailing the study ethics approval, see Appendix 1, 2 and 3. Finally, informed consent forms were given to the participants and this ensured they understood the purpose of the research, and that their participation was voluntary.

4.5 PGHD-TR1 and PGHD-TR2 Data Analysis

The analysis for the PGHD-TR1 survey was separated into three stages with the first stage presenting descriptively - the population demographic profile and their health-related choices, the second stage presented findings from the PGHD-TR-measured items based on the adapted four-dimensional TRI framework construct (Optimism, Innovativeness, Discomfort and
Insecurity) and the third stage presented the correlational analysis carried out while testing the proposed Study-1 PGHD-TR1 hypotheses.

As regards the PGHD-TR2 survey, the results were descriptively analysed and presented; as the findings made served the purpose of revealing the medical practitioners’ predisposition to PGHD practice in Lagos State. Prior to presenting the results of the PGHD-TR2 survey descriptively, a thematic analysis was done on all open-ended responses before being descriptively reported under the key concept they measured. Thematic analysis is amongst the most common types of analyses used in simplifying and reporting qualitative research (Guest, MacQueen and Namey 2011). This is done by identifying, examining and taking notes of how themes are distributed within the collected data set (Braun and Clarke 2006). These themes become the basis for categorising and reaching inference on the collected data (Fereday and Muir-Cochrane 2006).

Some questionnaire items for PGHD-TR2 were in ordinal scales and were descriptively reported on the basis of the 5-point Likert scale the items measured. The use of descriptive analysis in the PGHD-TR2 survey is supported by Pallant’s (2005) assertion, which suggests that the benefits of descriptive statistics are to enable the researcher to describe the characteristics of the sample, cross-check variables for any violation of the assumptions underlying the statistical techniques used and finally to help address specific research objectives.

4.5.1 PGHD-TR1 Data Analysis - Demographic Profile

This section descriptively presents the demographic profile of the 1,443 PGHD-TR1 survey respondents with details relating to their gender, age distribution, level of education and occupation.

- **Item 1 – Respondents’ Gender**

Of the 1,443 respondents in the PGHD-TR1 survey, the population gender distribution consisted of 743 males (51%) and 700 females (49%) as seen in Table 4.10. This shows a fair balance in the sample gender representativeness.
Table 4.10 PGHD-TR1 Survey Gender Distribution

<table>
<thead>
<tr>
<th>Gender</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>743</td>
<td>51.5</td>
</tr>
<tr>
<td>Female</td>
<td>700</td>
<td>48.5</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>

- Item 2 - Respondents’ Age

The age range for the survey was categorised as seen in Table 4.11 so as to ensure a balanced representativeness across the population. From the information shown in Table 4.11, more than 25% (367 respondents) of the population fell within the 26-35 age range, followed by 22% (313 respondents) in the 18-25 age range and 20% (293 respondents) within the 46-55 age range. This implied that the majority of the surveyed sample was mostly young and quite experienced adults. The 66 and above age range had the least representation of 5% (71 respondents) and this could either be attributed to their degree of eagerness to participate in the survey, not being able to complete the survey due to tiredness, poor comprehension of the PGHD concept or in some cases due to poor sight.

Table 4.11 PGHD-TR1 Survey Age Distribution

<table>
<thead>
<tr>
<th>Age</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-25</td>
<td>313</td>
<td>21.7</td>
</tr>
<tr>
<td>26-35</td>
<td>367</td>
<td>25.4</td>
</tr>
<tr>
<td>36-45</td>
<td>185</td>
<td>12.8</td>
</tr>
<tr>
<td>46-55</td>
<td>293</td>
<td>20.3</td>
</tr>
<tr>
<td>56-65</td>
<td>212</td>
<td>14.7</td>
</tr>
<tr>
<td>66 and above</td>
<td>73</td>
<td>5.1</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>

- Item 3 and 4 - Respondents’ Education and Occupation

The sample’s level of education and occupation is presented in Table 4.12, with the result showing a majority of 69% (998 respondents) of the population having a higher education qualification. Also, their occupation distribution as seen in Table 4.12 implied that the majority of the respondents are either self-employed (19%), students (18%) or civil servants (13.7%)
## Table 4.12 PGHD-TR1 Survey Education & Occupation Distribution

<table>
<thead>
<tr>
<th>Education</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Higher education (University, Polytechnic, College of education etc.)</td>
<td>998</td>
<td>69.2</td>
</tr>
<tr>
<td>Secondary school education</td>
<td>303</td>
<td>21.0</td>
</tr>
<tr>
<td>Primary school education</td>
<td>123</td>
<td>8.5</td>
</tr>
<tr>
<td>None</td>
<td>19</td>
<td>1.3</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Occupation</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Civil servant</td>
<td>198</td>
<td>13.7</td>
</tr>
<tr>
<td>Teacher</td>
<td>105</td>
<td>7.3</td>
</tr>
<tr>
<td>Self-employed</td>
<td>292</td>
<td>20.2</td>
</tr>
<tr>
<td>Academic staff</td>
<td>63</td>
<td>4.4</td>
</tr>
<tr>
<td>Student</td>
<td>266</td>
<td>18.4</td>
</tr>
<tr>
<td>Religious</td>
<td>35</td>
<td>2.4</td>
</tr>
<tr>
<td>Lawyer</td>
<td>61</td>
<td>4.2</td>
</tr>
<tr>
<td>Engineer</td>
<td>84</td>
<td>5.8</td>
</tr>
<tr>
<td>Banker</td>
<td>68</td>
<td>4.7</td>
</tr>
<tr>
<td>Scientist</td>
<td>24</td>
<td>1.7</td>
</tr>
<tr>
<td>Medical personnel</td>
<td>76</td>
<td>5.3</td>
</tr>
<tr>
<td>Private employee</td>
<td>115</td>
<td>8.0</td>
</tr>
<tr>
<td>Force personnel (Army, Navy, Air force, Police and Para-military)</td>
<td>31</td>
<td>2.1</td>
</tr>
<tr>
<td>Retiree</td>
<td>18</td>
<td>1.2</td>
</tr>
<tr>
<td>Unemployed</td>
<td>4</td>
<td>.3</td>
</tr>
<tr>
<td>House maker</td>
<td>3</td>
<td>.2</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Having already discussed the study area in section 4.2.1, and shown the respondents LGA distribution in Table 4.7 (questionnaire response rate), the next section sheds light on the population’s self-medication habit, health-check-up habit and opinion regarding hospital appointment in Lagos State Nigeria. The questions under these key concepts were asked, as they might be possible correlates to understanding their health choices and how PGHD might influence these choices.
4.5.2 PGHD-TR1 Survey – Respondents’ Self-Medication Habit

Four items listed below measured this key concept:

1. Have you ever self-medicated?
2. Which of these reason(s) justifies/justified why you self-medicate?
3. Are you aware and concerned that your drug purchase from a local pharmacy/shop might be a counterfeit drug and that this might be harmful to your health?
4. Will having seamless access to your health care provider and required information on prescription influence your decision not to self-medicate?

The relevance of this key concept in this survey was to investigate the root cause behind the general practice of self-medication within the study area and ascertain if PGHD could influence their self-medication choices. Osemene and Lamikanra (2012: 684) defined self-medication as the use of drugs with therapeutic intent but without professional advice or prescription by people, solely on their own initiative. Although there could be several justifications as to why people self-medicate Erhun and Erhun (2003), it is of interest to investigate how much of this could be attributed to patients’ poor access to health information and if such limitation could be addressed by PGHD.

- **Item 1 - Have you ever self-medicated?**

To ascertain their stance towards self-medication, the response generated from this question and shown in Table 4.13 revealed that out of 1,443, 88% (1,269 respondents) of the sample at one point self-medicated, while 12% (174 respondents) did not. This result supported the general assertion made by several authors in reviewed literature.

<table>
<thead>
<tr>
<th>Item 1</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Yes</td>
<td>1,269</td>
<td>87.9</td>
</tr>
<tr>
<td>No</td>
<td>174</td>
<td>12.1</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Table 4.13 PGHD-TR1 Survey - Response to Item 1 self-medication Habit
Item 2 - Which of these reason(s) justifies/justified why you self-medicate?

To understand why 88% of the surveyed population self-medicate, this multiple-choice question was asked and the response retrieved is shown in Table 4.14.

Table 4.14 PGHD-TR1 Survey - Response to Item 2 self-medication habit

<table>
<thead>
<tr>
<th>Item 2</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) High cost of hospital visits and prescription from hospital pharmacy</td>
<td>581</td>
<td>40</td>
</tr>
<tr>
<td>b) I have access to drugs in my local pharmacy/shop and although my purchase is not prescribed, the drugs are affordable</td>
<td>411</td>
<td>28</td>
</tr>
<tr>
<td>c) The local pharmacist or drug seller advises me on what type of medication to purchase when am ill</td>
<td>473</td>
<td>33</td>
</tr>
<tr>
<td>d) Difficulty in accessing healthcare amenities</td>
<td>469</td>
<td>32.5</td>
</tr>
<tr>
<td>e) It is a general practice in my family/area and nothing is wrong with it</td>
<td>255</td>
<td>17.7</td>
</tr>
<tr>
<td>f) I just assume the drug I should take when I cannot get to the hospital or reach a doctor</td>
<td>300</td>
<td>21</td>
</tr>
<tr>
<td>g) It is an informed choice from me</td>
<td>520</td>
<td>36</td>
</tr>
<tr>
<td>h) There is a doctor in the family</td>
<td>2</td>
<td>0.14</td>
</tr>
<tr>
<td>i) I have a medical background</td>
<td>6</td>
<td>0.42</td>
</tr>
<tr>
<td>j) I prefer local herbs and traditional medicine</td>
<td>5</td>
<td>0.35</td>
</tr>
<tr>
<td>k) I follow doctor advice</td>
<td>3</td>
<td>0.21</td>
</tr>
</tbody>
</table>

As seen from the response retrieved, 40% (581 respondents) of the population self-medicate as a result of “High cost of hospital visit and prescription from hospital pharmacy”, 36% (520 respondents) said, “It is an informed choice from me”, while 33% (473 respondents) attribute their self-medication justification to “Difficulty in accessing healthcare amenities”. Also, a significant percentage (28%, 411 respondents) of the respondents admitted that the reason they self-medicate was due to having access to affordable drugs in their local drugstore. To a large extent, it could be agreed that difficulty in accessing healthcare amenities, high cost of hospital visit and prescription from hospital pharmacy is amongst the major reasons why the majority of the respondents self-medicate.
The 88% of the entire PGHD-TR1 survey respondents who self-medicate (see Table 4.13) in a way mirror the over 75% of the Nigerian population who fall back on self-medication for survival due to poverty and absence of accessible health care facility (Leadership 2015). Giving the high prevalence of certain endemic illnesses in the study area, like malaria, typhoid and usual headache from everyday bustle, most Nigerians assume by default and are likely influenced by drug advertorials what medicine to take without proper advice from a qualified medical doctor (Erhun and Erhun 2003; Yusuff and Yusuf 2008). It is without a doubt that although self-medication might be a quick fix to the respondents’ respective reasons for self-medicating, it comes with a huge risk to their health such as untimely death in some cases due to the use of counterfeit or expired drugs, overdose of medication, the individual contending with drug-resistant ailment or even becoming resistant to antibiotics (Leadership 2015). Arikpo, Eja and Enyi-Idoh (2010) also reaffirmed that a high spate of self-medication in Nigeria has been linked to frequent diseases like liver, kidney, heart and even drug-resistant malaria. With this stated, the next question investigated if the respondents were aware that self-medication could be harmful to their health?

- **Item 3 - Are you aware and concerned that your drug purchase from a local pharmacy/shop might be a counterfeit drug and that this might be harmful to your health?**

This question requested a simple yes or no response from the respondents. From the retrieved response as seen in Table 4.15, 92% (1,169 respondents) of the surveyed population who said Yes to self-medication admitted being aware that self-medication could be harmful to their health. One hundred respondents (8%) said they weren’t aware of its harmfulness. The significance of this finding is that, although the majority of the populace surveyed were aware of the harm from self-medication, they still self-medicated. Having established that the majority of the surveyed population self-medicated, highlighted reasons why they self-medicate and were aware of the harm associated with self-medication, the next question asked if having seamless access to their healthcare provider and required information on prescription could influence their decision not to self-medicate.
### Table 4.15 PGHD-TR1 Survey – Response to Item 3 self-medication habit

<table>
<thead>
<tr>
<th>Item 3</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Yes</td>
<td>1,169</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>100</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1,269</td>
</tr>
</tbody>
</table>

### Item 4 - Will having seamless access to your healthcare provider and required information on prescription influence your decision not to self-medicate?

The result obtained for this question is presented in Table 4.16, and it could be seen that the respondents strongly believe that having seamless access to their healthcare provider and required information on prescription would positively influence their decision not to self-medicate. This result further implied that an aspect to solving the high spate of self-medication within the study area could be achieved through an affordable and accessible communication or correspondence between the surveyed population and their healthcare providers. Several studies have shown that outside the clinical environment, correspondence between patients and their healthcare providers improves patients’ health decisions and outcomes (Pagliari, Detmer and Singleton 2007: Shapiro et al. 2012).

### Table 4.16 PGHD-TR1 Survey – Response to Item 4 self-medication habit

<table>
<thead>
<tr>
<th>Item 4</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td>Yes</td>
<td>1,150</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>119</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1,269</td>
</tr>
</tbody>
</table>

### 4.5.3 PGHD-TR1 Survey – Health Check-Up Habit

This key concept investigated the respondents’ health check-up habit in order to understand their disposition towards regular health check-up. By so doing, the response retrieved from the items measuring this key concept helped inform the researcher on the general attitude of the surveyed population towards regular hospital visitation and health check-up. This further
served as an insight to subsequent analysis made regarding their disposition towards adopting PGHD.

The three items listed below measured this key concept:

1. **Do you go to the hospital for regular check-up?**
2. **How often do you go for health check-up?**
3. **I don’t go for regular check-ups but only go to the hospital to see a doctor when I feel unwell**

- **Item 1 - Do you go to the hospital for regular check-up?**

From the response retrieved for this question as seen in Table 4.17, 28% (407 respondents) answered *Yes (although I don’t have an on-going medical condition)*, 30.4% (438 respondents) answered *Yes (because I have a medical condition)* while 41.4% (598 respondents) answered *No*.

<table>
<thead>
<tr>
<th>Item 1</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes (although I don’t have an on-going medical condition)</td>
<td>407</td>
<td>28.2</td>
</tr>
<tr>
<td>Yes (because I have a medical condition)</td>
<td>438</td>
<td>30.4</td>
</tr>
<tr>
<td>No</td>
<td>598</td>
<td>41.4</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>

- **Item 2 - How often do you go for health check-up?**

This question was only applicable to those who go for a health check-up without having any existing medical condition (407 respondents). For those who said they went for health check-up as a result of their pre-existing medical condition, it was ideal to assume that their frequency of health check-up will be dependent on their health condition. This question also disregarded those who said they didn’t go for health check-up. Based on this, only 407 respondents or 28% of the entire surveyed population were valid to respond to this item and their response is shown in Table 4.18.
Table 4.18 PGHD-TR1 Survey – Response to Item 2 health check-up habit

<table>
<thead>
<tr>
<th>Item 2</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid Weekly</td>
<td>16</td>
<td>3.9</td>
</tr>
<tr>
<td>Monthly</td>
<td>40</td>
<td>9.8</td>
</tr>
<tr>
<td>Once every 3 months</td>
<td>80</td>
<td>19.7</td>
</tr>
<tr>
<td>Once every 6 months</td>
<td>133</td>
<td>32.7</td>
</tr>
<tr>
<td>Annually</td>
<td>138</td>
<td>33.9</td>
</tr>
<tr>
<td>Total</td>
<td>407</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Based on the retrieved response, the majority of the 407 respondents who answered this question go for a health check-up annually (40%, 138 respondents), followed by 133 respondents (33%) who go for a hospital check-up once every six months. It was striking to notice that 4% (16 respondents) admitted going for a health check-up weekly. Also 10% (40 respondents) of the valid population go for health check-up monthly, while 20% (80 respondents) go for a health check-up once every three months.

Although it is unclear how often one should go for a health check-up, most medical groups advocate for an annual health exam (eMedicineHealth 2015). Regardless of the debate between preventive care and annual check-ups, such as the high degree of anxiety, over diagnosis and non-cost effectiveness associated with an annual check-up, it is still of immense benefit to patients (Krogsbøll et al. 2012; Slate 2015).

Among the benefits of periodic health examination (eMedicineHealth 2015):

1. It serves as primary prevention by identifying risk factors common for chronic diseases
2. It could help detect diseases that have no apparent symptoms (secondary prevention)
3. An avenue to update clinical data since the last check-up
4. As a means for the doctor to counsel patients to promote and maintain a healthy behaviour while enhancing the patient-doctor relationship
This question also served as a narrative to understanding the population’s health habit and how it could alternate if PGHD was on offer. The next question was only valid to those who said they don’t go for health check-up, by asking them in the event they are ill, will they still visit the hospital.

- **Item 3 - I don't go for regular check-ups but only go to the hospital to see a doctor when I feel unwell**

Valid for only 598 respondents who said No to any form of regular health check-up, the findings as seen in Table 4.19 show that the majority of this population only visit the hospital when they are ill (94%, 564 respondents). Remarkably, 6% (34 respondents) of this population said they do not go to hospital even when ill.

**Table 4.19 PGHD-TR1 Survey – Response to Item 3 health check-up habit**

<table>
<thead>
<tr>
<th>Item 3</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valid True</td>
<td>564</td>
<td>94.3</td>
</tr>
<tr>
<td>False</td>
<td>34</td>
<td>5.7</td>
</tr>
<tr>
<td>Total</td>
<td>598</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**4.5.4 PGHD-TR1 Survey – Opinion on Hospital appointment**

This key concept investigated the respondents’ opinion on hospital appointment within the study area. The reason behind this was to gain an insight into what is obtainable at the moment regarding hospital visitation and appointment before measuring their optimism towards adopting a technology or practice (i.e. PGHD) that could help limit this challenge.

The five items below measured this key concept;

1. *Averagely how long does it take you to book an appointment at the hospital?*
2. *Counting from the day you book your appointment; how long does it normally take you to see the doctor?*
3. *How long do you wait on your appointment day before you meet the doctor?*
4. *Sometimes I end up not seeing the doctor on the appointment day.*
5. *Would you say that the whole exercise of booking an appointment and coming in on the appointment day is stressful?*
To make sense of the result generated from the 5 items measuring this key concept, *item 1* and *item 3* were compared and discussed alongside each other since they are related and share the same measurement scale. Also, the same was done for *item 4* and *item 5* while *item 2* was presented separately. The results from items measuring this key concept are presented in Table 4.20, 4.21 and 4.22 accompanied with chart illustrations in Figure 4.6.

- **Item 1** - *Averagely how long does it take you to book an appointment at the hospital?*
- **Item 3** - *How long do you wait on your appointment day before you meet the doctor?*

Looking at 4.12 and Table 4.20, both items results are almost similar. The majority “average amount of time” it takes the surveyed population to book an appointment at the hospital (*item 1*) and the “amount of time” they wait on appointment day (*item 2*) was *Under 1 hour*, followed by *under 2 hours* with the next most response. Although this question didn’t take into consideration if the respondent’s opinions were based on hospital appointment in private or public funded hospital, the significance of this question was to see how their response would vary if they had PGHD as an additional alternative for corresponding with their care provider.

### Table 4.20 PGHD-TR1 - Opinion on Hospital appointment – Items 1 and 3

<table>
<thead>
<tr>
<th>Item 1 - Averagely how long does it take you to book an appointment at the hospital?</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 30 minutes</td>
<td>280</td>
<td>19.4</td>
</tr>
<tr>
<td>Under 1 hour</td>
<td>475</td>
<td>32.9</td>
</tr>
<tr>
<td>Under 2 hours</td>
<td>338</td>
<td>23.4</td>
</tr>
<tr>
<td>Under 3 hours</td>
<td>252</td>
<td>17.5</td>
</tr>
<tr>
<td>4 hours and above</td>
<td>82</td>
<td>5.7</td>
</tr>
<tr>
<td>No idea</td>
<td>16</td>
<td>1.1</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item 3 - How long do you wait on your appointment day before you meet the doctor?</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 30 minutes</td>
<td>220</td>
<td>15.2</td>
</tr>
<tr>
<td>Under 1 hour</td>
<td>492</td>
<td>34.1</td>
</tr>
<tr>
<td>Under 2 hours</td>
<td>394</td>
<td>27.3</td>
</tr>
<tr>
<td>Under 3 hours</td>
<td>257</td>
<td>17.8</td>
</tr>
<tr>
<td>4 hours and above</td>
<td>80</td>
<td>5.5</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>
**Figure 4.6 PGHD-TR1 - Opinion on Hospital appointment – Items 1 and 3**

* **Item 1** - Averagely how long does it take you to book an appointment at the hospital?

* **Item 3** - How long do you wait on your appointment day before you meet the doctor?

- **Item 2 - Counting from the day you book your appointment; how long does it normally take you to see the doctor?**

As seen in Table 4.21, the result from this item showed how long it usually takes the surveyed population to see the doctor. Also, considerations were not made on the basis of the hospital being privately owned or publicly funded. An interesting discovery from this result is the fact that 25% (361 respondents) of the surveyed population waited at least up to two weeks or more before seeing the doctor. Given the poor doctor-to-patient ratio in Nigeria which stands at 1:3,500 against the World Health Organisation’s (WHO) standard of 1:600, most Nigerians who can financially afford private clinics use that as an alternative for their health needs, but such can’t be said for those who cannot afford this luxury (Ogunbekun 1999; Wouters 1993; The World Bank 2015).

**Table 4.21 PGHD-TR1 - Opinion on Hospital appointment – Item 2**

<table>
<thead>
<tr>
<th>Item 2</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>On same day</td>
<td>582</td>
<td>40.3</td>
</tr>
<tr>
<td>Within two days</td>
<td>270</td>
<td>18.7</td>
</tr>
<tr>
<td>Within one week</td>
<td>230</td>
<td>15.9</td>
</tr>
<tr>
<td>Within two weeks</td>
<td>149</td>
<td>10.3</td>
</tr>
<tr>
<td>Within one month</td>
<td>184</td>
<td>12.8</td>
</tr>
<tr>
<td>Sometimes up to 2 months or more</td>
<td>28</td>
<td>1.9</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>
- **Item 4** - *Sometimes I end up not seeing the doctor on the appointment day.*
- **Item 5** - *Would you say that the whole exercise of booking an appointment and coming in on the appointment day is stressful?*

These two items (see Table 4.22 and Figure 4.7) were compared together as they inquired from the respondents about their discontent regarding hospital appointment within the study area. A combined majority response from 61% (882 respondents) either *strongly agreed* or *agreed* that sometimes they end up not seeing the doctor on the appointment day (item 4). This is quite remarkable and further reaffirms the poor state of health delivery and standard in Nigeria. In support of their discontent with health appointment, 80% (1,153 respondents) *strongly agree* or *agree* that the whole exercise of booking an appointment and coming in on the appointment day is stressful.

**Table 4.22 PGHD-TR1 - Opinion on Hospital appointment – Items 4 and 5**

<table>
<thead>
<tr>
<th>Item 4 - Sometimes I end up not seeing the doctor on the appointment day.</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>161</td>
<td>11.2</td>
</tr>
<tr>
<td>Disagree</td>
<td>308</td>
<td>21.3</td>
</tr>
<tr>
<td>Undecided</td>
<td>92</td>
<td>6.4</td>
</tr>
<tr>
<td>Agree</td>
<td>446</td>
<td>30.9</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>436</td>
<td>30.2</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item 5 - Would you say that the whole exercise of booking an appointment and coming in on the appointment day is stressful?</th>
<th>No. of Respondents (Frequency)</th>
<th>Valid Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>70</td>
<td>4.9</td>
</tr>
<tr>
<td>Disagree</td>
<td>126</td>
<td>8.7</td>
</tr>
<tr>
<td>Undecided</td>
<td>94</td>
<td>6.5</td>
</tr>
<tr>
<td>Agree</td>
<td>474</td>
<td>32.8</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>679</td>
<td>47.1</td>
</tr>
<tr>
<td>Total</td>
<td>1,443</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Figure 4.7 PGHD-TR1 - Opinion on Hospital appointment – Items 4 and 5

* Item 4 - Sometimes I end up not seeing the doctor on the appointment day.

* Item 5 - Would you say that the whole exercise of booking an appointment and coming in on the appointment day is stressful?

In conclusion, the results presented thus far have shed light on some of the surveyed population health habits and opinions to healthcare provision within the study area. These results have evidenced that (a) 88% of the surveyed population self-medicate although they are aware of the harm associated with self-medication, (b) the high cost of hospital visits and prescription from hospital pharmacy, as well as high cost of accessing other health care services in Lagos State, are amongst the major reasons they self-medicate, (c) 61% (882 respondents) admitted that sometimes they end up not seeing the doctor and (d) 80% (1153 respondents) of the surveyed population are of the opinion that the whole exercise of booking a hospital appointment and coming in on the appointment day is stressful. With this knowledge established, the next key constructs underlying the four-dimensional TRI framework were used to measure the population technology-readiness towards PGHD adoption, with results and analysis presented below.

4.5.5 PGHD-TR1 Survey – Lagos State Patient-generated Health Data-Technology Readiness (PGHD-TR1)

Based on the result retrieved from the 1,443 respondents who participated in this PGHD-TR1 survey, insights have been gained regarding their demographic attributes, some of their health
habits and opinions on certain aspects of health service within the study area. Building on this, this section investigated their technology readiness (TR) towards the acceptance and adoption of PGHD in Lagos State.

The following constructs under the four-dimensional TRI framework were measured:

1. **Optimism** - (8 items and descriptively supported with 1 more question)
2. **Innovativeness** - (9 items and descriptively supported with 1 more question)
3. **Discomfort** - (3 items and descriptively supported with 2 more question)
4. **Insecurity** - (3 items and descriptively supported with 3 more question)

### 4.5.5.1 Assessment of Validity – (PGHD-TR1)

To arrive at an acceptable Cronbach’s alpha value for the PGHD-TR1 scale, five items had to be deleted so as to improve the alpha value for the corresponding dimension (see Table 4.24). The eliminated items under each dimension (construct) were used descriptively to support that TR-Dimension. After the deletion of these items and re-computation of the alpha value, a 23-item pool remained under the four-dimensional TRI framework adopted for this PGHD-TR1.

The final Cronbach’s alpha value ranged from 0.72 to 0.85 as seen in Table 4.23. Based on Nunnally (1978) assertion; all scales above the standard guideline of 0.70 to 0.80 is sufficient and this implied that the PGHD-TR1 scale was adequate.

**Table 4.23 PGHD-TR1 Internal Consistency, Cronbach’s Alpha**

<table>
<thead>
<tr>
<th>PGHD-TR1 Dimension</th>
<th>Items</th>
<th>Cronbach’s α</th>
<th>Reliability Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimism</td>
<td>8</td>
<td>0.72</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Innovativeness</td>
<td>9</td>
<td>0.85</td>
<td>Good</td>
</tr>
<tr>
<td>Discomfort</td>
<td>3</td>
<td>0.76</td>
<td>Acceptable</td>
</tr>
<tr>
<td>Insecurity</td>
<td>3</td>
<td>0.77</td>
<td>Acceptable</td>
</tr>
</tbody>
</table>

### 4.5.5.2 Item Pool for the PGHD-TR1 Survey

The 23 items measured under the respective four dimensions were scored (or reverse scored) on the basis of the 5-point Likert scale. Table 4.24 presents the final 23-item pool for the PGHD-TR1 survey carried out in Lagos State Nigeria from 5th of March to 10th of April 2015.
### Table 4.24 PGHD-TR1 23 Item Pool

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Optimism</th>
<th>8 items</th>
<th>Innovativeness</th>
<th>9 items</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPT1</td>
<td>I usually send SMS with my mobile phone.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPT2</td>
<td>I usually chat on the instant messaging applications on my mobile device.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPT3</td>
<td>I will be willing to adopt any practice/technology that alleviates the stress of booking health appointment to see the doctor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPT4</td>
<td>If it will contribute towards the improvement of my health, I would allow some of my health data to be collected outside clinical settings.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPT5</td>
<td>I would be willing to communicate electronically with my care provider/medical doctor.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPT6</td>
<td>I would be willing to regularly capture my health data as advised by my healthcare provider/medical doctor using a mobile device or any supporting health information technology tool.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPT7</td>
<td>I would be willing to regularly transfer the captured health data over to my healthcare provider/medical doctor using a mobile device or any supporting health information technology tool.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OPT8</td>
<td>If PGHD is standardized and shared concerns addressed, I would be willing to adopt PGHD.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>What incentives if put in place will make you more willing to adopt PGHD?</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Innovativeness</th>
<th>9 items</th>
</tr>
</thead>
<tbody>
<tr>
<td>INN1</td>
<td>Mobile phones and devices are an essential necessity for one to have.</td>
</tr>
<tr>
<td>INN2</td>
<td>I use my mobile device for other activities other than making and receiving calls and text</td>
</tr>
<tr>
<td>INN3</td>
<td>Internet connectivity is very essential towards the use of mobile devices</td>
</tr>
<tr>
<td>INN4</td>
<td>I normally have internet connection on my mobile phone or device</td>
</tr>
<tr>
<td>INN5</td>
<td>I use instant messaging applications like Blackberry messenger, Tango, Viber, Skype and WhatsApp on my mobile device</td>
</tr>
<tr>
<td>INN6</td>
<td>I use instant messaging applications for communication more than I use regular text message service (SMS) on my mobile device.</td>
</tr>
<tr>
<td>INN7</td>
<td>At some point, I have heard of the term mHealth?</td>
</tr>
<tr>
<td>INN8</td>
<td>What sort of activities do you use your mobile phone or device for? – [aggregated]</td>
</tr>
<tr>
<td>INN9</td>
<td>What will be your most suitable medium for communicating with your care provider/medical doctor electronically? – [aggregated]</td>
</tr>
<tr>
<td></td>
<td><strong>Which of the following electronic device will you be willing to use in communicating with your healthcare provider?</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discomfort</th>
<th>3 items</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIS1</td>
<td>Would you be willing to authorise an automatic text (SMS), Email or a mobile application notification to remind you to take your medication and send in your PGHD? [reverse scored]</td>
</tr>
<tr>
<td>DIS2</td>
<td>In the event you are not available or unreachable, would you permit an authorised next of kin to be contacted? [reverse scored]</td>
</tr>
<tr>
<td>DIS3</td>
<td>Would you be willing to regularly review &amp; give feedback to a dedicated mobile application designed to enable in the capture, storage, transfer, retrieval &amp; correspondence of your PGHD with your healthcare provider/medical doctor? [reverse scored]</td>
</tr>
</tbody>
</table>
Insecurity  3 items

<table>
<thead>
<tr>
<th>INS1</th>
<th>Do you think the ownership of PGHD is an issue that needs to be discussed and resolved amongst all involved stakeholders? [reverse scored]</th>
</tr>
</thead>
<tbody>
<tr>
<td>INS2</td>
<td>Do you feel the nature of an ailment (sickness) you are suffering from can influence your willingness to adopt PGHD? [reverse scored]</td>
</tr>
<tr>
<td>INS3</td>
<td>If this concern can be properly addressed, will you consider adopting PGHD practice (even if briefly) to see if it will improve your health outcome? [reverse scored]</td>
</tr>
</tbody>
</table>

- Who do you think should absolutely own the PGHD?
- Who do you feel should have access to this PGHD?
- What concerns do you share as regards the use of PGHD? - Patient-doctor relationship concerns

NOTE: Labels are shown only for items retained in the final PGHD-Technology Readiness Scale; bulleted items (■) were eliminated during the scale-refinement process due to their low coefficient alpha value, but were used in support of the initial dimension they measured descriptively. Rockbridge Associates and Parasuraman copyright the TRI, and its use in this study was with their permission. It is to be recalled that the nature of the PGHD-TR questionnaire wording needed to reflect what is obtainable within the study environment. This implied that, for example, question items as seen in OPT1 and INN1 might seem ordinary to respondents in a developed nation, but they are luxury for some respondents in a developing nation like Nigeria. PGHD-TR scaling from; “strongly disagree (1)” to “strongly agree (5)” on a five-point Likert scale.

4.5.5.3 The 23-Item PGHD-TR1 Mean Score

Having selected the 23 items used in measuring each of the TR-dimensions, each respondent’s response to these items has been aggregated and analysed using the statistical software package IBM SPSS 22 and their total mean is listed in Table 4.25. According to Parasuraman and Colby (2015), the mean TR score ranging from 1 = lowest, to 5 = highest, represents each respondent’s belief in each of the dimensions under investigation. Table 4.26 reports the overall mean for the PGHD-TR1 survey at 3.08, the standard deviation, distributional characteristics for the overall PGHD-TR1 and its four dimensions, as well as the pairwise correlations among them. As expected, correlations for the items measuring discomfort and insecurity (inhibitors) that were reverse scored are all in negative and smaller in magnitude. The effect of their negativity could be seen on the various motivator-inhibitor combinations in Table 4.26 under inter-item correlation coefficients.
Table 4.25 The 23-Item Mean Response for PGHD-TR1 under each TR-Dimension

<table>
<thead>
<tr>
<th>Item</th>
<th>Optimism (n = 1,443; mean)</th>
<th>Innovativeness (n = 1,443; mean)</th>
<th>Discomfort (n = 1,443; mean)</th>
<th>Insecurity (n = 1,443; mean)</th>
</tr>
</thead>
<tbody>
<tr>
<td>OPT1</td>
<td>3.93</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OPT2</td>
<td>3.91</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OPT3</td>
<td>4.44</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OPT4</td>
<td>4.22</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OPT5</td>
<td>4.28</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OPT6</td>
<td>4.26</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OPT7</td>
<td>4.31</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>OPT8</td>
<td>4.98</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>INN1</td>
<td>-</td>
<td>4.91</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>INN2</td>
<td>-</td>
<td>4.83</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>INN3</td>
<td>-</td>
<td>4.56</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>INN4</td>
<td>-</td>
<td>4.31</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>INN5</td>
<td>-</td>
<td>4.31</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>INN6</td>
<td>-</td>
<td>3.51</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>INN7</td>
<td>-</td>
<td>2.07</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>INN8</td>
<td>-</td>
<td>3.97</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>INN9</td>
<td>-</td>
<td>3.56</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>DIS1</td>
<td>-</td>
<td>-</td>
<td>1.18</td>
<td>-</td>
</tr>
<tr>
<td>DIS2</td>
<td>-</td>
<td>-</td>
<td>1.25</td>
<td>-</td>
</tr>
<tr>
<td>DIS3</td>
<td>-</td>
<td>-</td>
<td>1.18</td>
<td>-</td>
</tr>
<tr>
<td>INS1</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.10</td>
</tr>
<tr>
<td>INS2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>2.86</td>
</tr>
<tr>
<td>INS3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1.56</td>
</tr>
<tr>
<td>Mean Total</td>
<td>4.29</td>
<td>4.00</td>
<td>1.20</td>
<td>2.89</td>
</tr>
</tbody>
</table>

**NOTE:** The mean values shown are on a 1 to 5 overall TRI scale (n = 1,443 is the sample sizes for PGHD-TR1 survey). Mean TR Score (1 = lowest, 5 = highest)

Table 4.26 Summary Statistics for the PGHD-TR1 and Its Dimensions

<table>
<thead>
<tr>
<th>TR Dimension</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>OPT</th>
<th>INN</th>
<th>DIS</th>
<th>INS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimism (OPT)</td>
<td>4.2921</td>
<td>.57</td>
<td>1.00</td>
<td>.59</td>
<td>-.44</td>
<td>-.16</td>
</tr>
<tr>
<td>Innovativeness (INN)</td>
<td>4.0035</td>
<td>.92</td>
<td>.59</td>
<td>1.00</td>
<td>-.25</td>
<td>-.05</td>
</tr>
<tr>
<td>Discomfort (DIS)</td>
<td>1.2014</td>
<td>.72</td>
<td>-.44</td>
<td>-.25</td>
<td>1.00</td>
<td>.07</td>
</tr>
<tr>
<td>Insecurity (INS)</td>
<td>2.8390</td>
<td>.62</td>
<td>-.16</td>
<td>-.05</td>
<td>.07</td>
<td>1.00</td>
</tr>
<tr>
<td>Overall TR</td>
<td>3.084</td>
<td>.34</td>
<td>.51</td>
<td>.76</td>
<td>.20</td>
<td>.39</td>
</tr>
</tbody>
</table>

**NOTE:** All mean values are on a 5-point scale. The overall PGHD-TR1 score for each respondent was obtained by averaging the scores on the four dimensions (after reverse coding some scores on the discomfort and insecurity dimensions. Mean TR Score (1 = lowest, 5 = highest)
The overall PGHD-TR1 mean was derived as shown below:

- Overall PGHD-TR1 mean = (OVERALL_OPT + OVERALL_INN + OVERALL_DIS + OVERALL_INS) / 4
- Overall PGHD-TR1 mean = (4.29 + 4.00 + 1.20 + 2.89) / 4 = 3.08

The implication of the overall mean score under each TR-dimension for the surveyed population was:

For PGHD-TR Optimism dimension with an overall 4.29 mean score, the respondents were highly optimistic towards PGHD and the supporting technology used for PGHD correspondence. This implied that regardless of the respondents’ opinion of the initial health choices investigated earlier, up to 86% (approx. 1,238 Lagosians) of the 1,443 respondents surveyed were optimistic towards PGHD adoption in Lagos State. Expanding on this result, further analysis was carried out to show how the optimism dimension correlates with the population demography.

With a total mean score of 4.00 under the Innovativeness dimension, the surveyed population shares a general tendency to be a good technology pioneer and thought leader on new technology. Also expanding on this result; further analysis was carried out to show how the innovativeness dimension correlates with the population demography.

Looking at technology readiness inhibitor dimensions, all items under Discomfort had an overall mean score of 1.20 and items under Insecurity had an overall mean score of 2.89. As shown in Table 4.25 and Table 4.26, individual items measured under these two dimensions had a low mean value except for one item under insecurity (INS1) with a mean score of 4.10. Given that these items were reverse scored; a lower mean score implied that the respondents were not highly apprehensive of adopting PGHD. The item under Insecurity (INS1) asked the respondents “Do you think the ownership of patient-generated health data (PGHD) is an issue that needs to be discussed and resolved amongst all involved stakeholders?” With the mean score generated by this item at 4.10, it implied that issues surrounding the ownership of PGHD are a big concern that must be resolved by all involved stakeholders. Descriptively, the response retrieved for this item showed that 72% (1,039 respondents) were of the opinion that PGHD ownership should be resolved before the eventual adoption of PGHD in Lagos State.
From the PGHD-TR1 survey, it could be concluded that the population’s overall mean score exhibits evidence of being strongly motivated towards PGHD adoption in Lagos State based on TR-dimensions (optimism and innovativeness) measuring how motivated they are towards PGHD. Although the overall mean score on the inhibiting dimensions are of positive implication towards PGHD adoption in Lagos State, the aspect of PGHD ownership needs to be resolved by all involved stakeholders and backed with strong policy.

Overall, the total mean score from this PGHD-TR1 survey (by summing up the mean from the four dimensions) which stands at 3.08 is an indication that the surveyed population are highly likely to adopt PGHD, but with shared concerns that needs to be addressed. The next section employs the TR-based segmentation analysis that classifies users into specific profiles based on their TR score (Parasuraman 2000; Parasuraman and Colby 2001; Parasuraman and Colby 2015).

4.5.5.4 PGHD-TR1 TR-Based Segmentation Analysis

As already shown in Table 4.1 – (the description of each segmentation and accompanying characteristics), the overall TR-mean score of the PGHD-TR1 respondents at this point was expressed on the basis of each dimension’s mean score in Table 4.27. This was done in order to give a holistic picture of the respondents PGHD technology readiness.

Table 4.27 PGHD-TR1 Segmentation

<table>
<thead>
<tr>
<th>PGHD-TR1</th>
<th>Optimism</th>
<th>Innovativeness</th>
<th>Discomfort</th>
<th>Insecurity</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGHD-TR mean score</td>
<td>4.29</td>
<td>4.00</td>
<td>1.20</td>
<td>2.89</td>
</tr>
<tr>
<td>TR-impact</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Explorers</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
</tr>
</tbody>
</table>

From Table 4.27 above, the mean score of each PGHD-TR1 dimension has been listed with its corresponding TR-impact (high, moderate or low representation). The motivating TR-dimensions (optimism and innovativeness) in Table 4.27 both have a high TR score and, as a result, a high TR-impact, while the inhibiting dimensions (discomfort and insecurity) have a low TR-impact. In the TR-Segmentation Table - (see Table 4.1), the TR-segment that depicts the PGHD-TR1 listed TR-dimension value in Table 4.27 is the Explorer segment. Based on
this evidence, Study-1 for PGHD-TR1 concludes that the surveyed population falls within the explorers’ TR-segment. This implied that the Lagosians surveyed have a high degree of motivation with a low degree of resistance to PGHD.

4.5.5.5 Correlation Analysis Result for PGHD-TR1

Table 4.28 shows level of significance results from the nonparametric correlation analysis carried out on items measuring the studied population demography (age, gender, level of education) against specific items measuring each PGHD-TR construct and attitude towards self-medication. An alpha level of .05 for all statistical tests was used. The nature of data collected (i.e. nominal and ordinal) meant that nonparametric techniques like the Chi-Square test for \( (H_2b, H_{3c}, H_{3d}, H_{2e}) \), Mann-Whitney U test for \( (H_{1b}, H_{1c}, H_{1e}, H_{2a}, H_{3b}, H_{3c}, H_{3e}) \) and Spearman rank correlation test for \( (H_{1a}, H_{1d}, H_{3a}, H_{3d}) \) were employed in testing the proposed hypotheses.

- Chi-Square test \( (\chi^2) \) was used to test the statistical hypothesis between two question items that yielded only nominal data.

- Mann-Whitney U test was used to test the hypothesis between two question items that yielded ordinal and nominal data.

- Spearman rank correlation test used to test the hypothesis between two question items that yielded only ordinal data.

Table 4.28 PGHD-TR1 Correlational Analysis Result

<table>
<thead>
<tr>
<th>( N = 1443 )</th>
<th>( p ) Value</th>
<th>Inference</th>
<th>( r_s )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( H_{1a} ) Age ( \rightarrow ) OPT</td>
<td>.001**</td>
<td>Supported</td>
<td>( r_s = 0.113, p &lt; .001 )</td>
</tr>
<tr>
<td>( H_{1b} ) Age ( \rightarrow ) INN</td>
<td>.023</td>
<td>Supported</td>
<td>( U = 188717.5, p &lt; .05 )</td>
</tr>
<tr>
<td>( H_{1c} ) Age ( \rightarrow ) DIS</td>
<td>.999</td>
<td>Not Supported</td>
<td>( U = 44781, p &gt; .05 )</td>
</tr>
<tr>
<td>( H_{1d} ) Age ( \rightarrow ) INS</td>
<td>.001**</td>
<td>Supported</td>
<td>( r_s = 0.182, p &lt; .001 )</td>
</tr>
<tr>
<td>( H_{1e} ) Age ( \rightarrow ) SM</td>
<td>.001**</td>
<td>Supported</td>
<td>( U = 83652.5, p &lt; .001 )</td>
</tr>
<tr>
<td>( H_{2a} ) Gender ( \rightarrow ) OPT</td>
<td>.708</td>
<td>Not Supported</td>
<td>( U = 257379.5, p &gt; .05 )</td>
</tr>
<tr>
<td>( H_{2b} ) Gender ( \rightarrow ) INN</td>
<td>.612</td>
<td>Not Supported</td>
<td>( \chi^2 (1, N = 1443) = 0.257, p = 0.612 (p &gt; .05) )</td>
</tr>
<tr>
<td>( H_{2c} ) Gender ( \rightarrow ) DIS</td>
<td>.697</td>
<td>Not Supported</td>
<td>( \chi^2 (1, N = 1443) = 0.151, p = 0.697 (p &gt; .05) )</td>
</tr>
<tr>
<td>( H_{2d} ) Gender ( \rightarrow ) INS</td>
<td>.049</td>
<td>Supported</td>
<td>( U = 246662, N = 1443, p = 0.049 (p &lt; .05) )</td>
</tr>
<tr>
<td>( H_{2e} ) Gender ( \rightarrow ) SM</td>
<td>.820</td>
<td>Not Supported</td>
<td>( r_s = 0.052, p &gt; .05 )</td>
</tr>
<tr>
<td>( H_{3a} ) Education ( \rightarrow ) OPT</td>
<td>.002**</td>
<td>Supported</td>
<td>( r_s = 0.80, p &lt; .001 )</td>
</tr>
<tr>
<td>( H_{3b} ) Education ( \rightarrow ) INN</td>
<td>.001**</td>
<td>Supported</td>
<td>( U = 178312.5, p &lt; .05 )</td>
</tr>
<tr>
<td>( H_{3c} ) Education ( \rightarrow ) DIS</td>
<td>.012</td>
<td>Supported</td>
<td>( U = 38111, p &lt; .05 )</td>
</tr>
<tr>
<td>( H_{3d} ) Education ( \rightarrow ) INS</td>
<td>.001**</td>
<td>Supported</td>
<td>( r_s = 0.88, p &lt; .001 )</td>
</tr>
<tr>
<td>( H_{3e} ) Education ( \rightarrow ) SM</td>
<td>.379</td>
<td>Not Supported</td>
<td>( U = 106721, p &gt; .05 )</td>
</tr>
</tbody>
</table>
1. Population Age on PGHD-TRI constructs and attitude to Self-medication.

H1a. Age-OPT: The analysis revealed that there is a very strong positive correlation between the population age and their optimism: \( r_s = .113, N = 1,443, p = .001 \) (\( p < .01 \)). Remarkably, the respondents’ age correlation to optimism showed a pyramidal trend as 96% of respondents within the 46-55 years old age category showed more optimism, followed by 95% of respondents within the 36-45 years old age category and 91% of respondents within the 56-65 years old category. It appears that there is a continuous increase in level of optimism with regards to the respondents’ age, up until the 46-55 years old age category, after which a decline in optimism is observed.

H1b. Age-INN: The respondents’ age was statistically significant to their innovativeness: \( U = 188717.5, N = 1,443, p = .023 \) (\( p < .05 \)), 73% of the 1,443 respondents were unaware of mHealth compared to 27% who were aware, and it was interesting to observe that the level of innovativeness decreased as the respondents age increased.

H1c. Age-DIS: Age was not statistically significant to the respondents’ perceived discomfort: \( U = 44781, N = 1,443, p = .999 \) (\( p > .05 \)).

H1d. Age-INS: There was a very strong evidence of age being statistically significant to the degree of insecurity: \( r_s = .182, N = 1,443, p = .001 \) (\( p < .01 \)). It was observed that the degree of insecurity decreased as respondents’ age increased. Even when assured that all security concerns towards PGHD use will be addressed before implementation, the data showed that the younger respondents remained more sceptical concerning their PGHD security.

H1e. Age-Self-medication: The result revealed that: \( U = 83652.5, N = 1,443, p = .001 \) (\( p < .01 \)). This implied that there was a very strong evidence of age being statistically significant to the respondents’ attitude to self-medication. It was observed that attitude to self-medication increased as age increased.


H2a. Gender-OPT: Based on the findings made, gender was not statistically significant to the respondents’ degree of optimism: \( U = 257379.5, N = 1,443, p = .708 \) (\( p > .05 \)).
H2b. Gender-INN: Gender had no evidence of being statistically significant with the respondents’ degree of innovativeness: \( \chi^2 (1, N = 1,443) = .257, p = .612 (p > .05) \).

H2c. Gender-DIS: Gender was not statistically significant with the respondents’ degree of discomfort: \( \chi^2 (1, N = 1,443) = .151, p = .697 (p > .05) \).

H2d. Gender-INS: The result revealed that the degree of insecurity felt in the male group statistically, was significantly higher than the female group: \( U = 246662, N = 1,443, p = .049 (p < .05) \).

H2e. Gender-Self-medication: Gender was of no statistical significance to the respondents’ attitude towards self-medication: \( rs = .052, N = 1,443, p = .820 (p > .05) \).


H3a. Level of education-OPT: It was observed that degree of optimism was statistically significantly higher in those with a higher level of education, followed by those with secondary school education and least in those with primary education: \( rs = .80, N = 1,443, p = .002 (p < .01) \).

H3b. Level of education-INN: The degree of innovativeness was statistically significantly higher in those with a higher level of education, followed by those with secondary school education and least in those with primary education: \( U = 178312.5, N = 1,443, p = 0.001 (p < .01) \).

H3c. Level of education-DIS: It was observed that degree of discomfort was statistically significantly higher in those with a higher level of education, followed by those with secondary school education and least in those with primary education: \( U = 38111, N = 1,443, p = 0.012 (p < .05) \).

H3d. Level of education-INS: Interestingly, the degree of insecurity was statistically significantly higher in those with a higher level of education, followed by those with secondary school education and least in those with primary education: \( rs = 0.88, N = 1,443, p = .001 (p < .01) \).
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H3e. Level of education-Self-medication: The result revealed that level of education was not statistically significant to the respondents’ attitude to self-medication: U = 106721, N = 1,443, p = .379 (p > .05), 88% of the 1,443 respondents admitted they self-mediated compared to 12% who did not self-medicate.

4.5.6 Practical Implication of findings and Conclusion for PGHD-TR1

Having detailed the research methodology, the research method used, the sampling technique and all other aforementioned steps used in designing, pretesting, administering collecting and analysing the PGHD-TR1 survey, the implications of the finding include:

a. The PGHD-TR1 survey has established that the respondents within the sampled population for this study are mostly explorers based on their overall mean score under each dimension. This scoring is in line with the recommendations provided by Parasuraman (2000); Parasuraman and Colby (2001, 2015).

b. The aggregate mean score of the four dimensions gave the study sample a TR score of 3.08 and this is a positive tell-sign that the population will be positively predisposed, as well as being technology ready (explorers) towards accepting and adopting PGHD.

c. As seen from the insecurity dimension, one of the items under this dimension - INS1 asked: “Do you think the ownership of patient-generated health data (PGHD) is an issue that needs to be discussed and resolved amongst all involved stakeholders” and returned a mean score of 4.10. This being that high implied that issues relating to the ownership of PGHD is of high concern to the respondents and must be resolved by all involved stakeholders in the eventual implementation of PGHD in the State. Ideally, patients absolutely own and decide whom they share their PGHD with (Shapiro et al. 2012). As most of the respondents admitted that the nature of their ailment could influence their decision not to adopt the practice, it is essential that this is carefully addressed between patients and their healthcare providers. The need to ensure privacy, security and responsible use of PGHD in its eventual implementation will in no small measure encourage the adoption of PGHD in the State. This finding informed on the conceptualisation and development of the PGHD adoption framework in Chapter 8.
d. Looking at the hypothesised relationships between the respondents’ demographic attributes, the influence of age and level of education agreed the closest to the proposed hypothesised relationships, unlike their gender. In both age and level of education correlational analysis respectively, 4 out 5 of each item measured under the PGHD-TR1 constructs and their attitude to self-medicate showed a significant positive relationship.

e. The respondents’ age showed no evidence of statistical significance with the item measuring the discomfort construct, while level of education also did not have any statistical significance towards their attitude to self-medicate.

f. Interestingly, 4 out of the 5 hypothesised relationships under gender were insignificant as it only showed almost a weak evidence of positive relationship with the item measuring insecurity as seen in Table 4.26. This implied that gender plays no role in the population’s propensity to accept PGHD.

g. These findings from the PGHD-TR1 Study-1 correlational analysis suggests that the average Lagosians PGHD-TR disposition would most likely be influenced by age and level of education, regardless of gender. These findings further informed on the conceptualisation and development of the PGHD adoption framework in Chapter 8.

h. As internet connectivity keeps growing in Nigeria, findings from this study show that though the respondents were positively predisposed towards using their mobile device for capturing and sharing their PGHD, the frequency of PGHD correspondence with their care providers needs to be resolved within the involved parties. Irrespective of the respondents’ level of education, it was interesting to discover that 73% of them had no prior knowledge of mHealth, yet the majority of them (91%) agreed strongly that having a means to seamlessly reach their care providers would influence their decision not to self-medicate. This suggests that there is a strong link between access to healthcare information from care providers and patients’ attitude to self-medication in Lagos State. While PGHD has shown potentials to bridge such gap, it is important that its eventual implementation in the State takes into consideration its novelty, thus a great deal of public awareness across all age groups and educational levels on PGHD processes is required.
4.6 PGHD-TR2 Data Analysis – (Medical Practitioners)

In Table 4.8, the PGHD-TR2 overall response rate was shown. 47 medical doctors responded to the 200 questionnaires sent out for this survey and this implied a 23.5% response rate. Of these 47 medical doctors, 28 were male, while 19 were female. The questionnaire items focused on gaining insight into the medical doctors’ predisposition to PGHD, their knowledge or awareness of PGHD practice in the State and their opinion on the need for a PGHD adoption framework. The question construct concluded with a shift from their predisposition to disposition, in order to observe if any real change occurred from their initial PGHD predisposition as they responded to the questionnaire.

For clarity: predisposition is the likelihood, tendency or liability for someone to behave in a certain way, while disposition entails one’s inherent quality, character or tendency to act in a particular way (Oxford Dictionaries 2017).

4.6.1 On the Existence of PGHD Practice in Lagos State

Three items measured this construct. The first question asked the respondents: given your experience and knowledge as a medical practitioner, are there any existing PGHD frameworks in Lagos State or Nigeria? The unanimous result (47 of the respondents answered No) obtained from this question implied that there is absence of a PGHD framework in the State. Secondly, they all (100% of the respondents) admitted that there was no PGHD guidelines in Lagos State and Nigeria as a whole. From the third question in this construct concerning the need to have a dedicated PGHD framework developed for the State, the result obtained showed that 15 of the respondents (31.9%) agreed, while 32 of them (68.1%) strongly agreed that there was a need to have a dedicated PGHD framework developed for the State. In support of the findings obtained in PGHD-TR1, these findings further reaffirm the need to have a PGHD framework applicable to the study environment developed.

4.6.2 Medical Doctors’ Predisposition to PGHD in Lagos State

Six items measured this construct. From the first item regarding their predisposition to PGHD in Lagos State, the summary of the thematic analysis carried out on this open-ended question showed that 29 respondents (61.7%) out of the 47 medical doctors were positively predisposed to PGHD in Lagos State. 17 respondents (36.2%) were positively predisposed,
but with a hint of scepticism as evidenced in their response, while 1 respondent (2.1%) was negatively predisposed to PGHD in Lagos State (see Appendix 5 for the thematic analysis).

From the second item measuring this construct, the respondents were asked of their opinion regarding what *meaningful use* of PGHD in Lagos State would imply. Given it was an open-ended question, the thematic analysis carried is shown in Appendix 6. From the 47 responses obtained for this item, only one of the respondents wasn’t forthcoming with an answer. It could be summarised that though their opinions to what they believe of the PGHD meaningful use entail, the array of feedbacks retrieved shed interesting light on the medical practitioners’ predisposition to PGHD meaningful use.

From the third item on their predisposition towards their PGHD concerns, the thematic analysis identified five themes as evidenced in their responses. They included: 57.4% of them suggested concerns regarding the complexity, cost, competency and commitment (CCCC) of medical practitioners towards PGHD practice; 42.5% of them suggested concerns regarding the privacy and security of health information (PSHI); 63.8% of them suggested concerns regarding patient literacy, commitment and ethical issues (PLCEI); 55.3% of them suggested concerns regarding inadequate policy and government support (IPGS) for PGHD and 48.9% of them suggested concerns regarding inadequate technology and logistical support (ITLS). This finding implied that although all their concerns deserve equal attention, the majority of the respondents were overly concerned about patient literacy, commitment and ethical issues surrounding PGHD. (See Appendix 7 for the thematic analysis on all of the respondents’ PGHD concerns).

From the fourth item on their predisposition towards the PGHD concerns and in response to the aforementioned PGHD concerns, this question asked the respondents how their listed concerns can be resolved. Appendix 8 details all the suggestions made by the respondents towards resolving the concerns listed in Appendix 7. Only one respondent wasn’t forthcoming with a significant suggestion, while the rest (46 respondents) gave remarkable suggestions on how their identified PGHD concerns can be resolved.
From the fifth item regarding the notion that PGHD introduction into formal care can disrupt medical practitioners’ workflow as seen from reviewed literature, this question asked the 47 respondents of their opinion. Twenty-six respondents disagreed with this notion, 7 respondents were undecided, while 14 respondents are of the opinion that PGHD would disrupt their workflow.

The sixth item on the respondents’ predisposition asked: as a medical practitioner in Lagos State, what incentives do you think would accelerate PGHD acceptance into the State’s medical practice? The array of responses showed that out of the five themes evident in the retrieved responses, 30 respondents (68.3%) suggested the provision of enabling policies, environment and technology (PPET) for PGHD in the State; this was followed by 26 respondents (55.3%) who suggested incentives in the form of PGHD education, awareness and adequate information (EAAI) on PGHD usage for all involved stakeholders, 21 respondents suggested incentives to be driven by evidence-based development and implementation (EBD) of PGHD, 18 respondents suggested being incentivised through PGHD user development and reward (UDR) for the medical practitioners who champion PGHD use in the State. The least observed theme was on the basis of PGHD being integrated into a patient’s formal care (IPFC), 2 out of the 47 respondents offered no useful response to this question. See Appendix 9 for the thematic analysis carried out for this question. All the findings made from this PGHD-TR2 questionnaire construct immensely informed on the development of the PGHD adoption framework in Chapter 8.

4.6.3 Medical Practitioners’ Predisposition to PGHD Enabling Technology

Five items measured this construct and from the first item which asked if they would accept any technology or practice that empowers Lagos State patients in capturing, transferring and retrieving their reviewed PGHD. The results obtained showed that 15 of the respondents (31.9%) agree, while 32 of them (68.1%) strongly agree that they would accept enabling technology or practice that empowers PGHD in PGHD in Lagos State.

Considering that acceptance precedes adoption, the second question under this construct asked if they would adopt any technology or practice that empowers Lagos State patients in capturing, transferring and retrieving their reviewed PGHD. Results obtained showed that 16
(34%) of the respondents agreed, while 31 (66%) of them strongly agreed that they would adopt an enabling technology or practice that empowers PGHD in Lagos State.

To evaluate their personal interest in PGHD, the third question asked if they would personally go out of their way to support any technology or practice that empowers Lagos State patients in capturing, transferring and retrieving their reviewed PGHD. The result showed that they all still answered in the affirmative (14 respondents agreed, while 33 respondents strongly agreed).

The fourth item elicited the various types of information (data) the respondents would be willing to collect from their patients via PGHD. Forty-six out of the 47 medical doctors were forthcoming with various types of information they would collect from their patients, while one respondent implied caution as regards electronic dissemination of health information (see Appendix 10 for the thematic analysis).

The fifth item asked the respondents: given your knowledge of mHealth (mobile health), what will be the most suitable means or medium for communicating PGHD electronically with your patients? From the obtained feedback, 44 respondents (93.6%) suggested via a secured email medium. Interestingly, amongst those who suggested secured email, they also suggested a scheduled frequency in order not to be overwhelmed or distracted with so much information. Fourteen respondents (29.8%) suggested mobile application, 8 respondents (17%) suggested via a dedicated PGHD web-based platform, 5 respondents (10.6%) suggested via text message (SMS) and 1 respondent (2.1%) suggested via phone call. Most of the respondents also agreed that their choice regarding their mode of communication would also be influenced by how best they and their patients could optimise the PGHD practice.

4.6.4 Medical Doctors’ predisposition to PGHD Regulation, Ownership, Distribution and Access in Lagos State

Considering how sensitive the issues surrounding regulation, ownership, distribution and access to patients’ electronic health information are, five items measured this construct and findings made are descriptively reported. From the first item that asked: who do you think should be responsible for the regulation of PGHD practice in Lagos State, if PGHD is
implemented? The results obtained showed that 43 respondents (91.5%) suggested the State medical board and the government should be responsible for PGHD regulation, 2 respondents (4.3%) suggested medical doctors, while another 2 respondents (4.3%) suggested medical doctors and their patients. The majority response informed on the PGHD adoption framework conceptualisation and development in Chapter 8.

The second item asked the 47 respondents: who do you think should absolutely own and distribute patient-generated health data (PGHD)? Twenty-two respondents (46.8%) said it should be the *patient, but as directed by the patient’s doctor*, 20 respondents (42.6%) said PGHD should absolutely be owned and distributed by the *patient*, 2 respondents (4.3%) said PGHD should be owned and distributed by the *patient’s hospital*, while another 2 respondents (4.3%) said PGHD should be owned and distributed by the *medical doctors, but as directed by their patients*. Only 1 respondent asserted that the ownership and distribution of PGHD should be *a consensus that should be reached by all involved stakeholders*. Though from the literature, the patient should absolutely own his or her PGHD, it is evidenced that this doesn’t seem to be the consensus in the study environment. This result further justifies the need to have, in practice, a PGHD framework that truly reflects the realities of the environment in which it is functional.

The third item under this construct asked the respondents who they feel should have access to PGHD. The array of responses obtained is presented in Table 4.29 and this also supports the need to have defined guidelines towards PGHD, as well as nationally defined standards regarding patients’ data in various electronic formats.

**Table 4.29 Regarding who should have access to patients’ ‘PGHD’**

<table>
<thead>
<tr>
<th>Answer Option</th>
<th>No. of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>It needs to be agreed upon by all involved stakeholders</td>
<td>29 (61.7%)</td>
</tr>
<tr>
<td>Patients</td>
<td>20 (42.6%)</td>
</tr>
<tr>
<td>Patients personal doctor</td>
<td>20 (42.6%)</td>
</tr>
<tr>
<td>Patient’s family and care partners</td>
<td>14 (29.8%)</td>
</tr>
<tr>
<td>Any doctor in-case of emergency</td>
<td>13 (27.7%)</td>
</tr>
<tr>
<td>Hospital administration</td>
<td>9 (19.1%)</td>
</tr>
<tr>
<td>Medical research &amp; development companies</td>
<td>2 (4.3%)</td>
</tr>
<tr>
<td>Advert companies</td>
<td>0</td>
</tr>
<tr>
<td>Insurance company</td>
<td>0</td>
</tr>
<tr>
<td>Government</td>
<td>0</td>
</tr>
</tbody>
</table>
The fourth item asked the respondents if they believe the ownership of PGHD is an issue that needs to be discussed and resolved amongst all involved stakeholders. From the findings obtained, 35 respondents (74.5%) answered: No, it should belong to the patients’. 9 respondents (19.1%) were of the opinion that the issue of PGHD ownership should be discussed and resolved amongst involved stakeholders, while 3 respondents (6.4%) remained indifferent.

4.6.5 Medical Doctors’ Disposition to PGHD in Lagos State

Having observed the respondents’ predisposition to PGHD in the State, this questionnaire construct looked at their disposition to PGHD as measured by 9 items. These 9 items ranged from a series of beliefs regarding PGHD benefits and demerits if introduced in Lagos State. Table 4.30 summarises the responses obtained under this construct.

Table 4.30 Respondents Disposition to PGHD in Lagos State

<table>
<thead>
<tr>
<th>PGHD Disposition Construct: 10 Items</th>
<th>No. of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>S. Disagree</td>
</tr>
<tr>
<td>1. I believe PGHD practice can contribute towards reducing medical cost for Lagosians</td>
<td>2 (4.3%)</td>
</tr>
<tr>
<td>2. I believe PGHD practice can contribute towards reducing cost of health provision for the government of Lagos State.</td>
<td>2 (4.3%)</td>
</tr>
<tr>
<td>3. I believe PGHD practice can contribute towards improving patient appointment bottlenecks in Lagos State government hospitals.</td>
<td>0</td>
</tr>
<tr>
<td>4. I believe PGHD practice can contribute towards reducing the incidence of patient self-medication through seamless interaction with patients electronically.</td>
<td>0</td>
</tr>
<tr>
<td>5. I believe PGHD practice can contribute towards improving patient-doctor relationship by serving as a communication bridge.</td>
<td>0</td>
</tr>
<tr>
<td>6. I believe PGHD practice can contribute towards making Lagosians more proactive in their health choices.</td>
<td>0</td>
</tr>
</tbody>
</table>
7. I believe PGHD practice can contribute towards improving chronic care management in Lagos State.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1 (2.1%)</th>
<th>1 (2.1%)</th>
<th>19 (40.4%)</th>
<th>26 (55.3%)</th>
</tr>
</thead>
</table>

8. I believe if PGHD practice is a success in Lagos State, it could accelerate the shift towards implementing an extensive electronic health record (EHR) practice in Lagos State.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>0</th>
<th>5 (10.6%)</th>
<th>23 (48.9%)</th>
<th>19 (40.4%)</th>
</tr>
</thead>
</table>

9. Roles like patient-generated health data analyst will improve the likelihood of PGHD being accepted into Lagos State medical practice. I also believe such role will help reduce the burden (data collection, analysis and feedback) PGHD might portend on the workflow of medical personnel's.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1 (2.1%)</th>
<th>0</th>
<th>26 (55.3%)</th>
<th>20 (42.6%)</th>
</tr>
</thead>
</table>

10. Having gone through the questions asked in this survey, what is your disposition now towards PGHD, its likely adoption by Lagosians and acceptance in the Lagos State medical practise? Please also state other insights you have regarding the PGHD concept. (For item thematic analysis, see Appendix 11) [Item aggregated response count]

<table>
<thead>
<tr>
<th></th>
<th>Negatively Disposed</th>
<th>Undecided Positively disposed, but with caution (Skeptics)</th>
<th>Fully positively Disposed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 (2.12%)</td>
<td>14 (29.8%)</td>
<td>32 (68.1%)</td>
</tr>
</tbody>
</table>

From Table 4.30, the array of feedbacks retrieved regarding the respondents’ PGHD disposition strongly suggests that the majority of them are positively disposed to PGHD in Lagos State. Although their individual responses vary on many of the items, item 10 under this construct aggregated their open-ended responses regarding their PGHD beliefs. From the thematic analysis done on item 10 three themes were observed and quantifying these themes; only 1 respondent was negatively disposed to PGHD, 14 respondents (29.8%) were positively disposed to PGHD but with a degree of caution (skeptics), 32 respondents (68.1%) were fully positive towards their disposition to PGHD in Lagos State.

### 4.7 Chapter Summary

This PGHD-TR survey (PGHD-TR1 and PGHD-TR2) fits into the overall PGHD adoption framework design by being the first step to evidence the technology readiness of the Lagos
State population. This survey (Study-1) has also shed light on concerns that were considered during the conceptualizing and development of the PGHD adoption framework before validation. Amongst the limitations to the study was the high cost of funding for the long travel from the UK to Nigeria and movement within Lagos State. Building on the findings made from this PGHD-TR survey Study-1, the next phase of the research involved carrying out a PGHD-acceptance model study of diabetic patients in Lagos State General Hospital Odan. This was based on the underpinning theory of the technology acceptance model (TAM).
CHAPTER 5: STUDY-2 PGHD-ACCEPTANCE MODEL
THEORETICAL FRAMEWORK AND HYPOTHESES

The aim of Study-2 was to investigate the factors that could influence the acceptance of patient-generated health data through an actual PGHD exercise in General Hospital Odan, Lagos State Nigeria. With ethical approval granted, this study was done with collaboration from medical doctors in the aforementioned hospital and 53 consenting diabetic patients. By actualising this Study-2 aim, the following research objectives initially set in Chapter 1 are met:

Research objective 1: Review concepts central to the definition and usage of PGHD.

Research objective 3: Undertake a cross-sectional study of PGHD use by consenting diabetic patients in General Hospital Odan, Lagos State Nigeria.

Research objective 4: Propose from the studied consenting diabetic patients, a PGHD acceptance model for the implementation, adoption and use of PGHD in Lagos State.

Note: Research objective 2 already achieved in Chapter 4.

This chapter builds on the review of information system theories with emphasis placed on developing the theoretical framework of determinants/predictors (exogenous latent constructs) that would likely influence the 53 diabetic patients’ PGHD usage behaviour and possible acceptance (endogenous latent constructs) of PGHD in Lagos State Nigeria. It concludes by presenting the research hypotheses with justifications.

5.1 Theoretical Background

Over the past three decades, several researchers in the field of health informatics have conceptualised their study (Health information technology adoption and usage) on the strength of the Technology Acceptance Model (TAM). Hu et al. (1999) examined TAM using physicians’ acceptance of telemedicine technology. Although their study showed that the perceived usefulness construct in TAM reasonably proved physicians’ attitude and intention to use telemedicine technology, such could not be said of the perceived ease of use construct. Their study also highlighted the limitations of the parsimonious nature (the nature of being stingy in accommodating other possible external variables that could be at play) of TAM and suggested the need to integrate extra constructs or support the model with a combination of
other IT acceptance models so as to improve its applicability in a healthcare context. Using a quantitative approach based on TAM, Abu-Dalbouh’s (2013) study modified the TAM constructs to fit the context of his study while evaluating a system mobile tracking model on patient progress applications. In further support of the relevance of TAM towards conceptualising the patient-generated health data acceptance model (PGHD-AM) framework, TAM shares a unique attribute of being able to be re-adapted to fit the purpose (Kripanont 2007: 80; Taylor and Todd 1995a). Lanseng and Andreassen’s (2007) study of people’s readiness and attitude towards performing self-diagnosis responded to the parsimonious nature of TAM in Hu et al.’s (1999) study by combining together the Technology Readiness Index (TRI), which has the ability to predict future behavioural intent, and TAM in their study. This of course made their study more flexible and applicable to the changing technology trends in healthcare. It is to be recalled that Study-I PGHD-TR in Chapter 4 took this into account by investigating the population readiness towards PGHD use. This study (Study-2) investigates the same population to a greater depth, by concentrating on diabetic patients using the TAM.

After an extensive consideration of the implication of adaptation, the primary constructs of TAM and additional constructs adapted were based on their degree of parsimony and flexibility towards explaining this study samples usage intentions and behaviour from using the internet-based diabetes management system. Having highlighted the parsimony and flexibility considerations made, this chapter goes on to postulate a PGHD-AM theoretical framework that could assist in predicting behaviour intentions and usage behaviour through a practical investigation of consenting diabetic patients’ actual use of PGHD.

5.1.1 Basic Concept of the TAM Theoretical Framework
Earlier technology acceptance model studies by previous researchers focused on users’ acceptance of technology based on their behavioural intention and/or actual usage as the primary dependent variables (Compeau and Higgins 1995; Davis, Bagozzi and Warshaw 1989). Over time, modalities relating to adaptation and application of acceptance models have put into consideration the specific psychographic attributes of the population being investigated as seen in numerous acceptance models related studies (Venkatesh et al. 2003: 427). Without a doubt, this in no small measure influenced the building constructs adapted
for this PGHD-AM study. Taylor and Todd’s (1995) and Szajna’s (1996) independent investigations have shown that measuring user behaviour could either be done by solely focusing on actual technology use (usage behaviour), by intention to use (behavioural intention) or combining the two dependent variables together.

A cross-sectional study by Hu et al. (1999) examined the applicability of TAM towards explaining physicians’ intention based on their decision to accept telemedicine technology within a healthcare context. Still focusing on intention to use, the following cross-sectional studies by the listed researchers investigated individual acceptance of technology by measuring only behavioural intention as a key dependent variable: Agarwal and Prasad (1997); Agarwal and Karahanna (2000); Bhattacherjee (2001); Chau and Hu (2001, 2002); Chin and Gopal (1995); Gefen and Straub (2000); Gefen, Karahanna and Straub (2003); Hong et al. (2002); Jackson, Chow and Leitch (1997); Karahanna, Straub and Chervany (1999); Mathieson (1991); Straub, Keil and Brenner (1997); Venkatesh and Davis (1996); Venkatesh and Morris (2000). Unlike the previous cross-sectional studies aforementioned, the following cross-sectional studies measured only usage as the key dependent variable when considering technology acceptance: Adams, Nelson and Todd (1992); Davis (1989; 1992); Gefen and Straub (1997); Van der Heijden (2003); Hendrickson and Collins (1996); Igbaria, Parasuraman and Baroudi (1996); Igbaria, Zinatelli, Cragg and Cavaye (1997); Karahanna and Straub (1999); Lederer et al. (2000); Subramanian (1994); Szajna (1994); Teo, Lim and Lai (1999); Thompson, Higgins and Howell (1991). While it could be debated which approach is best, these modifications in the TAM adaptation by the listed studies show the extensive application of the TAM theory over time.

Looking at researchers who have combined the two key dependent variables in a single study, Mathieson, Peacock and Chin (2001); Moon and Kim (2001); Gillenson and Sherrell (2002); Venkatesh and Davis (2002) and Venkatesh et al. (2003) while employing a longitudinal study, they investigated how the two key dependent variables (behavioural intention and usage behaviour) influence individual acceptance of technology. Much earlier before the aforementioned researchers carried out their study, Davis, Bagozzi and Warshaw (1989, 1992); Taylor and Todd (1995a and 1995b) and Szajna (1996) all investigated technology acceptance while also considering the two key dependent variables. While relevant with time,
scope of study and study design, all the evidence (behaviour intention versus usage behaviour, a cross-sectional study versus longitudinal study) provided in these studies greatly informed towards the conceptualisation of the PGHD-AM constructs. Consequently, both the user intention and usage behaviour are investigated with the supporting six independent variables (constructs) presented and discussed in this chapter.

As regards the study design, Sekaran (2006) suggests that for a cross-sectional study, data are collected at one point in time, sometimes over a period of days, weeks or months, whereas in a longitudinal study, William et al. (2002: 267) suggest that data are collected via repeated observation of the same variables over long periods of time, often many decades. This PGHD-AM study adopts an abridged form of longitudinal study as the duration, though not too lengthy (3 months), still embodies all attributes of a longitudinal study. The reason for having the study last for 3 months was based on the collaborating medical doctors’ advice. According to them, the 3-month duration was the duration between each hospital visit by the diabetic patients in the study area and thus was a realistic timescale to observe if there was any difference made by the patients’ usage of PGHD on their average blood glucose level. On the implication of this 3-month duration on the study’s result validity, other studies on glycemic control for diabetes using various technologies have been designed around the 3-month duration with significant findings made (Liu et al. 2005; Franklin et al. 2006; Bloomgarden 2008; Rewers 2014; Gonder-Frederick 2016).

This study would have been a cross-sectional study if only behaviour intention was measured using a scenario-based approach, but having practically carried out all the exercises and processes involved in PGHD capture and sharing, it was necessary to also measure the participants’ usage behaviour, thus the reason for having an abridged longitudinal study. The investigation of both the independent and dependent TAM constructs further supports the effectiveness of the investigation carried out in this study. It was theoretically and practically justifiable to carry out the PGHD capture and share exercise in the study area, as the practice was novel to both the medical practitioners and diabetic patients in Lagos State Nigeria - evidenced in the PGHD-TR1 and PGHD-TR2 survey results.
Finally, the concept underpinning the user acceptance model for this study and adapted from Venkatesh et al. (2003: 727); and Kripanont (2007: 83) proposes that individual reaction or propensity (technology readiness investigated in Study-1) to use health information technology (HIT) for PGHD is likely to influence the actual usage of HIT and subsequently, the actual usage of HIT for PGHD may influence intention to use HIT for PGHD. This is illustrated in Figure 5.1.

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Figure 5.1 Basic Concept of PGHD-AM Study Model adapted from Venkatesh et al. (2003: 427); and Kripanont (2007: 83)

5.2 PGHD-AM Theoretical Framework

Collis and Hussey (2013) defined theoretical framework as a gathering of models and theories from the literature that support a positivistic research study. In simpler term, a theoretical framework seeks to justify and detail the steps and processes of a conceptual model and how the researcher theorizes and makes logical sense of the relationships amongst all variables identified to be significant to the model. Furthermore, the development of a conceptual framework helps in proposing hypotheses and justifies the need for analysing specific relationships (Yin 2013). This in no small measure leads to further investigation and improving upon our understanding of the various dynamics at play.

It is very important to understand what a variable signifies and the common, or in some instances, complex differences or similarities they share with other variables within a system or a model. After establishing the definition and relationships of all the variables in play within a model, i.e. formulating the theoretical framework, a sound hypothesis can be developed to investigate the validity of that theory (Sekaran 2006).

For the purpose of clarification:
- Theoretical framework has been defined in the first paragraph in this chapter section, but in simpler terms; theoretical framework could be viewed as the structure that supports a theory of a research study. According to USC Libraries (2017), theoretical framework is used to limit the scope of the relevant data by concentrating on precise variables and defining the specific perspective (framework) that the researcher will adopt in analysing and interpreting the collected data. Theoretical framework also facilitates the understanding of concepts and variables based on given definitions, and shapes new knowledge by validating or challenging existing theoretical assumptions.

- Theory in general as defined by Kerlinger (1986: 9) is a set of interconnected constructs, concepts, definitions, and propositions that present a systematic view of phenomena by postulating relations among variables with the purpose of predicting and explaining the phenomena.

- The terms conceptual framework and PGHD-AM framework are used interchangeably in this thesis. According to Miles and Huberman (1994: 18), conceptual framework is an analytical tool with several variations and contexts that explains graphically, or in narrative form, the themes under investigation and the presumed relationships among them. In the same context, this definition applies to the use of the PGHD-AM framework in this thesis.

- Model in the simplest of terms is defined as a thing used as an example to follow, illustrate, imitate or adapt in order to gain better insight (Cambridge dictionary 2017). In research, the term model, when used, implies a practical guidance for the realisation of a particular theory. In other words, model is a representation of a system that allows for the properties of the system to be investigated, thereby allowing for the prediction of future outcomes (InvestorWords 2017). This definition in this study’s context applies to the use and adaptation of the Technology Acceptance Model.

- In summary of the clarifications: Theoretical framework is the structure that can hold or support a theory of a research study; theories are general descriptions of the structure; models are descriptions of the structure in a particular context, and framework in general
(real or conceptual) is a structure that serves as a guide for the building of ideas and expands the structure into something useful that can be tested, replicated or implemented.

The proposed PGHD-AM framework (theoretical framework, conceptual framework) consists of two significant types of variables as illustrated in Figure 5.2.

1. Six independent variables (exogenous constructs) consisting of perceived usefulness (PU), perceived ease of use (PEOU), facilitating conditions (FC), social influence (SI), self-efficacy or perceived ability (SE) and patient data security (PDS). It is expected that these six core constructs will influence the patients’ PGHD usage behaviour.

2. Two dependent variables (endogenous constructs) that include patients’ PGHD usage behaviour (PGHDUSB) and patients’ PGHD behaviour intention (PGHDBI). It is expected that the patients’ PGHD usage behaviour will influence their behaviour intention.

Having stated the above, it is upon this conceptual framework that the hypotheses are tested. The hypotheses will seek to ascertain:

1. If the core constructs (PU, PEOU, FC, SI, SE and PDS) have any significant influence on patients’ PGHD usage behaviour (PGHDUSB).

2. If patients’ PGHD usage behaviour (PGHDUSB) has any significant influence on their behaviour intention (PGHDBI).

For this Study-2, the level of significance is measured by the probability of the P-value for each hypothesis being statistically significant at \( \leq 0.05 \), thereby the alternate hypothesis not being rejected. Further explanation is made in the analysis section of this Study-2. Figure 5.2 illustrates the proposed patient-generated health data acceptance model to be investigated and tested.
5.3 The Determinants: Six Major Constructs

As evidenced in Figure 5.2, established determinants relating to user acceptance have been adopted from past studies, while the addition of a determinant investigating patient data security was contextual. The six major determinants in this proposed PGHD-AM study are: perceived usefulness (PU), perceived ease of use (PEOU), facilitating conditions (FC), social influence (SI), self-efficacy/perceived ability (SE) and patient data security (PDS). The next subs-section further explains with justification, why the six constructs were integrated into the proposed PGHD-AM.

5.3.1 Perceived Usefulness (PU)

The validation of TAM perceived usefulness (PU) construct by Davis (1989), TAM2 as proposed, investigated and validated by Venkatesh and Davis (2000), as well as Taylor and Todd (1995a) combined TAM and theory of planned behaviour (C-TAM-TPB) shows that PU is a direct determinant of behaviour intention. The results of some studies appear to suggest that PU is also a direct determinant of usage behaviour (Thompson, Higgins and Howell 1991; Taylor and Todd 1995a; Igbaria, Parasuraman and Baroudi 1996; Gefen and Straub 1997; Gefen and Keil 1998; Teo, Lim and Lai 1999; Lederer et al. 2000 and Kripanont 2007). Furthermore, evidence and investigations by Agarwal and Prasad (1997); Venkatesh et al.
(2003) and Rogers (2010) reaffirm the close similarity in characteristics between perceived usefulness and the relative advantage of perceived characteristics of the Rogers’ Innovation Diffusion Theory. The aforementioned pointers were amongst the rationale for using perceived usefulness as a direct determinant of usage behaviour in this abridged longitudinal study. Davis (1989: 453) defined perceived usefulness as:

“The degree to which a person believes that using a particular system would enhance his or her job performance”.

For this study phase, patient generate health data acceptance model (PGHDAM), perceived usefulness is significantly expected to determine PGHD usage behaviour of the diabetic patients being studied.

5.3.2 Perceived Ease of Use (PEOU)

Perceived ease of use was posited to have a significant influence in directly determining behaviour intention in TAM, TAM2 and C-TAM-TPB - according to the models’ respective scholars. Also, evidence from Thompson, Higgins and Howell (1991); Adams, Nelson and Todd (1992); Igbaria, Parasuraman and Baroudi (1996); Gefen and Straub (1997); Gefen and Keil (1998); Teo, Lim and Lai (1999); Lederer et al. (2000) and Kripanont (2007) has shown that PEOU is a direct determinant of usage behaviour. In respect to Rogers’ Innovation Diffusion Theory, PEOU is similar to the complexity of its perceived characteristics, though in the opposite direction (Agarwal and Prasad 1997; Venkatesh et al. 2003; and Rogers 2010). This argument and evidence from previous studies supported the inclusion of PEOU in this study. Davis (1989: 320) defined perceived ease of use as:

“The degree to which a person believes that using a particular system would be free of effort”.

5.3.3 Facilitating Conditions (FC)

According to Taylor and Todd (1995b) who proposed the Decomposed Theory of Planned Behaviour (DTPB), facilitating conditions (FC) was a key construct that exhibited a direct relationship with behaviour intention and usage. They opined that understanding the impact of
resource and technology facilitating conditions could inform management on potential drivers and barriers to usage. In other words, the absence of facilitating resources or enablers would likely present obstacles to usage and could deter formation of intention and actual usage. Interestingly, Taylor and Todd’s (1995b) investigation posits that presence of facilitating resources is not a guarantee for usage encouragement. Venkatesh et al. (2003) showed that although FC, as a determinant, exhibited no significance in predicting behaviour intention, it was significant in predicting usage.

Contextually, it was very important to investigate the impact of enablers and a facilitating environment such as provision of free glucometer, test strips, free pre and post HbA1c test and continuous doctor follow-up on the study primary subjects (diabetic patients) - thus the relevance of investigating if FC as a construct will be a direct determinant of PGHD usage behaviour within the study area. The investigation of FC was also informed from the result of Study-1 where the majority of the respondents highlighted how cost of health information technology tools would be a deterrent to PGHD adoption. Venkatesh (2003: 453 defined facilitating conditions as:

“The degree to which an individual believes that an organisational and technical infrastructure exist to support the use of the system” (Venkatesh et al. 2003: 453).

5.3.4 Social Influence (SI)

Social influence or social pressure, as highlighted by Ajzen and Fishbein (1980) in the Theory of Reasoned Action (TRA), is a subjective norm and in concert with attitude are the two factors that determine intention. This assertion has also been evidenced in several theories such as TPB, DTPB, TAM2 and C-TAM-TPB (Venkatesh et al. 2003). Lucas and Spitler’s (1999) field study of Broker workstations showed that social influence (SI) is a direct determinant of behavioural intention, similar to investigation by Venkatesh and Morris (2000).

Although SI has been shown to directly determine behavioural intention, studies by Davis, Bagozzi and Warshaw (1989); Mathieson (1991); Dishaw and Strong (1999); Chau and Hu (2001, 2002a, 2002b); Venkatesh and Morris (2000) and Venkatesh et al. (2003) seem to
disagree. The argument behind this discrepancy is suggested to be due to the unique varying conditions and the environment the studies were carried out in. It is of note that SI has also been known to have significant effects on usage (Igbaria, Parasuraman and Baroudi 1996; Thompson, Higgins and Howell 1991).

Giving the dynamics within the study area and all the arguments being generated on how significant or nonsignificant SI is towards determining behavioural intention and usage, it was decided to test the impact of SI in this study. Based on these justifications, SI is used in this study as a direct determinant of PGHD usage behaviour. Venkatesh et al. (2003: 451) defined social influence as:

“The degree to which an individual perceives that other important persons believe he or she should use the system”

5.3.5 Self-Efficacy (SE)

Over time, self-efficacy (SE) has been strongly linked as a predictor of computing behaviour which in turn has shown great prowess in predicting one’s behavioural intention and actual behaviour (Downey 2006; Hwang and Yi 2002). As a construct that is of interest to both researchers and IT professionals, self-efficacy originated from the Social Learning Theory and according to the proponents of this theory, self-efficacy relates to an individual’s perceived ability (Bandura 1977a, 1977b, 1986, 1995a). It is the self-belief about one’s capability to start and complete a specific task as demonstrated in their behaviour (1995b; Bandura, Freeman and Lightsey 1999). In relation to the contextual adoption of health information technology, Compeau and Higgins (1991) suggest that individuals with higher levels of self-efficacy are expected to share a common attribute of possessing higher behavioural intention and IT usage. This was supported by Taylor and Todd’s (1995b) findings in DTPB that implied that self-efficacy was an important determinant of perceived behavioural control, as well as a decisive determinant of both intention and usage behaviour.

Although self-efficacy hinges on an individual’s training dexterity as an influence on system acceptance, Venkatesh et al. (2003) argues that computer self-efficacy has no significant impact on behaviour intention. This and other theoretical evidences beg the need to
investigate how SE as a construct could play a significant role towards determining the PGHD adoption (behavioural intention) and usage behaviour of the studied population (diabetic patients). Taylor and Todd (1995b: 150) defined self-efficacy as:

“An individual’s self-confidence in his/her ability to perform a behaviour”.

5.3.6 Patient’s Data Security (PDS)

This construct was introduced specifically due to the nature of the investigation being carried out in order to see if and how patient data security significantly influences behavioural intention and actual usage of PGHD. Buttressing the need for this construct investigation, Li, Lou and Ren (2010: 52) opine that security and privacy of patient-related data are two indispensable components for any system or framework that is recommended for adoption for new users, while reassuring usage continuity for existing users. According to them, patient data security implies that at all times, patients’ data are securely stored even when transferred across media, while data privacy implies the patients’ data can only be accessed by people who have authorization to view and use the data responsibly (Li, Lou and Ren 2010: 52). Also, other arguments that have supported the need to investigate how this determinant could impact behavioural intention and actual usage of PGHD is seen from the legal arguments on requirements concerning patient data security and protection of patient health data by Van der Haak et al. (2003). The case for mobile health patient data standardisation was made by Luxton, Kayl, and Mishkind (2012) as a means towards improving data security.

Other studies detailing patient concerns on the need for guaranteed health data privacy and security during patient-generated health data capture, distribution, usage and other possible health information exchanges across platforms and institutions are seen from the studies carried out by Rindfleisch (1997); Lu et al. (2005); Demiris et al (2008); Detmer et al. (2008) and Blumenthal (2009). Generally, one aspect all these studies have in common, as described by Barber (1998), is the significant role patient data security plays in determining whether patients’ confidence is strong towards adoption and usage of the system. This patients’ confidence cuts across how meaningful and responsible use of the received PGHD by the medical doctors, government, insurance firms and other involved institutions promotes value
to all involved stakeholders (Huba and Zhang 2012; Shapiro et al. 2012; Deering, Siminerio and Weinstein 2013; Howie et al. 2014).

Based on the arguments presented, it is evident that there is a need to see how the contextual investigation of this determinant could play a significant role towards determining the PGHD adoption (behavioural intention) and usage behaviour of the studied population (diabetic patients). Founded on the reviewed literature and from personal informed observations and investigations in Study-1 (PGHD-Technology Readiness Study), patient data security is integrated into the PGHD-AM as a direct determinant of PGHD usage behaviour. All the evidence from the reviewed literature and from Study-1 informed the definition of PDS as:

*The degree to which an individual believes that PGHD captured, shared, stored across all media and other related correspondence with a patient’s healthcare provider, within a healthcare institution and across other associated institutions, is free of security vulnerability and privacy breach.*

**5.3.7 PGHD-AM Measurement Items - Core Constructs**

With the exception of the patient data security (PDS) construct, the remaining measurement items employed in this proposed research model for PGHD-AM had their core constructs or five key determinants: perceived usefulness, perceived ease of use, social influence, facilitating conditions and self-efficacy (see Figure 5.2) adapted from the measurement items originally used in founding numerous information system theories such as TAM (Davis 1989), TAM2 (Venkatesh and Davis 2000), behaviour DTPB (Taylor and Todd 1995b) and UTAUT (Venkatesh et al. 2003). Also, adaptation of these key determinants was reinforced by their ability to offer a statistical explanation and prediction ability towards user behaviour on the phenomenon under investigation (Davis 1989; Davis, Bagozzi and Warshaw 1989; Taylor and Todd 1995b; Venkatesh and Davis 2000; Venkatesh et al. 2003). As an accepted practice, the measurement scale which can either be in the form of a 5 or 7-point Likert scale (in this study, 7 points were used), that allows respondents to rate their beliefs with series of statements by choosing the corresponding numbers was used (Han 2003).

Further supporting the robustness of the measurement item, it was found that the construct convergent reliability and discriminant validity of PU and PEOU both possess statistically
significant reliability and validity. Subsequently, since PU and PEOU are powerful beliefs constructs that influence and determine user behaviour regarding information technologies in organisations, applying them to the study measurement scales and psychometric properties are evidence of strong empiricism and robustness of the PGHD-AM study. Notwithstanding this, Han (2003) argues that researchers need to be conscious that the uniqueness of each user (or as in the case of this study, a population) also applies to their uniqueness in their perceptions of PU and PEOU, and this likely will differ across contexts in terms of technology and organisation.

5.4 User Behaviour

For this phase of the study, the two dependent variables as evidenced in numerous acceptance model theories, are usage behaviour and behaviour intention. It is expected that usage behaviour will influence behaviour intention, and it is upon this basis that the investigation and measurement are made for the PGHD-AM.

5.4.1 Usage Behaviour (USB)

As this will be the first of such empirical investigations towards establishing actual PGHD usage behaviour within the study area, all assumptions made so far in theorising the PGHD-AM will either be validated or disproved by this dependent variable. Also, since the diabetic patients involved in the 3-month abridged longitudinal study did so voluntarily, this phase of the study is carried out in the context of voluntary use and, as has been done in previous studies, through the free will of the participants (Ajzen and Fishbein 1980). This implies logically that involved patients’ intention to adopt and use PGHD is closely associated with their usage behaviour since, their use of PGHD supporting technology relies on their free volition. The significant relationship shared between usage behaviour and behaviour intention has been demonstrated in studies carried out by Davis (1989); Bagozzi (1992); Taylor and Todd (1995b); Szajna (1996); Venkatesh and Davis (2000); Mathieson, Peacock and Chin (2001); Moon and Kim (2001); Gillenson and Sherrell (2002) and Venkatesh et al. (2003).

Based on the analogy that the study participants’ (patients’) extant experience through similar information technology usage (such as mobile phones, mobile-enabled devices and technology-driven health monitoring devices), it is assumed that this will translate to their
intention to adopt and use HIT supporting devices for PGHD purpose. Consequently, this study phase expects that self-reported usage (usage behaviour) will have a significant influence on behaviour intention to adopt and use HIT-supporting devices for PGHD purpose (self-predicted future usage) in the future.

5.4.2 Behaviour Intention (BI)

Going by the technology acceptance model (TAM) assertion that intention to use is an appropriate substitute for predicting user behaviour regarding a specific technology (Davis 1989), this assertion has been corroborated in studies by Mathieson, Peacock and Chin (2001); Moon and Kim (2001); Gillenson and Sherrell (2002) and Venkatesh et al. (2003) where behaviour intention (BI) shares a strong correlation with usage behaviour (USB). As depicted in most acceptance model frameworks, user behaviour strongly relies on the influence of behaviour intention and this is a reciprocal relationship. Therefore, BI plays a very significant role towards predicting usage behaviour when the user or users have a common previous knowledge with the technology under study (Taylor and Todd 1995b).

A strategic approach to avoid being too presumptive with claims made in this study required carrying out the real life exercises involved with PGHD capture, sharing and feedback. This necessitated the designing of the 3-month abridged longitudinal study, while not disregarding the participants’ previous experience of HIT usage. To arrive at the 53 diabetic patients’ PGHD behaviour intention, it is expected that this will be informed and influenced through their actual usage of PGHD tools and involved processes. Consequently, it is strongly believed that BI will be significant towards predicting future PGHD usage behaviour (Davis 1989; Bagozzi 1992; Taylor and Todd 1995b; Szajna 1996; Venkatesh and Davis 2000; Mathieson, Peacock and Chin 2001; Moon and Kim 2001; Gillenson and Sherrell 2002; Venkatesh et al. 2003).

5.5 Research Hypotheses

This study phase tests two groups of hypotheses. The first group entails testing the direct path hypotheses in order to establish the significance between six key determinants, and how they influenced the 53 participants’ usage behaviour regarding the Internet-based diabetes management system (IBDMS) and all other enabling technology they used for PGHD
correspondence with their health healthcare provider. The second group is the hypothesis for testing the influence of their actual PGHD usage behaviour (PGHDUSB) on their behaviour intention (PGHDBI).

**Group 1a; The six determinants and PGHD Usage Behaviour**

**H₁₁ₐ**: Perceived usefulness has a significant influence on PGHD usage behaviour (PGHDUSB).

**H₁₂ₐ**: Perceived ease of use has a significant influence on PGHD usage behaviour (PGHDUSB).

**H₁₃ₐ**: Facilitating conditions has a significant influence on PGHD usage behaviour (PGHDUSB).

**H₁₄ₐ**: Social influence has a significant influence on PGHD usage behaviour (PGHDUSB).

**H₁₅ₐ**: Self-efficacy has a significant influence on PGHD usage behaviour (PGHDUSB).

**H₁₆ₐ**: Patient data security has a significant influence on PGHD usage behaviour (PGHDUSB).

**Group 2; PGHD Usage Behaviour and Behaviour Intention**

**H₂₁ₐ**: PGHD usage behaviour (PGHDUSB) has a significant influence on behaviour intention (PGHDBI).

**5.6 Chapter Summary**

This chapter has proposed a theoretical framework based on relevant theories and models of technology acceptance in conjunction with the results from previous studies which presented strong evidence toward the formation of the research model for this *Study-2*. The development of the theoretical framework has been based with an understanding of (1) how the core determinants are related to usage behaviour, and (2) the participants’ actual PGHD usage behaviour relationship with their eventual behaviour intention towards PGHD adoption and continuous use.

Two groups of hypotheses have been proposed (1) direct path hypotheses for the six determinants on PGHDUSB and (2) Influence of PGHDUSB toward their PGHDBI. In order to test the proposed PGHDAM research model, Structural Equation Modelling (SEM) with
SPSS AMOS version 24.0 is used to test the proposed hypotheses in Chapter 7, the next Chapter reports on Study-2 preliminary analysis.
CHAPTER 6: STUDY-2 PGHD ACTUAL USE PRELIMINARY DATA ANALYSIS

Building upon the previous Chapter, this chapter presents all the data collected for Study-2. Starting from the first step taken towards approaching and recruiting the participants for the 3-month study, this chapter lays emphasis on all the processes and justification for the data collected. Overall, the what, when, how, where, why and who questions concerning the data collected are answered in this chapter. From 20th January 2016 to the 19th February 2016 (one month recruitment period), a total of 53 participants (patients) voluntarily agreed to participate in the PGHD-AM study. For each successful patient recruited, a total of 36 PGHD uploads were expected from them over the course of their active participation in the 3-month study. In total, 1,908 PGHD uploads were expected from the 53 participants, but the study was able to accomplish 1,302 PGHD uploads (68% PGHD capture compliance). Justification for the stated number of PGHD expected to be captured was based on the study design. Due to the constant follow-up from the medical doctors involved with the study, both pre- and post- HbA1c diabetic patients’ results were captured. All this was done in collaboration with the Lagos State Health Service Commission and medical doctors at General Hospital Odan, Lagos State (Department of Medicine, Endocrine Unit).

For the participant recruitment criteria, each consenting participant was above 18 years of age, independent of gender and literacy, must be a diabetic patient (regardless of type) at General Hospital Odan and would have shown good understanding of the capture and upload processes involved in the study during the recruitment education phase.

The participants involved in this Study-2 were:

(1). The researcher who enlightened both the doctors and patients on how to go about uploading the captured PGHD over the Internet-Based Diabetes Management System (IBDMS). The researcher was responsible for ensuring the correct data were collected, as well as facilitated all resources required for the 3-month study.

(2). The seven medical doctors who carried out the pre- and post-HbA1c tests informed the patients on what was expected of them over the course of the 3-month study, educated them on how to use glucometer for blood sugar monitoring and on the best health choices that
would improve their health outcomes, and continuously followed-up the patients over the course of the study.

(3). The patients who were the primary participants in the study gave their individual consent to participate. They were educated on all that was required of them for the study. They took the necessary HbA1c tests (pre and post) and were provided with glucometers and test strips. They were responsible for capturing and uploading their PGHD as and when due over the course of the 3-month study and also provided all other required data asked of them concerning the study.


In accordance with established scientific methods, this PGHD-AM research process hinged upon the concepts of hypothetico-deductive method comprising eight steps (Sekaran 2006). These entail: observation, preliminary information gathering, further information gathering via literature review, theory formulation (theorising), hypothesising, data collection, data analysis and deduction. All aspects of these eight steps have been described at various points in this thesis chapter. Figure 6.1 illustrates how the PGHD-AM study was initiated at the study area from start till finish, and in line with the patient engagement framework. The patient engagement framework is aimed at guiding healthcare institutions in developing and strengthening their patient engagement strategies through the use of eHealth tools and resources (Shapiro-Mathews and Barton 2013; Butler 2014; HIMSS 2014). This framework was adapted as a guideline during the approach and eventual engagement of the diabetic patients who participated in Study-2.

The framework consists of five constructs that work sequentially:

1. **Starting with “Inform Me” but referred to in this study as “Approach Me” due to the nature of the study environment. For this study, Approach Me initiates the first step towards identifying the diabetic patients who met the inclusion criteria for the study. It entailed introducing the PGHD concept to each patient during their appointment session with their doctors. After the doctor’s discussion with the patient, a decision was made based on the doctor’s judgement of the patient’s disposition towards participating in the study.**

2. **Engage Me:** This construct formalises the study recruitment aspect of the patients by their doctors. A formal consent sheet was given to each patient at this stage and after careful
perusal, gave their consent, thereby making their participation official, though voluntary. Also, their right to withdraw at any point in time from the study was read to them.

3. *Empower Me:* This phase entailed educating the 53 successfully recruited patients on the PGHD processes. The most suitable means for sharing their PGHD (web via the IBDMS, phone call, or SMS) was established, and a free Pre-HbA1c test was undertaken by each of them. Also, the education covered how to: monitor their blood sugar levels using the freely provided glucometer and test strips, when to carry out the blood sugar self-test (fasting and postprandial), medication adherence, and best practices regarding dieting and exercise. Although they were aware of the follow-up from their doctors, each patient had a bespoke arrangement with his or her doctor as regards the frequency of sending in their PGHD, and how many PGHDs were expected to be sent by them during the study duration. Contingencies were also provided in case of loss of patients contact and any other unknowns.

4. *Partner Me:* This construct entailed the actual exercises carried out towards supporting the 53 diabetic patients PGHD share and feedback throughout the study period. Weekly follow-up was maintained by the doctors in order to encourage the patients’ continuous participation, enhanced shared-decision making and access to their generated data.

5. *Support My e-Community:* Towards this construct, the doctors advised the participating diabetic patients on how continuous sharing of their PGHD could add value to their health outcomes. Such values are in the form of: cost saving from repeated physical hospital visits, convenience of reach (improved communication), tailored diabetes care self-management plan, reminders for daily care and improved overall care quality as regards doctor-patient shared decision making via PGHD adoption are amongst the tangible and intangible benefits they could gain through the support of their e-community. Still in support of their e-community, this construct also entailed integrating useful PGHDs shared by the patients into their hospital folders (file) – this was totally novel to this study.

Table 6.1 expands on the patient engagement framework adopted as a model for approaching and engaging the recruited participants for PGHD *Study-2.* Further emphasis is laid on the stakeholders involved in the study and the relationship they share with each other.
1. **Approach Me:**
With ethical approval & consent from all involved collaborators, approach in order to inform possible participants (patients’).

2. **Engage Me:**
Diabetic patients’ recruitment started from 20th January 2016 till the 19th February 2016 at General Hospital Odan, Lagos State. Patients where were recruited by doctors on their appointment days.

3. **Empower Me:**
53 successful recruited diabetic patients were educated on PGHD processes by doctors; Pre HbA1c tests were carried out, glucometer and test strips given to them. The 3 months PGHD capture and share study begins. Efforts made by the doctors to improve capture and share compliance.

4. **Partner With Me:**
Over the course of the 3 months PGHD capture, share and feedback period, weekly follow-up was maintained by the doctors. This was done by the doctors in order to encourage patients continuous participation, enhanced shared-decision making and access to data.

5. **Support My e-Community:**
PGHD shared by patients are reviewed by doctors during each follow-up session and at the doctor’s judgement, the most meaningful data shared are formally integrated into patient’s hospital file. Patients are also advised on how best to electronically manage (safety store and responsibly share) their PGHD for future use.

Figure 6.1 Patient Engagement Framework - adapted from (HIMSS 2014)
Table 6.1 PGHD Study-2 Stakeholders and the Patient Engagement Framework

<table>
<thead>
<tr>
<th>The Researcher:</th>
<th>Conceptualised &amp; designed Study in collaboration with LSHSC. Study ethically approved.</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Doctors:</td>
<td>In liaison with the researcher, and were the ones in direct contact with the patients.</td>
</tr>
<tr>
<td>The Patients:</td>
<td>They are the primary participants for the study after consenting to participate. They must be diabetic and show good understanding of what the study involves after being enlightened on the study requirements by their doctor. Above all, the patient should show strong willingness to participate in the study based on the doctor’s judgement.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Approach Me</th>
<th>Engage Me</th>
<th>Empower Me</th>
<th>Partner with Me</th>
<th>Support My e-community</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Doctor approaches patient</td>
<td>a. The 53 recruits were educated on PGHD &amp; what the study entailed</td>
<td>a. Patients that needed glucometer and test-strips were provided with one.</td>
<td>a. A two way relationship with doctor &amp; patients</td>
<td>PGHD shared by patients are reviewed by doctors during each follow-up session and at the doctor’s judgement the most meaningful data shared are formally integrated into patient’s hospital file. Patients are also advised on how best to electronically manage (safely store and responsibly share) their PGHD for future use.</td>
</tr>
<tr>
<td>b. If approach is successful - doctor engages patient (recruits patient for study)</td>
<td>b. Pre HbA1c test done &amp; researcher collect data ID 2.</td>
<td>b. Overall facilitation of a suitable environment for the PGHD process is promoted and any support needed by the patients provided.</td>
<td>b. Patient captures PGHD, shares it and gets feedback from doctor via weekly follow-up from his or her assigned doctor.</td>
<td></td>
</tr>
<tr>
<td>c. If approach is unsuccessful due to patient not meeting inclusion criteria or unwilling to participate - doctor disregard engaging patient for the study</td>
<td>c. PGHD upload arranged to suit each patient during the study duration. PGHD captured on Mondays, Wednesdays, &amp; Fridays &amp; uploaded over the weekend either by doctors or patients who didn’t request for doctors help for upload.</td>
<td>c. Doctor partner’s with patient to enhance shared-decision making, &amp; is easily reachable via agreed medium with patient</td>
<td>c. Doctor partner’s with patient to enhance shared-decision making, &amp; is easily reachable via agreed medium with patient</td>
<td></td>
</tr>
</tbody>
</table>
6.1.1 List of Study-2 Data Set

As could be seen in Table 6.2, a list and justification of all the data collected for Study-2 is presented. It was necessary to have this presented in order to have a holistic view of the various data collected for this particular study phase. Also, it was expected that this would help readers comprehend the *when, how, where, why and who* aspect of the data collected for this PGHD-AM study. Figure 6.2 illustrates the data flow of all the data employed for this study phase, from beginning to end. This was done so as to show the progression of the entire data collected for PGHD Study-2. Having highlighted the justifications and sequence of the entire data used in this study, the next section presents an anonymised version of the 53 participating patients (demographic details, and how long they have been diagnosed with diabetes).

The aforementioned data listed above and presented in the subsequent pages set the tone for the preliminary analysis carried out in this chapter and The PGHD –Acceptance Model through structural equation modelling in the next Chapter.
<table>
<thead>
<tr>
<th>Data ID</th>
<th>When</th>
<th>Where</th>
<th>How</th>
<th>Why</th>
<th>Who (Stakeholders)</th>
<th>Ethical Approval/Supervised by</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data ID 1:</strong> Internet-Based Diabetes Management System for PGHD Study-2 (Pilot)</td>
<td>From 5\textsuperscript{th} November till 11\textsuperscript{th} December 2015 [6 weeks]</td>
<td>Coventry University UK.</td>
<td>This was designed using Bristol Online Survey web tool</td>
<td>To test the usability of the platform that was used for collecting the primary participants (diabetic patients’) PGHD</td>
<td>• Designed by the researcher</td>
<td>This was supervised and approved by researcher’s supervisory team. Also, the chief medical consultant (endocrinologist) moderated the content, tested the platform usability and gave final approval for the system.</td>
</tr>
<tr>
<td><strong>Data ID 2:</strong> PGHD Phase 2 Study, Participant Profile and Consent Sheet</td>
<td>From 20\textsuperscript{th} January till 19\textsuperscript{th} February 2016 [5 weeks]</td>
<td>At General Hospital Odan, Lagos State (Department of Medicine, Endocrine Unit)</td>
<td>Through an online survey designed by the researcher, but administered to the patients by the participating medical doctors</td>
<td>In order to have an insight into the patients’ demographic i.e. their age, gender, occupation, education level, LGA, diabetes type &amp; duration of their diabetes. Also, to ascertain the participating patients’ ability to use the glucometer device, operate internet-enabled mobile device for PGHD sharing &amp; correspondence with their doctor. Finally, to educate them on what was</td>
<td>• Designed by the researcher • Administered by the doctors • Responded to by the diabetic patients’ (primary participants’)</td>
<td>Approved by Coventry University, LSHSC and General Hospital Odan, Lagos State, Nigeria.</td>
</tr>
<tr>
<td>Data ID</td>
<td>Description</td>
<td>Details</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td><strong>Data ID 3:</strong> Internet-Based Diabetes Management System for PGHD Study-2</td>
<td>From 25th January 2016 till 20th June [22 weeks]: It lasted 3 months (12 weeks) for each patient and 22 weeks overall. This was because all the patients weren’t recruited on the same day. At the patient’s place of choice (home, work place etc.) Frequency of PGHD capture was set after consultation with involved medical doctors and the patients. As a result of the consultations, PGHD was set to be captured on Mondays, Wednesdays and Fridays. For the PGHD upload (sharing), patients who could access the IBDMS link without help did soon their own while those who requested help were assisted during their follow-up sessions with their doctors. It served as the main platform for PGHD sharing by patients with their doctors. Secondly, it served as a repository for all the PGHD shared by the patients with their doctors. This enabled the patients and their doctors have an improved shared decision making. Finally, this database enabled the researcher to monitor the patients’ compliance.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td><strong>Data ID 4:</strong> Participants</td>
<td>On the 19th of April 2016. Coventry University UK. This was designed using Bristol To test the reliability and validity of the measuring instrument.</td>
<td>• Designed by the researcher • Patients or doctors uploaded the PGHD Approved by Coventry University, LSHSC and General Hospital Odan, Lagos State, Nigeria.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data ID 5:</td>
<td>5. Participants Experience &amp; PGHD-Acceptance Model Survey</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time</td>
<td>From 20th April till 31st May 2016 (7 weeks)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>At General Hospital Odan, Lagos State (Department of Medicine, Endocrine Unit)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Method</td>
<td>Online Survey web tool instrument</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Description</td>
<td>Randomly administered to 17 relevant persons who had idea of the PGHD Study-2 (but not the primary participants) researcher’s supervisory team. Also, the chief medical consultant (endocrinologist) moderated the question items for construct validity.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data ID 6:</th>
<th>6. The 3 Months PGHD Study - Medical Doctors Experience and Opinion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
<td>At the end of each doctor’s participation in the study from 8th of June till 15th of June (1 week)</td>
</tr>
<tr>
<td>Location</td>
<td>At General Hospital Odan, Lagos State (Department of Medicine, Endocrine Unit)</td>
</tr>
<tr>
<td>Method</td>
<td>Over the dedicated online survey link by participating medical doctors at General Hospital Odan, Lagos State (Department of Medicine, Endocrine Unit)</td>
</tr>
<tr>
<td>Description</td>
<td>In order to gain insight on the medical doctors’ personal experience and opinion concerning the study. Designed by the researcher and administered to the doctors Approved by Coventry University, LSHSC and General Hospital Odan, Lagos State, Nigeria.</td>
</tr>
</tbody>
</table>

| Location | Approved by Coventry University, LSHSC and General Hospital Odan, Lagos State, Nigeria. |
Figure 6.2 Study data collection flow for PGHD Study-2

**Data ID 1:** Recruitment Phase
- Lasted 5 weeks from 20th January till 19th February 2016
- Collected the 53 participants profile & Pre HbA1c test result collected.

**Data ID 2:** PGHD Phase 2 Study - Participants Profile And Consent Sheet

**Data ID 3:** Internet-Based Diabetic Management System For PGHD Stud-2
- 3 months PGHD collection phase (Mon, Wed, Fri and uploads over the weekend
- Lasted 22 weeks from 25th January till 20th June 2016
- Continuous monitoring & follow-up by the 6 collaborating doctors

**Data ID 4:** Study completion phase from the 20th April till 31st May 2016 (7 weeks)
- Collected Post HbA1c, participants experience and PGHD-AM survey

**Data ID 5:** Participants Experience & PGHD-Acceptance Model Survey

**Data ID 6:** The 3 Months PGHD Study - Medical Doctors Experience & Opinion
- Collected this data from 8th of June till 15th of June (1 week)
6.2 Reliability Analysis of the Instrument: Pilot Study – Data ID 4

Just as was done with the measuring instruments in PGHD Study-1, it is pertinent to ensure through pre-test that the data collected from any study meet reliability requirements. This is achieved through pre-testing the study measuring instrument for reliability and validity of the data it is expected to collect. In the case of reliability, Cavana, Delahaye and Sekaran (2001) opined that reliability is the degree of goodness of measure given that the study measuring instrument is free from bias, and that findings from this study will remain unchanged even if the study is repeated in the future or with another sample. PGHD Study-2 applied the most used test of inter-item consistency reliability i.e. Cronbach’s coefficient alpha (Cronbach 1951; Nunnally 1979; Sekaran 2006).

As seen in Table 6.3, the Cronbach’s coefficient alpha for the pilot study with 17 separate respondents is presented (Data ID 4). According to Sekaran (2006), reliabilities score (internal consistencies) below 0.6 are regarded to be poor, while those from 0.7 and above are deemed acceptable, and those scoring over 0.8 are considered good. Although a score below 0.6 in explanatory research is deemed marginally acceptable, the general agreed Cronbach’s limit is 0.7 and the closer the coefficient gets to 1.0 the better (Robinson, Shaver and Wrightsman 1991; Sekaran 2006).

Table 6.3 Summary of Cronbach’s Alphas, Inter-Item Correlation and Item-to-Total Correlation Values in Pilot Study

<table>
<thead>
<tr>
<th>Measurement Items (Interval Scale)</th>
<th>Items</th>
<th>Cronbach’s Alpha</th>
<th>Reliability Results</th>
<th>Inter-Item Correlation</th>
<th>Item-to-Total Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participants Experience: Engagement</td>
<td>6</td>
<td>0.984</td>
<td>good</td>
<td>0.875–1.0</td>
<td>0.921 – 0.967</td>
</tr>
<tr>
<td>Participants Experience: Knowledge Gained</td>
<td>9</td>
<td>0.869</td>
<td>good</td>
<td>-0.15–0.883</td>
<td>0.313-0810</td>
</tr>
<tr>
<td>Participants Experience: Cultural Moderators</td>
<td>4</td>
<td>0.893</td>
<td>good</td>
<td>0.442-0.855</td>
<td>0.541-0.892</td>
</tr>
<tr>
<td>Perceived Usefulness (PU)</td>
<td>5</td>
<td>0.934</td>
<td>good</td>
<td>0.540-0.887</td>
<td>0.785-0.915</td>
</tr>
<tr>
<td>Perceived Ease of Use (PEOU)</td>
<td>4</td>
<td>0.901</td>
<td>good</td>
<td>0.795-0.938</td>
<td>0.872-0.944</td>
</tr>
<tr>
<td>Attitude/Usage Behaviour</td>
<td>3</td>
<td>0.897</td>
<td>good</td>
<td>0.849-0.905</td>
<td>0.845-0.919</td>
</tr>
<tr>
<td>Behaviour Intention</td>
<td>3</td>
<td>0.906</td>
<td>good</td>
<td>0.867-0.867</td>
<td>0.867-0.867</td>
</tr>
<tr>
<td>Social Influence (SI)</td>
<td>5</td>
<td>0.891</td>
<td>good</td>
<td>0.871-0.940</td>
<td>0.928-0.950</td>
</tr>
<tr>
<td>Self-Efficacy(SE)</td>
<td>4</td>
<td>0.901</td>
<td>good</td>
<td>0.960-0.986</td>
<td>0.975-0.981</td>
</tr>
<tr>
<td>Facilitating Conditions (FC)</td>
<td>4</td>
<td>0.941</td>
<td>good</td>
<td>0.951-0.986</td>
<td>0.960-0.991</td>
</tr>
<tr>
<td>Patient Data Security</td>
<td>5</td>
<td>0.921</td>
<td>good</td>
<td>0.950-0.983</td>
<td>0.973-0.987</td>
</tr>
</tbody>
</table>
For the PGHD Study-2 pilot study, Cronbach’ alpha values the for measured items were in the 0.8 to 1.0 range indicating the items in each set (construct) were positively correlated to one another and since this was higher than the ideal 0.70 score, all measured items were considered good and acceptable.

Asides from the Cronbach’ alpha, the inter-item and item-to-total correlations are also used to evaluate internal consistency (Streiner 2003; Hair et al. 2006). Robinson, Shaver and Wrightsman (1991) suggest that item-to-total correlations should exceed at least 0.50, while inter-item correlations should exceed 0.30. For the PGHD Study-2 pilot study, item-to-total correlation values all exceeded 0.5 except in the items that measured Participants Experience: Knowledge Gained. The inter-item correlation values also exceeded 0.3 (see Table 6.3) except for items in Participants Experience: Knowledge Gained. Overall, the entire listed values in Table 6.3 showing Cronbach’s alpha, inter-item correlation and item-to-total correlation suggest that the questionnaire used was a very reliable measuring tool.

6.3 Validity Analysis: Pilot Study – Validity of the Instrument
Streiner (2003) posits that validity is the degree a data collected truly represents the phenomenon it is investigating. It is an ongoing debate for most market research; if data collected for reaching conclusion truly reflects the opinion (attitudes and behaviour) of potential consumers - one way to assuage this debate is through validation and this applies to all forms of research (Ticehurst and Veal 2000). To reach validation, Sekaran (2006) suggested various types of validity tests for testing goodness of measures, such as content validity, construct validity and criterion-related validity.

6.3.1 Content Validity
Also known as face validity, it involves assessing items and the concept they aim to elicit information on through the response of experts. This was done for the PGHD Study-2 questionnaire items during the pre-test phase. All the questionnaires used in this study were sent over to the collaborating medical doctors for content validity. The effect of this on the final output meant that some questions were reworded, moved to measure other constructs or deemed irrelevant and as such deleted. Also, a pilot study consisting of 17 random persons was carried out (see Table 6.3) and this helped in the final design of all questionnaires used in this study.
### 6.3.2 Construct Validity

For this study, the application of construct validity affirmed how sound the data collected via the questionnaires used align with the theories and phenomenon they aimed to investigate. The establishment of construct validity can be reached through: (a) Factor analysis, (b) Correlational analysis (convergent and discriminant validity) and (c) The multitrait-multimethod matrix of correlations. Depending on suitability, it has also been argued that the most widely accepted types of validity are discriminant, nomological, and convergent validity (Campbell and Fiske 1959; Nunnally, Bernstein and Berge 1967; Churchill Jr 1979; Peter 1981). Zikmund (2003) suggests that convergent validity is also identical to criterion validity where items that are indicators of a particular construct are expected to commonly share a high degree of variance. As regards discriminant validity, Zikmund (2003) suggests that a measure has discriminant validity if it exhibits low correlation with measures of different constructs.

The construct validity carried out in this study comprised both convergent and discriminant validity and is presented in Table 6.3 - where the item-to-total correlations and inter-item correlation for the measuring tool (questionnaire) exceeded the ideal 0.50 and 0.30 ranges respectively. An exception to this was the construct *Participants Experience: Knowledge Gained* - which saw one item out of nine items measuring that construct not meeting the ideal 0.50 and 0.30 value. As a result of good Cronbach’s alpha value (reliability test), correlation values for all the constructs and overall positive results of the convergent validity of this pilot study, minor corrections were implemented to the questionnaire’s wording.

In Chapter 7, a more in-depth convergent validity and discriminant validity through exploratory factor analysis and confirmatory factor analysis were also used for establishing the PGHD acceptance model *Study-2 measurement validity*. 
6.4 PGHD Study-2 Demographic Data: Participants’ Profile - Population

Sekaran (2006) defined population in any research as all the groups of persons the researcher aims to investigate regarding a particular phenomenon. The study took place in the Department of Medicine, Endocrine Unit, General Hospital, Odan, Lagos State, Nigeria, from 20\textsuperscript{th} January till 15\textsuperscript{th} June 2016. The study population comprised diabetic outpatients who normally come for a scheduled appointment with their doctors every three months. The hospital is the first General hospital in Nigeria, established in 1893 and, as such remains amongst the most patronised by Lagos State residents (General Hospital Lagos 2013). There are over 4 million diabetics in Nigeria, which amounts to a national prevalence of 2.4%, and Lagos State is the most populous state in Nigeria with the highest number of diabetics in the country (International Diabetes Federation 2014; Fasanmade and Dagogo-Jack 2015: 822; The Guardian 2016). Given the paucity of data on the number of diabetic patients residing in Lagos State, likewise in the Lagos Island LGA the study took place; it was justified to adopt purposive sampling approach to represent the diabetic population after discourse with the involved medical doctors. A total of 53 diabetic patients were successfully recruited for the study which lasted 3 months for each patient. Also, 7 medical doctors were involved in the study and were responsible for dealing with the patients directly. The 7 doctors (1 senior consultant endocrinologist and 6 junior doctors) participated as they were the current doctors seeing the diabetic patients during the time of this study. It is to be noted that the primary subjects under investigation in this study were the diabetic patients.

6.4.1 PGHD Study-2 Sample Size

A sample is a subset of a population and Sekaran (2006) posits that in order to establish a true representativeness of a wider population, sample design and sample size must meet some criteria. Such criteria as proposed by Roscoe (1975) based on a rule of thumb are:

- Ideal sample sizes for most research should be larger than 30 and less than 500.
- If samples are to be distributed into categories, a minimum sample size of 30 for each category is ideal.
- In multivariate research, each sample size should be preferably 10 times larger than the number of variables in the study.

Unlike in PGHD Study-1 (n=1,443) where all the 20 Local Government Areas (LGAs) in the state were investigated for PGHD technology readiness, the sampling for this study was
purposively narrowed down to only 1 LGA due to the available time, fund and human resources.

While adopting a purposive sampling technique, a convenient sample of 53 random diabetic patients (33 females and 20 males) who met the selection criteria and voluntarily agreed to participate in this study constituted the primary participants for this PGHD Study-2. The participants were approached for the research on behalf of their doctors as they came for their regular follow-up meeting. The sampling selection criteria considered any individual: that must have been diagnosed for diabetes by a medical doctor, attends regular clinic appointments, is mentally sound to respond to questions and questionnaires, shows competency towards self-monitoring of their diabetes or willing to be taught by their doctors, and exhibits the ability for PGHD capture, and shares or is willing to make available a proxy. Most importantly, the participant must have shown great enthusiasm to voluntarily participate in the study without being incentivised. Prior to enlisting each participant, an enlightenment exercise was carried out by their doctor on what the study entailed and at the end of this, the doctors decided which participants met the inclusion criteria.

For the purpose of clarification, in healthcare terminology; a healthcare proxy is an advance medical directive usually in the form of a legal document that authorises another person (a proxy) to make health care decisions in case a person (the patient) is rendered incapable or unfit of making a decision or carrying out certain actions (MedicineNet.com 2016). The usage of the word patient proxy in this thesis falls under the context of this definition.

6.4.3 Participants Profile: Main Survey – Data ID 2
In order to gain insight of the 53 patients studied, Table 6.4 presents the distribution of the participants’ gender, age, body mass index (BMI), occupation, the local government where they reside, duration of each participant’s diabetes and their pre-HbA1c test result. Table 6.5 presents their diabetes self-monitoring habit and it is believed this will give an understanding of the participants’ self-monitoring habits prior to the study. Most of the parameters presented in Tables 6.4, 6.5 and 6.6 were captured as they set the baseline for the subsequent analyses that evaluates how significant regular PGHD capture and share benefited the participants and their doctors.
<table>
<thead>
<tr>
<th>Participant Unique ID.</th>
<th>Gender</th>
<th>Age (Years)</th>
<th>Age Diagnosed with DM (Years)</th>
<th>Duration of Participants Diabetes Mellitus (DM)</th>
<th>Weight (kg)</th>
<th>Height (m²)</th>
<th>BMI (kg/m²)</th>
<th>Pre-HbA1c Result</th>
<th>Occupation</th>
<th>LGA</th>
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<td>P1</td>
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<td>48</td>
<td>47</td>
<td>1 year</td>
<td>58kg</td>
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<td>19.2 kg/m²</td>
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<td>Lecturer</td>
<td>Ikorodu</td>
</tr>
<tr>
<td>P2</td>
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<td>6 years</td>
<td>101kg</td>
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<td>35.79 kg/m²</td>
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<td>Retiree</td>
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<td>46</td>
<td>2 years</td>
<td>100kg</td>
<td>1.59m</td>
<td>39.56 kg/m²</td>
<td>7.8%</td>
<td>Trader</td>
<td>Lagos-Island</td>
</tr>
<tr>
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<td>63</td>
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<td>75kg</td>
<td>1.7m</td>
<td>25.95 kg/m²</td>
<td>9.9%</td>
<td>Building contractor</td>
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<td>44.5</td>
<td>6 months</td>
<td>69kg</td>
<td>1.63m</td>
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<td>5.6%</td>
<td>Trader</td>
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<td>49</td>
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<td>39</td>
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<td>74kg</td>
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<td>26.53 kg/m²</td>
<td>10.3%</td>
<td>Trader</td>
<td>Lagos-Island</td>
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<td>56</td>
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<td>85kg</td>
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<td>32.79 kg/m²</td>
<td>12.4%</td>
<td>None</td>
<td>Eti-Osa</td>
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<td>14%</td>
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<td>51</td>
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<td>74kg</td>
<td>1.60m</td>
<td>28.91 kg/m²</td>
<td>6.9%</td>
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<td>P16</td>
<td>Female</td>
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<td>58</td>
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<td>71kg</td>
<td>1.55m</td>
<td>29.55 kg/m²</td>
<td>6.9%</td>
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<td>2 years</td>
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</tr>
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<td>55kg</td>
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<td>Technician</td>
<td>Kosofe</td>
</tr>
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<td>63</td>
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<td>Ajeromi-Ifelodun</td>
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<td>Eti-Osa</td>
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<td>56</td>
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<td>56kg</td>
<td>1.74m</td>
<td>18.5 kg/m²</td>
<td>9.1%</td>
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<td>Surulere</td>
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<td>43</td>
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<td>5.6%</td>
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<td>Weight</td>
<td>Height</td>
<td>BMI</td>
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<td>Surulere</td>
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<td>Housewife</td>
<td>Ikorodu</td>
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<tr>
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<td>44</td>
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<td>1.63m</td>
<td>29.73 kg/m²</td>
<td>8.5%</td>
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<td>31.16 kg/m²</td>
<td>8.3%</td>
<td>Trader</td>
<td>Lagos-Island</td>
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<tr>
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<td>1 year</td>
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<td>Badagry</td>
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<td>10.8%</td>
<td>Trading</td>
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<tr>
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<td>80kg</td>
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<td>5.6%</td>
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<td>Lagos-Island</td>
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<td>33</td>
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<td>64kg</td>
<td>1.52m</td>
<td>27.7 kg/m²</td>
<td>8.7%</td>
<td>Trader</td>
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<tr>
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<td>1.71m</td>
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<td>11.3%</td>
<td>Trader</td>
<td>Lagos-Island</td>
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<td>20.8 kg/m²</td>
<td>10.4%</td>
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<td>26</td>
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<td>1.78m</td>
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<td>14%</td>
<td>Cobbler</td>
<td>Lagos-Island</td>
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<td>16 years</td>
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<td>7.8%</td>
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<td>Lagos-Island</td>
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<td>48</td>
<td>2 months</td>
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<td>19.23 kg/m²</td>
<td>9.1%</td>
<td>Business man</td>
<td>Ikorodu</td>
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<td>36</td>
<td>10 years</td>
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<td>1.56m</td>
<td>36.57 kg/m²</td>
<td>11.7%</td>
<td>Business woman</td>
<td>Lagos-Island</td>
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<td>63</td>
<td>3 years</td>
<td>80kg</td>
<td>1.61m</td>
<td>30.86 kg/m²</td>
<td>5.3%</td>
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<td>Lagos-Island</td>
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<td>53</td>
<td>48</td>
<td>5 years</td>
<td>81kg</td>
<td>1.47m</td>
<td>37.48 kg/m²</td>
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<td>Trader</td>
<td>Mushin</td>
</tr>
<tr>
<td>P51</td>
<td>Female</td>
<td>83</td>
<td>78</td>
<td>5 years</td>
<td>68kg</td>
<td>1.56m</td>
<td>27.94 kg/m²</td>
<td>6.7%</td>
<td>Nil</td>
<td>Surulere</td>
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<td>34</td>
<td>33</td>
<td>1 year</td>
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<td>1.95m</td>
<td>18.67 kg/m²</td>
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<td>Apapa</td>
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<tr>
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<td>37</td>
<td>33</td>
<td>4 years</td>
<td>78kg</td>
<td>1.7m</td>
<td>26.99 kg/m²</td>
<td>9.4%</td>
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<td>Alimosho</td>
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Table 6.5 Summary of PGHD Study-2 Participants’ Profile: Main Survey

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<th>Mean Age at Diagnosis</th>
<th>Mean Duration of Participants with Diabetes (Years)</th>
<th>Mean Weight (kg)</th>
<th>Mean Height (m²)</th>
<th>Mean BMI (kg/m²)</th>
<th>Pre-HbA1c Result</th>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>53.4</td>
<td>48.1</td>
<td>5.3 years</td>
<td>76.75</td>
<td>1.643</td>
<td>28.5</td>
<td>8.84%</td>
</tr>
<tr>
<td>Minimum</td>
<td>21</td>
<td>21</td>
<td>1 month</td>
<td>41</td>
<td>1.40</td>
<td>14.33</td>
<td>5.3%</td>
</tr>
<tr>
<td>Maximum</td>
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<td>78</td>
<td>24 years</td>
<td>123</td>
<td>1.95</td>
<td>47.45</td>
<td>14%</td>
</tr>
<tr>
<td>Std. Deviation</td>
<td>12.7</td>
<td>11.1</td>
<td>5.4 years</td>
<td>18.07</td>
<td>0.11</td>
<td>7.3</td>
<td>2.4</td>
</tr>
</tbody>
</table>

As seen from Table 6.4, a total of 53 diabetic patients comprising of 33 (62.3%) females and 20 (37.7%) males were studied for 3 months. The mean age of the population studied was 53.4 ± 12.7 years, with a mean age at diagnosis for diabetes mellitus (DM) of 48.1 ± 11.1 years. The study population had a mean duration of DM 5.3 ± 5.4 years and amongst the 53 DM patients, 11 patients were newly diagnosed while the patient with the longest DM duration had been a diabetic for 24 years. The participants’ occupation was collected in order to have an idea of how diverse they were, and it did not influence the selection criteria process. From the local government area (LGA) distribution, Lagos-Island LGA had the highest number of participants (23 patients) while other LGAs were also fairly represented. The participants mean BMI was 28.5 ± 7.3 kg/m². The BMI is a value derived from the mass (weight) and height of an individual, and this was used as one of the clinical parameters to measure if at the end of the 3-month study, there was any significant effect on the participants BMI value as a result of PGHD sharing with their doctors. With an average BMI of 28.5 kg/m², the studied population is well over the normal range and could be regarded as being overweight (NHS 2016). Coincidentally, all the participants had type 2 DM and 52 out of the 53 patients at the time of study were outpatients, while only 1 diabetic patient was admitted to the hospital for another illness.

Also from Table 6.4, the participants’ glycated haemoglobin (HbA1c) data could be seen and this was carried out in a laboratory during the recruitment phase when it was obvious the patient would participate in the study. For this study, the participants’ pre-HbA1c test was carried out in order to measure the average amount of diabetic control over a period of 3 months before they got involved in the study. They were all informed that this test would be
repeated again at the end of the study. As a guideline, a non-diabetic HbA1c level ranges between 4.0-6.0%, and diabetic patients who manage to keep their level below 6.5% are regarded as having good glycemic control (Diabetes UK 2016). The mean HbA1c level for the studied population was at 8.84 ± 2.4% and though the lowest recorded HbA1c level was at 5.3%, the result happened to be that of a patient who at the time of the test was exhibiting good glycemic control. The highest HbA1c level recorded was 14%. Overall, the population of HbA1c level was higher than the recommended level during the recruitment phase. To see how this stands at the end of the 3 months study was amongst the reasons the participants’ HbA1c level was included as one of the clinical parameters to test how PGHD could impact their glycemic control.

### 6.4.4 PGHD Study-2: Participants’ Disposition to Self-Monitoring

Table 6.6 gives further insight into the participants’ disposition to continuous glucose monitoring (CGM), or their self-monitoring habit, as well as their ownership and usage ability of a glucometer. The table also sheds light on their previous knowledge of PGHD and how they all preferred to be contacted by their doctors during the study period.

#### Table 6.6 PGHD Study-2 Participants’ Disposition to Self-Monitoring

<table>
<thead>
<tr>
<th>Question</th>
<th>Response</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asides from fixed hospital appointments or spontaneous hospital visits, do you self-monitor your diabetes presently?</td>
<td>Yes</td>
<td>22 (42.3%)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>30 (57.7%)</td>
</tr>
<tr>
<td>Do you own a glucometer?</td>
<td>Yes</td>
<td>25 (47.2%)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>28 (52.8%)</td>
</tr>
<tr>
<td>Presently, can you use a glucometer?</td>
<td>Yes</td>
<td>42 (79.2%)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>11 (20.8%)</td>
</tr>
<tr>
<td>In the past, have you engaged or presently engage in any form of patient-generated health data sharing practice?</td>
<td>Yes, in the past</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Yes, presently</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>53 (100%)</td>
</tr>
<tr>
<td>How do you wish to be contacted?</td>
<td>Phone call</td>
<td>51 (96.2%)</td>
</tr>
<tr>
<td></td>
<td>SMS</td>
<td>1 (1.9%)</td>
</tr>
<tr>
<td></td>
<td>Email</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>All of the above</td>
<td>1 (1.9%)</td>
</tr>
</tbody>
</table>
From Table 6.6, 30 participants (57.7%), which is the majority of the studied population, did not carry out any form of self-monitoring of their DM condition, compared to 22 participants (42.3%) who did. This figure agreed to a great extent with the number of participants who answered Yes to owning a glucometer (25 participants) and the majority 28 participants who did not own one. To bridge this gap, this study facilitated the provision of a free glucometer and test-strips to all the participants as a means to enable them to carry out continuous glucose monitoring of their diabetes. A sizeable proportion of the participants (79.2%) acknowledged they could operate a glucometer, but in order to be certain, they were all shown how to use one during the recruitment phase by their doctors. When asked if they had been involved in any form of PGHD sharing, the result shown in Table 6.6 highlights their unawareness of PGHD and this further buttressed the need to investigate the population in order to see how significantly PGHD impacts on all the involved stakeholders.

Finally, their preferred medium for communication is shown in Table 6.6 and, not surprisingly given the population profile, they chose to be reached via phone calls. This was discussed with each patient and agreement was reached with their doctors on how they would be contacted for follow-up during the study period.

6.4.5 PGHD Study-2: Participants’ Compliance

To ensure positive compliance from the participants, as well making sure the study did not inconvenience them or their doctors’ workflow, an agreement was reached to have them capture their PGHDs on Mondays, Wednesdays and Fridays, and have the captured data uploaded to the internet-based diabetes management system (IBDMS) over the weekend. Assistance was provided to those who could not carry out the upload process themselves by having their doctor assist in helping them to upload their PGHD during the patient’s weekly follow-up call. As a result of constant monitoring of participants’ upload and weekly follow-up from the doctors, the study achieved an overall 68.2% compliance. This was regarded as a success given the difficulty in having patients and doctors commit to such a study over a 3-month period.

The baseline for the study compliance was worked out by calculating the expected amount of PGHD each patient was expected to upload each week (Monday, Wednesday and Friday = 3
PGHD uploads) $X$ (12 weeks or 3 months for the period the study was meant to last) $X$ (N=53, the total population involved with the study). i.e. (no. of PGHD uploads from a participant weekly) $X$ (study duration; 12 weeks) $X$ (N=53).

- 3 PGHD weekly $X$ 12 weeks $X$ 53 = 1,908 PGHD uploads.

Then, the 3 months study compliance based on PGHD uploads was derived by finding the percentage of the received uploads from the expected PGHD uploads.

\[
\begin{array}{c|c|c}\hline
\text{PGHD received:} & 1,302 & 100 \\
\hline
\text{PGHD Uploads expected:} & 1,908 & 1 \\
\hline
\end{array}
\]

\[
= 68.2\% \text{ PGHD Capture & Upload Compliance}
\]

The logic for the days of the week (Monday, Wednesday and Fridays) that were chosen for PGHD capture was due to the general knowledge of patients’ blood glucose fluctuations in the study environment. This was based on common lifestyles and hospital records associated with the environment of the population being studied, as suggested by the Chief Consulting endocrinologist in charge of the hospital department where the study took place.

Mondays were chosen as the participants will be getting off the weekend (Friday, Saturday and Sunday) indulge in food and drink, and as a result might have consumed so much sugar, alcohol or forgotten to take their medication due to other societal commitments.

Wednesdays were chosen as it was expected that midweek stress from work might affect the patients’ glycemic control.

Fridays were also chosen as this signified the end of the week and beginning of the weekend when patients with diabetes usually change their lifestyle as a result of weekend hobbies and other weekend engagements.
Figure 6.3 Study-2 actual PGHD Flow

Figure 6.3 illustrates the PGHD capture and share flow for the study. It starts with the patients capturing their PGHD on the agreed days with their doctors. This is then followed by weekend uploads for the weeks PGHD capture. Upload assistance is rendered to patients who requested for assistance by their doctors during the weekly follow-up session. Patients who don’t need assistance simply access the IBDMS via the unique link provided for the study. The patient’s doctor monitors compliance and analyses the patient’s PGHD upload. The whole process allows for a two-way communication with either patient or doctor in the case of any emergency from the patient or as observed from the patient’s uploaded PGHD by his or her doctor. The whole process allows the patient to keep his or her own personal record while enabling the patient’s doctor to integrate the most meaningful patient health data from the IBDMS to the patient’s formal hospital records.

6.4.6 PGHD Study-2 Upload Content

For the 3 months study that achieved a 68.2% PGHD capture and upload compliance, the clinical parameters studied by the doctors for each patient involved in the study included: diabetes types, anthropometry for their BMI (height and weight), blood pressure, chronic
complications of their diabetes, if any, and the treatment types they were receiving. These were observed both at the beginning and at the end of the study.

For the weekly PGHD capture and upload to the IBDMS, the PGHD analysed by the doctors included the participants’:

1. blood sugar level
2. dieting
3. medication adherence
4. physical exercise
5. other diabetic symptoms

6.4.6.1 Participants’ Blood Sugar Level Analysis

Each patient was advised to have their blood sugar level captured 2 hours before breakfast (fasting blood sugar) and 2 hours after breakfast (postprandial glucose test). The required procedures for the tests were shown to participants who couldn’t carry out the glucose tests prior to the study. All blood glucose tests uploaded as part of the participants’ patient-generated health data (PGHD) were confidential and only accessible to those who were involved with the study (the medical doctors and the researcher who made the IBDMS available). The medical doctors had access to the IBDMS and each doctor monitored and followed the progress of the patients under his or her care.

Results from the patients’ continuous glucose monitoring were not analysed in this study. The researcher’s interest for this data-set (continuous glucose monitoring levels) was to ensure that the patients had the ability to capture, share and receive feedback concerning their PGHD from their doctors. For the doctors, the researcher’s interest regarding the patients’ continuous glucose monitoring levels was to ensure that the doctors were able to monitor patient compliance, give feedbacks where and whenever needed, and to have the much-needed data required for patient-doctor shared decision making concerning the patient’s health.

6.4.6.2 Participants’ Dieting Analysis

Though the patients were advised on how best to diet while ensuring good glycemic control during the recruitment stage, the collection of this data enabled their doctors to monitor how
well they took this advice. Unlike the blood glucose that was captured for breakfast only due to available resources (test-strips), this data set involved the 53 diabetic patients’ daily dietary intake for the days they had to capture their PGHD (Mondays, Wednesdays and Fridays) throughout the duration of the study. Since the analysis of this data was only privy to the involved medical doctors, it wasn’t analysed in this study. Furthermore, the participants’ insights from adhering to dietary advice received from their doctor during the course of this study were amongst the measured items in the actual PGHD-AM survey.

6.4.6.3 Participants Medication Adherence Analysis
Medication adherence was amongst the PGHD shared by the patients with their doctors. The record of this data set was also privy to each patient’s assigned medical doctor given its sensitivity. Analysis of this data set was done on a weekly basis during the weekly follow-up sessions by the involved medical doctors and their assigned patients. Results from the medical doctors’ experience and opinion survey (Data ID 6) suggest that the ability to observe patients’ medication adherence retrospectively, improved (doctors’) understanding of their patients’ diabetes self-management. Table 6.7 presents the participants’ compliance to medication adherence as recorded by their uploaded PGHD.

6.4.6.4 Participants’ Physical Exercise Analysis
This data set was also privy to the doctors and was amongst the weekly follow-up discourse they had with their patients. Given the age (average age 53.4 years) and occupation of the studied sample, it was quite a difficult task convincing them to exercise. Frequency of the various forms of exercises that were bespoke to each participant was suggested by their assigned medical doctor and this formed the PGHD collected for this data set. Table 6.7 presents the participants’ compliance to physical exercise as recorded by their uploaded PGHD.

6.4.6.5 Participants’ Other Diabetes Symptoms Analysis
This data set consisted of all symptoms of hypoglycaemia and hyperglycaemia experienced by the participants during the study duration. This enabled them to keep a record of such episodes while allowing their doctors to stay abreast of such occurrences. This particular data set was very vital and was amongst the PGHD integrated into each patient’s hospital file.
Table 6.7 presents a summary of the participants’ episodic symptoms of hypoglycaemia and hyperglycaemia as recorded by their uploaded PGHD.

### Table 6.7 Basic Summary of PGHD Upload Content

<table>
<thead>
<tr>
<th>PGHD item</th>
<th>Response option</th>
<th>No. of PGHD uploaded for the item</th>
<th>Total uploaded for the item</th>
<th>Expected PGHD Upload for the item</th>
<th>Participants compliance %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did I take all my medication today and as at when due</td>
<td>Yes</td>
<td>1103</td>
<td>1153</td>
<td>1908</td>
<td>60.4%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>50</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did I take my medication at the right time today</td>
<td>Yes</td>
<td>1210</td>
<td>1231</td>
<td>1908</td>
<td>64.5%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>21</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Any other unrelated medication taken today</td>
<td>Yes</td>
<td>71</td>
<td>1163</td>
<td>1908</td>
<td>61%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1092</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did I have any form of physical exercise today</td>
<td>Yes</td>
<td>148</td>
<td>1198</td>
<td>1908</td>
<td>62.8%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1037</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I couldn't because I wasn't feeling well today</td>
<td>13</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>I couldn't because of my disability</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Have you had symptoms of low blood sugar level</td>
<td>Yes</td>
<td>18</td>
<td>1242</td>
<td>1908</td>
<td>65.1%</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>1224</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

From table 6.7, it could be deduced that the average compliance for most of the PGHD uploads not deemed too sensitive for the researcher to analyse fell within the compliance range of 60-65%. From the general PGHD upload compliance (68.2%) presented in section 6.4.5, it could be assumed that more than half of the studied population complied with PGHD.
upload. Numerous reasons were given by participants who couldn’t keep up with regular PGHD capture and uploads; amongst the most given reasons were either due to patient travelling or some participants running out of test-strips and not being keen on getting replacements. Overall, the doctors involved with the study agreed that the nature of the study design improved compliance when compared to their previous experience with patients they had given advice to adopt continuous glucose monitoring (self-monitoring) within the study environment. A full copy of the PGHD captured items is seen in the Appendix 6.1.

6.6 Participants Post-Study Personal Experience

Table 6.8 presents results from Data ID 5 and this consisted of various experiences gained by the participants over the study duration. These experiences (5 constructs) include their (patients) disposition to how they reported and got feedback on hypoglycaemia and hyperglycaemia symptoms, how engaged they felt with the study, experience on knowledge gained as a result of the study, how compliant they believed they were with the study and if certain cultural moderators influenced their participation with the PGHD study. Aside from participants’ post–study experience on constructs measuring hypoglycaemia and hyperglycaemia symptoms (measured by Yes or No) and PGHD capture compliance (measured by True or False), the 3 remaining constructs were measured on a 7-point Likert scale. Conclusion was reached on each of the 3 constructs measuring study engagement, knowledge gained and impact of PGHD on cultural moderators on the strength of their mean score. For participants’ post-study experience on constructs measuring hypoglycaemia and hyperglycaemia symptoms and PGHD capture compliance, conclusion was reached on the strength of the respondents’ percentage response.
<table>
<thead>
<tr>
<th>Construct</th>
<th>Item Response</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1a. Participants’ post-study experience: Hypoglycaemia</strong></td>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
</tr>
<tr>
<td><strong>Item 1. Did you have any hypoglycaemia symptoms over the course of the 3 months study? (n=53)</strong></td>
<td>10 (18.9%)</td>
<td>43 (81.1%)</td>
</tr>
<tr>
<td><em><em>Item 2. Did you capture and upload them over the IBDMS-PGHD platform? (n</em>=10)</em>*</td>
<td>10 (100%)</td>
<td>0</td>
</tr>
<tr>
<td><em><em>Item 3. Do you believe your constant monitoring and keeping in-touch with your doctor ensured the episode was promptly addressed and managed? (n</em>=10)</em>*</td>
<td>10 (100%)</td>
<td>0</td>
</tr>
<tr>
<td><strong>1b. Participants’ post-study experience: Hyperglycaemia</strong></td>
<td><strong>Yes</strong></td>
<td><strong>No</strong></td>
</tr>
<tr>
<td><strong>Item 1. Did you have any hyperglycaemia symptoms over the course of the 3 months study? (n=53)</strong></td>
<td>22 (41.5%)</td>
<td>31 (58.5%)</td>
</tr>
<tr>
<td><strong>Item 2. Did you capture and upload them over the IBDMS-PGHD platform? (n=22)</strong></td>
<td>22 (100%)</td>
<td>0</td>
</tr>
<tr>
<td><strong>Item 3. Do you believe your constant monitoring and keeping in-touch with your doctor ensured the episode was promptly addressed and managed? (n*22)</strong></td>
<td>22 (100%)</td>
<td>0</td>
</tr>
<tr>
<td><strong>2. Participant’s Experience: PGHD Capture Compliance &amp; Challenges</strong></td>
<td><strong>True</strong></td>
<td><strong>False</strong></td>
</tr>
<tr>
<td><strong>Item 1. At the early stage, I could not operate my glucometer even after the initial usage demonstration. (n=53)</strong></td>
<td>9 (17%)</td>
<td>44 (83%)</td>
</tr>
<tr>
<td>Item 2.</td>
<td>I couldn’t operate my glucometer because it malfunctioned. (n=53)</td>
<td>5 (9.4%)</td>
</tr>
<tr>
<td>---------</td>
<td>---------------------------------------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>Item 3.</td>
<td>I misplaced my glucometer</td>
<td>0</td>
</tr>
<tr>
<td>Item 4.</td>
<td>I ran out of test strips</td>
<td>22 (41.5%)</td>
</tr>
<tr>
<td>Item 5.</td>
<td>At some point, I couldn’t reach my doctor</td>
<td>8 (15.1%)</td>
</tr>
<tr>
<td>Item 6.</td>
<td>At some point, I travelled and could not comply with the study while away</td>
<td>4 (7.5%)</td>
</tr>
<tr>
<td>Item 7.</td>
<td>I was eager to resolve on my own - any PGHD capture and sharing challenges faced during the duration of the study in order to ensure compliance</td>
<td>53 (100%)</td>
</tr>
<tr>
<td>Item 8.</td>
<td>Loss of interest</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>3. Participant's Experience: Study Engagement</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Item 1.</th>
<th>During the study recruitment stage, I clearly understood what the study entailed and what was expected from all parties involved. (n=53)</th>
<th>Strongly Disagree (1)</th>
<th>Quite Disagree (2)</th>
<th>Slightly Disagree (3)</th>
<th>Neutral (4)</th>
<th>Slightly Agree (5)</th>
<th>Quite Agree (6)</th>
<th>Strongly Agree (7)</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6 (11.3%)</td>
<td>47 (88.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.89</td>
</tr>
<tr>
<td>Item 2.</td>
<td>I felt fully engaged with the study from inception till conclusion. (n=53)</td>
<td>1 (1.9%)</td>
<td>5 (9.4%)</td>
<td>47 (88.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.87</td>
</tr>
<tr>
<td>Item 3.</td>
<td>I was satisfied with the level of follow-up by the medical doctor. (n=53)</td>
<td>1 (1.9%)</td>
<td>5 (9.4%)</td>
<td>47 (88.7%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.81</td>
</tr>
<tr>
<td>Item 4.</td>
<td>I believe I was properly empowered to participate in this study. (n=53)</td>
<td>1 (1.9%)</td>
<td>11 (20.8%)</td>
<td>41 (77.4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.75</td>
</tr>
<tr>
<td>Item 5.</td>
<td>I received sufficient all-round support</td>
<td>1 (1.9%)</td>
<td>11 (20.8%)</td>
<td>41 (77.4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.75</td>
</tr>
</tbody>
</table>
during the course of the study. \( (n=53) \)

**Item 6.** I adequate all-round guidance during the course of the study. \( (n=53) \)

<table>
<thead>
<tr>
<th>Strongly Disagree (1)</th>
<th>Quite Disagree (2)</th>
<th>Slightly Disagree (3)</th>
<th>Neutral (4)</th>
<th>Slightly Agree (5)</th>
<th>Quite Agree (6)</th>
<th>Strongly Agree (7)</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (1.9%)</td>
<td>11 (20.8%)</td>
<td>39 (77.4%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>6.71</td>
</tr>
</tbody>
</table>

### 4. Participant's Experience: Knowledge Gained

<table>
<thead>
<tr>
<th>Item 1.</th>
<th>I am now more informed of my lifestyle due to awareness and shared responsibility associated with continuous monitoring and correspondence of my PGHD with my medical doctor. ( (n=53) )</th>
<th>1 (1.9%)</th>
<th>2 (3.8%)</th>
<th>50 (94.3%)</th>
<th>6.92</th>
</tr>
</thead>
<tbody>
<tr>
<td>Item 2.</td>
<td>I am now better informed about PGHD capture, proper utilization and ownership. ( (n=53) )</td>
<td>1 (1.9%)</td>
<td>6 (11.3%)</td>
<td>46 (86.8%)</td>
<td>6.85</td>
</tr>
<tr>
<td>Item 3.</td>
<td>I am now more interested in capturing my PGHD giving its potential health benefits</td>
<td>1 (1.9%)</td>
<td>3 (5.7%)</td>
<td>49 (92.5%)</td>
<td>6.91</td>
</tr>
<tr>
<td>Item 4.</td>
<td>I am now more open to learn how to use various health information technology tools to capture and share my PGHD. ( (n=53) )</td>
<td>2 (3.8%)</td>
<td>2 (3.8%)</td>
<td>49 (92.5%)</td>
<td>6.89</td>
</tr>
<tr>
<td>Item 5.</td>
<td>My acquired experience from this study would influence me to continuously capture and share my PGHD with my doctor. ( (n=53) )</td>
<td>1 (1.9%)</td>
<td>4 (7.5)</td>
<td>48 (90.6%)</td>
<td>6.89</td>
</tr>
<tr>
<td>Item 6.</td>
<td>The frequency of communication with my doctor has improved as a result of my PGHD sharing. ( (n=53) )</td>
<td>1 (1.9%)</td>
<td>2 (3.8%)</td>
<td>50 (94.3%)</td>
<td>6.92</td>
</tr>
<tr>
<td>Item 7.</td>
<td>There is an added benefit to my health as a result of frequent communication with my doctor. ( (n=53) )</td>
<td>1 (1.9%)</td>
<td>2 (3.8%)</td>
<td>50 (94.3%)</td>
<td>6.92</td>
</tr>
<tr>
<td>Item 8.</td>
<td>My openness towards discussing my diabetes with my doctor has improved. ( (n=53) )</td>
<td>1 (1.9%)</td>
<td>2 (3.8%)</td>
<td>50 (94.3%)</td>
<td>6.92</td>
</tr>
<tr>
<td>Item 9.</td>
<td>I would be eager to share my PGHD usage</td>
<td>1 (1.9%)</td>
<td>2 (3.8%)</td>
<td>50 (94.3%)</td>
<td>6.92</td>
</tr>
</tbody>
</table>
Participants' Experience: PGHD Influence on Cultural Moderators.

<table>
<thead>
<tr>
<th>Item</th>
<th>Statement</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Item 1.</strong> I am better informed on the need to speak with my doctor instead of self-medicating. (n=53)</td>
<td>2 (3.8%)</td>
<td>51 (96.2%)</td>
</tr>
<tr>
<td><strong>Item 2.</strong> I would most likely seek information from my doctor regarding the composition, suitability, dosage and impact of any local herbs (traditional medication) before taking it. (n=53)</td>
<td>2 (3.8%)</td>
<td>51 (96.2%)</td>
</tr>
<tr>
<td><strong>Item 3.</strong> I am more informed and eager to understand my health needs instead of leaving it to chance and faith. (n=53)</td>
<td>3 (5.7%)</td>
<td>50 (94.3%)</td>
</tr>
<tr>
<td><strong>Item 4.</strong> I should be as involved as my doctor is in trying to understand the justification behind clinical decisions made regarding my health. (n=53)</td>
<td>3 (5.7%)</td>
<td>50 (94.3%)</td>
</tr>
</tbody>
</table>

Constructs 3, 4 & 5 Summary

<table>
<thead>
<tr>
<th>Constructs 3, 4 &amp; 5 Summary</th>
<th>No. of Items</th>
<th>Construct Scoring</th>
<th>Overall Mean</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construct 3: Participant's Experience: Study Engagement</strong></td>
<td>6</td>
<td>Strongly Disagree 1</td>
<td>Strongly unengaged</td>
<td>6.82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quite Disagree 2</td>
<td>Quite unengaged</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slightly Disagree 3</td>
<td>Slightly unengaged</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neutral 4</td>
<td>Neutral</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slightly Agree 5</td>
<td>Slightly engaged</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quite Agree 6</td>
<td>Quite engaged</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strongly Agree 7</td>
<td>Strongly engaged</td>
<td></td>
</tr>
<tr>
<td>Constructs 3, 4 &amp; 5 Summary</td>
<td>No. of Items</td>
<td>Construct Scoring</td>
<td>Overall Mean</td>
<td>Result</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>--------------</td>
<td>-------------------</td>
<td>--------------</td>
<td>--------</td>
</tr>
<tr>
<td><strong>Construct 4: Participant's Experience: Knowledge Gained</strong></td>
<td>9</td>
<td>Strongly Disagree 1</td>
<td>Strongly, no knowledge gained</td>
<td>6.90 (no. of items = 9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quite Disagree 2</td>
<td>Quite no knowledge gained</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slightly Disagree 3</td>
<td>Slightly, no knowledge gained</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neutral 4</td>
<td>Neutral</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slightly Agree 5</td>
<td>Slight knowledge gained</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quite Agree 6</td>
<td>Quite some knowledge gained</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strongly Agree 7</td>
<td>Very strong knowledge gained</td>
<td></td>
</tr>
<tr>
<td><strong>Construct 5: Participant's Experience: PGHD influence on Cultural Moderators (CM).</strong></td>
<td>4</td>
<td>Strongly Disagree 1</td>
<td>CM strongly not influenced by PGHD</td>
<td>6.95 (no. of items = 4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quite Disagree 2</td>
<td>CM quite not influenced by PGHD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slightly Disagree 3</td>
<td>CM slightly not influenced by PGHD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Neutral 4</td>
<td>Neutral</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Slightly Agree 5</td>
<td>CM slightly influenced by PGHD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quite Agree 6</td>
<td>CM quite influenced by PGHD</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Strongly Agree 7</td>
<td>CM strongly influenced by PGHD</td>
<td></td>
</tr>
</tbody>
</table>
As could be seen from Table 6.8, all the items measuring the 5 constructs that were used to investigate the participants’ post-study experience showed that for construct 1; Participants’ post-study experience: Hypoglycaemia and hypoglycaemia - there was adequate report of hypoglycaemia and hyperglycaemia symptoms. The result also showed that for the 10 participants who reported on hypoglycaemia and 22 participants who reported on hyperglycaemia, a 100% feedback response was obtained when asked if their doctors ensured correspondence. Also, participants who had the low or high sugar level symptoms, totally agreed that constant monitoring and keeping in-touch with their doctors via PGHD uploaded to the IBDMS ensured the episodes were promptly addressed and managed.

For construct 2: Participant's Experience: PGHD Capture Compliance & Challenges – although there were certain challenges that hindered compliance for some of the participants, all of them agreed that they were still keen to resolve the issues that could have impeded their compliance with their PGHD capture and upload. The study recorded 100% no loss of interest and this could be attributed to the extent of unique tailoring of the study design to fit each participant, adequate facilitation to enable them to capture and share their PGHDs and weekly medical doctor follow-ups arranged for each patient by their doctor.

For construct 3 measuring: Participant's Experience: Study Engagement – the average mean score from the 6 items was 6.82 on a 7-point Likert scale and this implied that they were strongly engaged. Ensuring that they were all properly engaged throughout the 3-month study duration in no small measure yielded success of the study and this was all due to the unique approach of considering the study sample and how both their environment and hospital organisation could interact to bring out the best dedication in all involved stakeholders in the study. Lessons learnt from this particular construct informed on the PGHD adoption framework which this study aims to deliver.

For construct 4 measuring: Participant's Experience: Knowledge Gained - the average mean score from the 9 items was 6.90 on a 7-point Likert scale and this implied that Very Strong knowledge was gained by the studied population. Devising measures to manage and transfer this gained knowledge by the participating patients and the collaborating medical doctors formed the basis of the knowledge management chapter in this research.
For construct 5 measuring: *Participant's Experience: PGHD influence on Cultural Moderators* - the average mean score from the 4 items was 6.95 on a 7-point Likert scale and this implied that common cultural moderators shared within the studied population was *strongly influenced by PGHD study*. Common practice of self-medicating, self-administration of traditional medicine without dosage instruction or knowledge of side effects, leaving medical decisions to faith and a nonchalant attitude towards understanding decisions made by the doctor regarding their health had been strongly impacted upon by the knowledge and usage of PGHD. Decisions reached from this preliminary analysis were based on the strength of the results obtained and further analysis was carried out to see how the other measured variables wholly agreed with the presented data.

### 6.7 Comparing Pre- and Post-HbA1c and Pre-BMI results

As one of the clinical parameters used to measure the impact of PGHD on the participants’ diabetes management as seen from their HbA1c level and their body mass index (BMI), the post-study HbA1c level and BMI result are presented in Table 6.9 and comparison made with the pre-study HbA1c level and BMI result. All clinical results obtained for this study were unlinked from the patients prior to being communicated to the researcher. The authenticity and validity of the results is based on the fact that they were captured by the collaborating medical doctors after which the patients’ identities were anonymised before the raw data passed onto the researcher.

<table>
<thead>
<tr>
<th></th>
<th>HbA1c (n=53)</th>
<th>BMI (n=53)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-Study Result</strong></td>
<td>8.84%</td>
<td>28.5 (kg/m²)</td>
</tr>
<tr>
<td><strong>Post-Study Result</strong></td>
<td>7.39%</td>
<td>28.4 (kg/m²)</td>
</tr>
<tr>
<td><strong>Observed Difference</strong></td>
<td>1.45%</td>
<td>0.1(kg/m²)</td>
</tr>
</tbody>
</table>

Results from Table 6.9 show a remarkable reduction in the participants’ HbA1c level from an average mean count of 8.84% (pre-study level) to 7.39% (post-study level). Although the 53 participants’ post-study mean HbA1c level didn’t meet the stipulated 6.5% level for a diabetic patient with good glycemic control (Diabetes UK 2016), a 1.45% reduction from the initial
level is an improvement. There was no significant improvement on the participants’ BMI as the initial mean BMI of 28.5 (kg/m\(^2\)) was not different from the mean post study BMI 28.4 (kg/m\(^2\)) result.

6.8 Chapter Summary
Insights have been shed on the participants’ profile, pre- and post-study opinions and experiences, as well as evident improvement on their HbA1c level as seen from the presented data in Table 6.9. Descriptively, the 3-month PGHD study data on the medical doctors’ experience and opinion is presented in Appendix 6.1. The next Chapter delivers the study-2: PGHD-acceptance modelling and testing of the research hypotheses carried out through structural equation modelling.
CHAPTER 7: STUDY-2 PGHD-ACCEPTANCE MODELLING

The previous Chapter was a preliminary data analysis of Study-2, detailing the content and construct validity, the study demographics and definition of all data sets collected from every stakeholder involved in the study. Also presented in the previous chapter were the 53 diabetic patients’ (participants’) anonymised health profile and their post-study experience. Having yet to explain the rationale behind the participants’ usage and behaviour intention, this chapter investigates and presents significant determinants influencing their behaviour. It is believed that these determinants are expected to play significant roles towards explaining the participants’ usage and behaviour intention towards PGHD.

To provide answers to the pending questions, the proposed PGHD acceptance model (see Chapter 5, Figure 5.2) is tested and modified in consideration of goodness of fit of the model to data. Subsequently, a fitting model of PGHD acceptance is generated. It is expected that with the interpretation of the PGHD-acceptance model generated, there will be better understanding of diabetic patients’ actual usage of PGHD, roles played by all stakeholders and processes involved, promotion of PGHD use within the study area, as well as the requirements to be met towards the realisation of a validated PGHD adoption framework for Lagos State Nigeria. Also, it is expected that this empirical evidence will make the much-needed data and literature lacking within the study area available for both academics, healthcare practitioners in Nigeria and other interested institutions.

This chapter starts by investigating how reliable and valid the research constructs are through the application of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) so as to establish convergent and discriminant validity of the PGHD-AM research constructs. The causal analysis of the PGHD-AM research model is carried out through structural equation modelling (SEM), which is a multivariate statistical analysis technique used in analysing structural relationships. Hair et al. (2006) suggested that analysing the predictors, which are the causal relationships of determinants and behaviour, could be best carried out through SEM. This is because SEM enables its users to build appropriate models that are unlike normal multivariate statistics or multiple regression models. SEM was carried out using the SPSS AMOS 24.0 software and this was as a result of its usability - allowing users to postulate,
assess, re-assess and produce models in a most natural form through path diagrams that can show hypothesised relationships amongst variables (Arbuckle 2005; 2010).

### 7.1 Constructs of the Research Model

The research model being proposed consists of eight latent constructs. Capaldi and Patterson (2012) opine that latent constructs can only be measured or represented by one or more variables (indicators) since they cannot be measured directly. For the model, observed or measured variables were questionnaire items obtained from responses of the 53 diabetic patients in this Study-2, and they represented the indicators associated with each latent construct.

Six out of the eight latent constructs were exogenous constructs, while the remaining two were endogenous constructs. Hair et al. (2006) differentiated between exogenous and endogenous constructs through their varying degree of independence and dependence. While exogenous constructs are multi-item equivalents of independent variables that cannot be affected by any other construct in the model, endogenous constructs are the opposite. The reviewed literature was the basis for reaching a consideration as to which item belongs to each specific latent construct. Table 7.1 presents the 8 constructs and the corresponding number of items measuring them, the codes representing them as well as definitions of each construct. EFA and CFA are carried out towards establishing the goodness of fit of data measuring the eight constructs. By applying the aforementioned two-step approach, the likelihood of having the complexities associated with a poor model fit is highly reduced (Hox 1995).

<table>
<thead>
<tr>
<th>Construct</th>
<th>No. of Items</th>
<th>Items</th>
<th>Construct Code</th>
<th>Construct Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>5</td>
<td>pu1-pu5</td>
<td>PU</td>
<td>Perceived usefulness</td>
</tr>
<tr>
<td>2*</td>
<td>4</td>
<td>peou1-peou4</td>
<td>PEOU</td>
<td>Perceived ease of use</td>
</tr>
<tr>
<td>3*</td>
<td>4</td>
<td>fc1-fc4</td>
<td>FC</td>
<td>Facilitating conditions</td>
</tr>
<tr>
<td>4*</td>
<td>5</td>
<td>si1-si5</td>
<td>SI</td>
<td>Social influence</td>
</tr>
<tr>
<td>5*</td>
<td>4</td>
<td>se1-se4</td>
<td>SE</td>
<td>Self-efficacy</td>
</tr>
<tr>
<td>6*</td>
<td>5</td>
<td>pds1-pds5</td>
<td>PDS</td>
<td>Patient data security</td>
</tr>
<tr>
<td>7**</td>
<td>3</td>
<td>pghdusb1-pghdusb3</td>
<td>PGHD_USB</td>
<td>PGHD actual usage behaviour</td>
</tr>
<tr>
<td>8**</td>
<td>3</td>
<td>pghdbi1-pghdbi3</td>
<td>PGHD_BI</td>
<td>PGHD behaviour intention</td>
</tr>
</tbody>
</table>

* = Exogenous Latent Construct  ** = Endogenous Latent Construct
Altogether, 33 items measured the eight constructs (27 items measuring six exogenous constructs and 6 items measuring two endogenous constructs) as seen in Table 7.1.

7.2 Construct Reliability and Validity of the Research Model

Having pre-established to an extent the reliability and validity of the measurement scale from the result shown in the PGHD-AM pilot-study in Table 6.3, in-depth construct reliability and validity results of the actual data collected during the PGHD-AM study are presented in this section. Since reliability demonstrates consistency of measurements, it was pertinent to measure internal consistencies of all involved 8 constructs. By capturing the extent of a measure as implied by its common latent construct, one is able to estimate the parameters of a model (Anderson and Gerbing 1988; Hooper, Coughlan and Mullen 2008).

First, it was necessary to report the squared multiple correlations (SMC) of the items before presenting results obtained from the convergent and discriminant validity through EFA and CFA. The SMC is as an item reliability coefficient that measures the correlation between a distinct variable and the construct it aims to measure. The SMC value is realised by squaring the standardised loading of an indicator. Highlighting with an example, if the standardised loading for an observed variable happens to be 0.90, then the equivalent SMC is 0.81 with an error variance of 0.19 consequently. Ideally, the SMC of a good observed variable should exceed 0.50, though SMC of 0.30 is still acceptable (Cunningham 2008).

Looking at Table 7.2, most SMCs of the 27 observed variables (indicators) belonging to the six exogenous latent constructs (PU, PEOU, SE, SI, FC, and PDS) exceeded 0.50 - implying good and acceptable reliability of indicator variables. Only four indicators were considered to have values below the 0.50 threshold and were deleted in order to improve the model fit to the data, leaving a total of 23 indicators. The deleted indicators include; pu5 = 0.437, se4 = 0.474, si4 =, 0.404, si5 = 0.474 (see Table 7.2 in bold). It could also be seen that after the deletion of indicators with SMC estimates below 0.50, their respective constructs Cronbach’s alpha value improved. One indicator (fc3 = 1.009*) had an SMC estimate greater than 1, and was interpreted with caution as the SEM analysis progressed.
Table 7.2 Squared Multiple Correlations for indicators in Six Exogenous Constructs

<table>
<thead>
<tr>
<th>Construct Items</th>
<th>SMC Estimate (before deletion)</th>
<th>SMC Estimate (after deletion)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pu1</td>
<td>.828</td>
<td>.815</td>
</tr>
<tr>
<td>pu2</td>
<td>.761</td>
<td>.760</td>
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<tr>
<td>pu3</td>
<td>.919</td>
<td>.943</td>
</tr>
<tr>
<td>pu4</td>
<td>.772</td>
<td>.753</td>
</tr>
<tr>
<td>pu5</td>
<td>.437</td>
<td>-</td>
</tr>
<tr>
<td>Cronbach’s alpha: PU</td>
<td>.934</td>
<td>.946</td>
</tr>
<tr>
<td>peou1</td>
<td>.533</td>
<td>.533</td>
</tr>
<tr>
<td>peou2</td>
<td>.759</td>
<td>.757</td>
</tr>
<tr>
<td>peou3</td>
<td>.825</td>
<td>.827</td>
</tr>
<tr>
<td>peou4</td>
<td>.682</td>
<td>.683</td>
</tr>
<tr>
<td>Cronbach’s alpha: PEOU</td>
<td>.901</td>
<td>.901</td>
</tr>
<tr>
<td>se1</td>
<td>.844</td>
<td>.893</td>
</tr>
<tr>
<td>se2</td>
<td>.846</td>
<td>.813</td>
</tr>
<tr>
<td>se3</td>
<td>.619</td>
<td>.587</td>
</tr>
<tr>
<td>se4</td>
<td>.474</td>
<td>-</td>
</tr>
<tr>
<td>Cronbach’s alpha: SE</td>
<td>.901</td>
<td>.905</td>
</tr>
<tr>
<td>si1</td>
<td>.799</td>
<td>.814</td>
</tr>
<tr>
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<td>si3</td>
<td>.887</td>
<td>.897</td>
</tr>
<tr>
<td>si4</td>
<td>.404</td>
<td></td>
</tr>
<tr>
<td>si5</td>
<td>.474</td>
<td></td>
</tr>
<tr>
<td>Cronbach’s alpha: SI</td>
<td>.891</td>
<td>.949</td>
</tr>
<tr>
<td>fc1</td>
<td>.697</td>
<td>.677</td>
</tr>
<tr>
<td>fc2</td>
<td>.891</td>
<td>.944</td>
</tr>
<tr>
<td>fc3</td>
<td>1.009*</td>
<td>1.009*</td>
</tr>
<tr>
<td>fc4</td>
<td>.641</td>
<td>.602</td>
</tr>
<tr>
<td>Cronbach’s alpha: FC</td>
<td>.941</td>
<td>.941</td>
</tr>
<tr>
<td>pds1</td>
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<td>.782</td>
</tr>
<tr>
<td>pds3</td>
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<td>.685</td>
</tr>
<tr>
<td>pds4</td>
<td>.685</td>
<td>.687</td>
</tr>
<tr>
<td>pds5</td>
<td>.642</td>
<td>.642</td>
</tr>
<tr>
<td>Cronbach’s alpha: PDS</td>
<td>921</td>
<td>.921</td>
</tr>
</tbody>
</table>

- 27 indicators before deletion. 23 indicators after deletion
All SMC estimates for the 6 indicators under the two endogenous latent constructs showed values above the 0.50 threshold as seen in Table 7.3. For item reliability, Cronbach’s alpha for the two endogenous constructs were quite good, with ranges from .897 to .906.

Table 7.3 SMC for 6 indicators in Two Endogenous Constructs

<table>
<thead>
<tr>
<th>Construct Items</th>
<th>SMC Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>pghd_usb1</td>
<td>.803</td>
</tr>
<tr>
<td>pghd_usb2</td>
<td>.890</td>
</tr>
<tr>
<td>pghd_usb3</td>
<td>.565</td>
</tr>
<tr>
<td><em>Cronbach’s Alpha: PGHD-USB</em></td>
<td>.897</td>
</tr>
<tr>
<td>pghd_bi1</td>
<td>.751</td>
</tr>
<tr>
<td>pghd_bi2</td>
<td>.856</td>
</tr>
<tr>
<td>Pghd_bi3</td>
<td>.690</td>
</tr>
<tr>
<td><em>Cronbach’s Alpha: PGHD-BI</em></td>
<td>.906</td>
</tr>
</tbody>
</table>

7.2.1 Convergent and Discriminant Validity – Exploratory Factor Analysis (EFA)

To establish construct validity, it is relevant to show the convergence and discrimination within observed variables measuring specific constructs. Convergent validity is established if two similar constructs agree with each other, while discriminant validity relates to the ease of differentiation between two constructs that are not supposed to be related (Campbell and Fiske 1959). In ensuring the convergent and discriminant validity of the measured variables, exploratory factor analysis (EFA) was carried out and there were eight factor loadings. EFA is a multivariate technique and a type of factor analysis that aims to identify causal relationships between measured variables within a scale (Norris and Lecavalier 2010; Fabrigar et al. 1999). According to Fabrigar et al. (1999), factor loadings in SEM are numerical values that indicate the direction and strength of a factor within a measured variable. In other words, factor loading indicates how strong a specific factor affects the measured variable and is a good test for convergent and discriminant validity. Maximum likelihood extraction was used due to its ability to enable researchers to calculate various indices of goodness of fit of a model (Cudeck and O’Dell 1994).
To show evidence of good convergence within the variables observed and how they related to each other, all items loaded without cross-loadings on their respective factor in Table 7.4. Having stated that the PGHD-AM research model consisted of eight constructs (6 exogenous and 2 endogenous constructs), the eight factor loadings showed that each variable identified with its common factor (construct) in Table 7.4.

Table 7.4 Exploratory Factor Analysis Loadings for PGHD-AM Variables

<table>
<thead>
<tr>
<th>Pattern Matrixa</th>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>pu1</td>
<td>.897</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>.866</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>pu3</td>
<td>.975</td>
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<td>pu4</td>
<td>.833</td>
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<td>peou1</td>
<td>.732</td>
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<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
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<td>.784</td>
<td></td>
</tr>
</tbody>
</table>

Extraction Method: Maximum Likelihood.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 6 iterations.
For evidence of adequacy, the cumulative percentage of variance as explained by the eight components (constructs) was 80.52%, indicating a good fit based on Lin and Hsieh’s (2005) study. As evidence for convergent validity seen in the EFA pattern matrix (see Table 7.4), all loadings were above 0.5 (Cudeck 2000). For evidence of discriminant validity, there were no strong cross-loadings, and the observed factor correlation matrix showed no diagonal value above 0.7, which would have indicated items sharing the majority of their variance (see Appendix 12).

7.2.2 Convergent and Discriminant Validity – Confirmatory Factor Analysis (CFA)

It is important to extensively test the validity of a measure in order to avoid bias and to ensure the measurement scale remains a perfect representation of the variable it intends to measure (Segars and Grover 1993). Carrying on from the EFA, the CFA analysis which revalidates the convergent and discriminant validity carried out through EFA is done in this research by applying structural equation modelling (SEM) techniques. Confirmatory factor analysis (CFA) is another form of factor analysis that aims to test if the collected data fits the hypothesised measurement model based on a general understanding of related theory and previous studies (Jöreskog 1967). In other words, CFA goes a step further from where EFA stops, by testing if measures of a construct are reliable and valid to a researcher's understanding of the characteristics of that construct. Anderson and Gerbing (1988) further reaffirm that SEM techniques can be used to estimate convergent and discriminant validity. For convergent validity in CFA, each observed indicator within a specific latent construct is expected to load above 0.7, and for discriminant validity, correlations between latent constructs (greater than 0.80 or 0.90) indicate a lack of discriminant validity (Holmes-Smith, Cunningham and Coote 2006).

7.2.2.1 Confirmatory Factor Analysis for Six Exogenous Latent Constructs

To carry out CFA in this study, the six exogenous constructs is tested for measurement of good fit first, followed by the two endogenous latent constructs. A two-step investigation is carried out on the six latent constructs (comprising of 23 indicators). The first step involved deleting either one of two indicators from SEM analysis if their shared sample correlation value exceeded 0.90, as this will result to instances of multicollinearity (Holmes-Smith, Cunningham
and Coote 2006). Results from the sample correlations showed no evidence of two indicators correlating above 0.9, therefore no indicator was deleted (see Appendix 13). The second step involved checking to see if there was any anomaly with the residual covariance between two indicators. The standardised residual covariance amongst two indicators is the residual covariance amongst these two indicators divided by the estimate of its standard error. According to Jöreskog and Sörbom (1984), in SEM analysis, standardised residual covariance should ideally not have an absolute value exceeding 2. Brown (2014) further suggest that a significant standardised residual covariance occurs when two indicators have an absolute value greater than 2.58, and at this value, the model fit is significantly decreased. From the CFA performed through AMOS SEM analysis on the six latent constructs, there was no evidence of residual covariance above 2.58 (see Appendix 14).

Remarkably, the SEM analysis on AMOS 24 highlighted indicator fc3 as having a negative variance and thus inadmissible. In SEM, the occurrence of such out-of-range variance estimate is referred to as Heywood case and in order to improve the model fit, McDonald (2014) recommends deletion of such indicator. As a result of this, indicator fc3 was deleted, and indicator pu2, whose estimate was quite good, was also deleted so as to improve overall model fit. Altogether, a total of six indicators were deleted, taking into consideration the initial four deleted indicators due to low SMC estimate value and these two indicators (pu2 and fc3).

The remaining 21 indicators were now investigated for evidence of convergent and discriminant validity. For evidence of convergent validity, the 21 indicators’ factor loadings when standardised results were requested exceeded 0.7, while for discriminant validity, there was no correlation value between two latent constructs exceeding 0.80 (see Table 7.5). There were instances of negative correlations between latent constructs and this simply implied the two constructs are inversely related. McDonald (2014) suggests that this occurrence is not wrong, therefore carries little or non-implication to the model. Furthermore, the purpose of estimating correlation between exogenous constructs is to investigate if there are any multicollinearity effects - since the absolute value of construct correlations shouldn’t exceed 0.8 (McDonald 2014).
Other indices for attesting to goodness of fit of the model based on the CFA carried out are presented in Table 7.5. Convergent validity was evidenced by the average variance extracted (AVE) values all being above 0.5, and reliability evidenced by the CR values all being above 0.7. Evidence of discriminant validity in the model is based on the square root of the AVE being greater than any inter-factor correlation in this matrix.

### Table 7.5 CFA Reliability and Validity Check Value for Six Exogenous Constructs

<table>
<thead>
<tr>
<th>Construct</th>
<th>CR</th>
<th>AVE</th>
<th>MSV</th>
<th>MaxR(H)</th>
<th>FC</th>
<th>PU</th>
<th>PEOU</th>
<th>SE</th>
<th>SI</th>
<th>PDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC</td>
<td>0.895</td>
<td>0.741</td>
<td>0.037</td>
<td>0.954</td>
<td>0.861</td>
<td></td>
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<tr>
<td>PU</td>
<td>0.942</td>
<td>0.843</td>
<td>0.140</td>
<td>0.975</td>
<td>-0.131</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>PEOU</td>
<td>0.903</td>
<td>0.700</td>
<td>0.027</td>
<td>0.980</td>
<td>0.115</td>
<td>0.163</td>
<td>0.837</td>
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<tr>
<td>SE</td>
<td>0.906</td>
<td>0.764</td>
<td>0.051</td>
<td>0.985</td>
<td>0.070</td>
<td>0.044</td>
<td>0.037</td>
<td>0.874</td>
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<td></td>
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<tr>
<td>SI</td>
<td>0.951</td>
<td>0.866</td>
<td>0.056</td>
<td>0.988</td>
<td>0.059</td>
<td>-0.170</td>
<td>-0.030</td>
<td>0.225</td>
<td>0.931</td>
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</tr>
<tr>
<td>PDS</td>
<td>0.925</td>
<td>0.712</td>
<td>0.140</td>
<td>0.990</td>
<td>-0.193</td>
<td>0.374</td>
<td>-0.060</td>
<td>-0.080</td>
<td>-0.236</td>
<td>0.844</td>
</tr>
</tbody>
</table>

From the CFA carried out, the model in Figure 7.1 yielded a $\chi^2$ (chi-square) of 234.238, degrees of freedom (df) = 174 and $p$ value = 0.002. It indicated that the model fits the data, but could still be improved upon. Since the Chi-square statistic is very sensitive with samples size, it is necessary to look at other indices of good-fit measures (Hooper, Coughlan and Mullen 2008: 54). The majority of the fit measures indicated goodness of fit of the model to the data - considering the size of the sample under study (CMIN/DF = 1.346, RMSEA = 0.082, PCLOSE = 0.042, TLI = 0.917, CFI = 0.931, NFI = 0.784, GFI = 0.740, AGFI = 0.655, SRMR = 0.077) (see Table 7.7 for the reference of fit measures and Appendix 15 for goodness of fit threshold). Justifying the acceptance for the RMSEA value obtained in this study, Kenny, Kaniskan, and McCoach (2014) argue the irrelevance of computing RMSEA for low df model and small sample sized model.

While MacCallum, Browne and Sugawara (1996) have indicated ideal fit measures ranges respectively as 0.01 (excellent), 0.05 (good), and 0.08 (mediocre fit), other researchers have suggested 0.10 as the cut-off for models with poor fit (Kenny 2015). Kenny (2015) further suggested that the use of confidence intervals and tests of PCLOSE could be helpful towards understanding sampling error in RMSEA since there is greater sampling error for small df and
small sample sized model. Therefore, as seen in this study, a model with a small sample size can have an artificially big RMSEA values, it is necessary to reiterate that goodness of fit is inversely related to sample size and the number of variables in the model (Hair et al. 2010).

Figure 7.1 Standardised Estimates for Six Exogenous Latent Constructs

<table>
<thead>
<tr>
<th>Standardised Estimates: Chi-square = 234.238, Degree of Freedom = 174, Probability = .002, CMIN/DIF = 1.346, RMSEA = 0.082, PCLOSE = 0.042, TLI = 0.917, CFI = 0.931, NFI = 0.784, GFI = 0.740, AGFI = 0.655, SRMR = 0.077</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Six Exogenous Latent Constructs:</strong> PU = Perceived Usefulness, PEOU = Perceived Ease of Use, SE = Self-Efficacy, SI = Social Influence, FC = Facilitating Conditions, PDS = Patient Data Security</td>
</tr>
</tbody>
</table>

7.2.2.2 Confirmatory Factor Analysis for Two Endogenous Latent Constructs

As done for the exogenous latent constructs, the two endogenous latent constructs go through the same procedural two-step investigation (Anderson and Gerbing 1988). The first step involved investigating to make sure no two indicators share a correlation value exceeding 0.9 in
order to avoid instances of multicollinearity. Results from the sample correlations between the endogenous indicators showed no evidence of two indicators correlating above 0.9, therefore no indicator was deleted (see Appendix 16).

For the next-step, the standardised residual covariance is investigated to see if any pair of indicators have absolute values exceeding 2.58, and the results obtained showed that there was no such instance (see Appendix 17). Therefore, none of the six indicators were deleted. Further investigation to check for reliability and validity (convergent and discriminant) is presented in Figure 7.2. For evidence of convergent validity, the 6 indicators’ factor loading when standardised results were computed, exceeded 0.7, while for discriminant validity, the correlation value between the two latent constructs did not exceed 0.80 (see Appendix 17).

Additional results supporting goodness of fit from the CFA carried out for the two endogenous latent constructs as seen in Figure 7.2 yielded a $\chi^2$ (chi-square) of 10.166, degree of freedom = 8 and p value = 0.254. This indicated that the model fits the data. Given that chi-square statistic is very sensitive with samples size, supplementary indices of good-fit measures support the model fit - (CMIN/DF = 1.271, RMSEA = 0.072, PCLOSE = 0.343, TLI = 0.980, CFI = 0.989, NFI = 0.954, GFI = 0.942, AGFI = 0.847, SRMR = 0.043).
Figure 7.2 Standardised Estimates for Two Endogenous Latent Constructs

Standardised Estimates: Chi-square = 10.166, Degree of Freedom = 8, Probability = 0.254, = 0.413, CMIN/DIF = 1.271, RMSEA = 0.072, PCLOSE = 0.343, TLI = 0.980, CFI = 0.989, NFI = 0.954, GFI = 0.942, AGFI = 0.847, SRMR = 0.043

Two Endogenous Latent Constructs: PGHDUSB = Patient-generated Data User Behaviour, PGHDBI = Patient-generated Data Behavioural Intention

Having shown both the exogenous and endogenous latent constructs reliability and validity (convergent and discriminant) as seen from the EFA and CFA results, the research causal model is ready to be tested. Before testing the research model, the measures of fit this study relies upon are presented and discussed first before proceeding to test the causal model.

7.3 Measures of Fit

The importance of measures of fit as an integral component of structural equation modeling (SEM) has been continually emphasised over time (Bentler and Bonnet 1980; Kenny and McCoach 2003). Hu, Bentler and Hoyle (1995) opine that fit indices measure the extent of
correspondence between a hypothesised latent variable model and the data. While the importance of fit measures cannot be ignored, there is still ongoing debate on the ideal circumstance that would yield a perfect model fit as it relates to the effects of sample size and number of parameters used in measuring the fit (Hu, Bentler and Hoyle 1995; Ding, Velicer, and Harlow 1995; Marsh et al. 1998; Bagozzi and Yi 2012). Various fit measures, depending on category have specific functionality towards model evaluation, such as, measures of minimum sample discrepancy function, measures based on the population discrepancy, goodness of fit index (GFI), adjusted goodness of fit index (AGFI) and related measures, comparison to a baseline model and measures of parsimony (Arbuckle 2005; Bollen and Stine 1992; Browne et al. 1993; Fabrigar et al. 1999; Kenny and McCoach 2003).

1. **Minimum Sample Discrepancy Function:**

   This measure is obtained by calculating the minimum value of the discrepancy as reported in the CMIN (chi-square statistic ($\chi^2$)) result. In the case of maximum likelihood estimation as was used in the SEM analysis in this study, the chi-square statistic is reported under the CMIN column in AMOS 24. The chi-square statistic is a general measure of how many of the implied moments and their sample moments vary. With an increase in variation of the implied and sample moments, the larger the chi-square statistic the stronger evidence against the null hypothesis.

   In this measure, its P value represents the probability of getting as large a discrepancy with the present sample under suitable distributional assumptions, assuming a properly specified model. The P value offers the means of selecting the model by testing its hypotheses to eliminate any models that are not consistent with the existing data. Therefore, P or “p value” result for this fit measure signifies that the test of the hypothesis that the model fits the population is perfect.

   CMIN/DF ($\chi^2 / df$) is the minimum discrepancy divided by its degrees of freedom and the ratio for correct models should ideally be close to 1. While Arbuckle (2005) suggests that it is uncertain how far from 1 the ratio should get before concluding that a model is unacceptable, Byrne (2006) recommends a ratio not exceeding 3 before concluding model
unacceptability. Given that the chi-square statistic ($\chi^2$) is very sensitive to sample size, it is essential to consider other indices that also support goodness of fit.

2. Measures Based on the Population Discrepancy:
In recent years, the root mean square error of approximation (RMSEA) has become one of the most informative fit indices (Diamantopoulos and Siguaw 2000: 85). Steiger and Lind (1980) were the first to introduce using population discrepancy function as a measure of model adequacy. This measure is obtained by fitting a model to the population moments instead of sample moments fitting. According to MacCallum, Browne and Sugawara (1996) RMSEA value of 0.05 or less would imply good fit of the model in relation to the degrees of freedom, but such judgement is relative and subjective. Likewise, RMSEA value of 0.08 or less would indicate a reasonable error of approximation, but unideal to accept a model whose RMSEA exceeds 0.1 (Browne et al. 1993; Hu and Bentler 1999; Steiger 2007).

PCLOSE which relates to the RMSEA is the “$p$ value” for testing the null hypothesis (Browne et al. 1993). It ensures that the population RMSEA is not greater than 0.05 ($H_0$: RMSEA $\leq$ 0.05).

3. Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI) and Related Measures:
This measure was conceived by Jöreskog and Sörbom (1984) for Maximum Likelihood (ML) and Unweighted Least Squares (ULS) estimation, and generalised to measure other estimation criteria by Tanaka and Huba (1985). When the GFI value becomes adjusted, it gives the adjusted goodness of fit index (AGFI). The goodness of fit index (GFI) is a measure of fit between the hypothesized model and the observed covariance matrix while the adjusted goodness of fit index (AGFI) corrects the GFI, which is usually affected by the number of indicators of each latent variable. The GFI and AGFI values range between 0 and 1, with a value of over 0.9 indicating generally acceptable model fit (Baumgartner and Homburg 1996).
4. Comparison to a Baseline Model:

Usually, three significant indices are used for reporting this measure and they include: the normed fit index (NFI), the Tucker-Lewis coefficient (TLI), and the comparative fit index (CFI). The CFI is expected to fall within the range of 0 to 1. A CFI value greater than 1 is reported as 1, while values less than 0 is reported as 0.

5. Measures of parsimony:

According to Schermelleh-Engel, Moosbrugger and Müller (2003), a model high in parsimony is a model with comparatively limited parameters and relatively many degrees of freedom, while a model with many parameters and few degrees of freedom is seen to be complex or lacking in parsimony. Most researchers who have dealt with fit measures continually try to balance these two conflicting concepts (simplicity and goodness of fit). Degrees of freedom (df) is also amongst one of the fit measures for parsimony.

Table 7.6 Summary of Fit Measures Used in this Research

<table>
<thead>
<tr>
<th>Fit Measures</th>
<th>Fit Measures’ Indications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chi-square ($\chi^2$)</td>
<td>A p value greater than 0.05 indicates an acceptable fit.</td>
</tr>
<tr>
<td>CMIN/DF ($\chi^2$/df) or (normed chi-square)</td>
<td>A value close to 1 and not exceeding 3 indicates a good fit. A value less than 1 indicates an overfit of the model.</td>
</tr>
<tr>
<td>RMSEA</td>
<td>A value about 0.05 or less indicates a close fit of the model. A value of 0.0 indicates the exact fit of the model. A value of about 0.08 or less indicates a reasonable error of approximation.</td>
</tr>
<tr>
<td>PCLOSE</td>
<td>PCLOSE is a $p$ value for testing the null hypothesis that the population under study is not greater than 0.05 ideally (Browne et al. 1993)</td>
</tr>
<tr>
<td>TLI</td>
<td>The Tucker-Lewis Index (TLI). A typical TLI value ranges between 0 and 1, but is not limited to this range. TLI value close to 1 indicates a very good fit, while value greater than 1 indicates an overfit of the model (Bentler and Bonett 1980).</td>
</tr>
<tr>
<td>CFI</td>
<td>Comparative Fit Index (CFI). A CFI value ranges between 0 and 1, but a value closer to 1 indicates a very good fit (Bentler 1990).</td>
</tr>
<tr>
<td>NFI</td>
<td>Normed Fit Index (NFI). NFI value ranges between 0 and 1. NFI closer to 1 or 1 indicates a perfect fit (Bentler and Bonett 1980).</td>
</tr>
<tr>
<td>GFI</td>
<td>Goodness of Fit Index (GFI). Value always less than or equal to 1 and 1 indicates a perfect fit (Jöreskog and Sörbom 1984)</td>
</tr>
<tr>
<td>AGFI</td>
<td>The Adjusted Goodness of Fit Index (AGFI) takes into account the</td>
</tr>
</tbody>
</table>

191
Model estimation in IBM AMOS 24 SEM statistics software package is by default carried out via maximum likelihood estimation (MLE). The MLE method estimates the parameters of a statistical model given observations, by finding parameter values that maximize the likelihood of making the observations, considering the parameters at hand (Byrne 2016). It is important to note that the MLE method corresponds with many well-known estimation methods in statistics, but is the default estimation method in AMOS and produces very desirable properties (Arbuckle 2005). Since the output in AMOS, when parameters are computed in MLE, comes out as both unstandardised and standardised model during path analysis, it is important to shed light on what these terms mean.

<table>
<thead>
<tr>
<th>CR</th>
<th>Composite Reliability (CR) is a measure used for demonstrating adequate reliability of model and is carried out before testing a causal model: An ideal CR value should be greater than 0.7 at least.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MaxR(H)</td>
<td>Maximum reliability or H is a more robust form of CR.</td>
</tr>
<tr>
<td>AVE</td>
<td>Average Variance Extracted (AVE) is a measure used for demonstrating adequate convergent validity of model and is carried out before testing a causal model. An ideal AVE value should be greater than 0.5.</td>
</tr>
<tr>
<td>MSV and ASV</td>
<td>Maximum Shared Variance (MSV) and Average Shared Variance (ASV) is a measure used for demonstrating adequate discriminant validity within a model and is carried out before testing a causal model. MSV and ASV values should not exceed the AVE value.</td>
</tr>
<tr>
<td>SRMR</td>
<td>Standardised Root Mean Square Residual (SRMR): Hooper, Coughlan and Mullen (2008) opine that both the root mean square residual (RMR) and standardized root mean square residual (SRMR) are square root of the discrepancy between the sample covariance matrix and the model covariance matrix. Reporting the SRMR as against RMR removes interpretation difficulty, and its value ranges from 0 to 1, with a value of 0.09 or less being indicative of an acceptable model (Hu and Bentler 1999).</td>
</tr>
</tbody>
</table>

**7.3.1 Model Estimation**

Model estimation in IBM AMOS 24 SEM statistics software package is by default carried out via maximum likelihood estimation (MLE). The MLE method estimates the parameters of a statistical model given observations, by finding parameter values that maximize the likelihood of making the observations, considering the parameters at hand (Byrne 2016). It is important to note that the MLE method corresponds with many well-known estimation methods in statistics, but is the default estimation method in AMOS and produces very desirable properties (Arbuckle 2005). Since the output in AMOS, when parameters are computed in MLE, comes out as both unstandardised and standardised model during path analysis, it is important to shed light on what these terms mean.
During path analysis, an unstandardised model’s regression weights, covariances, variances and intercepts (when mean structures are analysed) are displayed in the path diagram. The regression weights detail the influence of one or more variables on another variable (Byrne 2006). Whereas in a standardised model, depending on what functions are selected in the output tab via the analysis properties before calculating estimates, the path diagram displays the standardised regression weights (given that mean = 0 and variance = 1.0 (Byrne 2016)), the standardised factor and sample correlations, as well as the squared multiple correlations (SMC). Arbuckle (2005) suggested that the correlations and the standardised regression weights remain independent of the units in which the variables under investigation are measured. Although the fit measures detail how good the model fits with the data, The SMC determines the strength of the structural paths in the model (Montanelli and Humphreys 1976). Since a model’s SMC is the ratio of its variance that is accounted through its predictors, it was very necessary that this study considers the SMC of all the variables, together with the fit measures so as to be able to explain the resulting structural model (Arbuckle 2005; Byrne 2016).

7.4 Patient-generated Health Data Acceptance Model

After testing and modification, the model has been titled “Patient-generated Health Data Acceptance Model” and is abbreviated as “PGHDAM” throughout the rest of this research. From the proposed research model in Figure 7.3, which adapted various aspects of theories underpinning technology acceptance, a presentation of the possible influence of the six latent constructs (exogenous variables: PU = Perceived Usefulness, PEOU = Perceived Ease of Use, SE = Self-Efficacy, SI = Social Influence, FC = Facilitating Conditions, PDS = Patient Data Security) towards usage behaviour (endogenous variable: PGHDUSB), and the possible influence of usage behaviour (PGHDUSB) towards behaviour intention (endogenous variable: PGHDBI) are shown. While exogenous or independent variables don’t rely on other variables and have no single-headed arrows pointing towards them, endogenous or dependent variables on the other hand rely on other variables and have single-headed arrows pointing towards them (Arbuckle 2005).

To test the proposed research model, SEM data analysis is carried out on the direct path hypotheses, by investigating:

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(A) How does the six exogenous variables influence the participants’ usage behaviour towards using the Internet-based diabetes management system (the dedicated PGHD correspondence platform used for the study)?

(B) How does their actual PGHD usage behaviour influence the behaviour intention towards PGHD adoption?

Figure 7.3 Proposed Research Model (Proposed PGHDAM)

In reference to the proposed research model, the following hypotheses are tested:

A; Determinants and PGHD Usage Behaviour

H\textsubscript{1}1a: Perceived usefulness has a significant influence on PGHD usage behaviour (PGHDUSB).

H\textsubscript{1}2a: Perceived ease of use has a significant influence on PGHD usage behaviour (PGHDUSB).

H\textsubscript{1}3a: Facilitating conditions has a significant influence on PGHD usage behaviour (PGHDUSB).

H\textsubscript{1}4a: Social influence has a significant influence on PGHD usage behaviour (PGHDUSB).

H\textsubscript{1}5a: Self-efficacy has a significant influence on PGHD usage behaviour (PGHDUSB).

H\textsubscript{1}6a: Patient data security has a significant influence on PGHD usage behaviour (PGHDUSB).
B; Usage Behaviour and Behaviour Intention

H$_{2}$a: PGHD usage behaviour (PGHDUSB) has a significant influence on behaviour intention (PGHDBI).

The initial model prior to modification is presented in Figure 7.4 with unstandardised estimates and with standardised estimates in Figure 7.5.

![Figure 7.4 Initial PGHD Acceptance Model with Unstandardised Estimates](image)

Initial Patient-generated Health Data Acceptance Model Unstandardised Estimates: Chi-square = 437.485, Degree of Freedom = 302, Probability = .000, CMIN/DIF = 1.449, RMSEA = 0.093, PCLOSE = 0.001, TLI = 0.863, CFI = 0.882, NFI = 0.709, GFI = 0.685, AGFI = 0.606, SRMR = 0.0807

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Two Endogenous Latent Constructs:</td>
<td>PGHDUSB = Patient-generated Data User Behaviour, PGHDBI = Patient-generated Data Behavioural Intention</td>
</tr>
</tbody>
</table>
Figure 7.5 Initial PGHD Acceptance Model with Standardised Estimates

Initial Patient-generated Health Data Acceptance Model Standardised Estimates: Chi-square = 437.485, Degree of Freedom = 302, Probability = .000, CMIN/DIF = 1.449, RMSEA = 0.093, PCLOSE = 0.001, TLI = 0.863, CFI = 0.882, NFI = 0.709, GFI = 0.685, AGFI = 0.606, SRMR = 0.0807


Table 7.7 Parameter Summary for Initial PGHD-AM

<table>
<thead>
<tr>
<th></th>
<th>Weights</th>
<th>Covariances</th>
<th>Variances</th>
<th>Means</th>
<th>Intercepts</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
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<td>15</td>
<td>35</td>
<td>0</td>
<td>0</td>
<td>113</td>
</tr>
</tbody>
</table>

Investigating the SEM output, all standardised regression weights (factor loadings) were good and correlations between latent variables were good as well as seen in Figure 7.5. For sample
correlation, none exceeded 0.9 (see Appendix 18), and standardised residual covariance) had no absolute value exceeding 2.58 (see Appendix 19).

Most of the fit measures indicated goodness of fit of the model to data while some did not meet the ideal threshold. As seen from the obtained results in Figure 7.4 and 7.5, the research model fits almost well to the data based on the $\chi^2$ (chi-square) of 437.485, the degree of freedom = 302 and on the p value = 0.000, but could still be improved upon. Given that the Chi-square statistic is very sensitive to the sample size it is as well necessary to look at other fit measures (Hooper, Coughlan and Mullen 2008: 53). The results from other measures of good fit showed that: CMIN/DF = 1.449, RMSEA = 0.093, PCLOSE = 0.0001, TLI = 0.863, CFI = 0.882, NFI = 0.709, GFI = 0.685, AGFI = 0.606, and SRMR = 0.0807 (see Table 7.6 for the reference of fit measures).

Having met all reliability and validity criteria of the model through EFA and CFA, Grice (2001) suggested the unit-weighted factor score modelling approach as it can perform better or just as much as the alternative exact-factor scores towards improving overall model fit by reducing model complexity, and has been used in several organisational studies (Chen, Aryee and Lee 2005; Frels, Shervani, and Srivastava 2003; Kaufman Stamper and Tesluk 2001; Lee and Peccei 2007; Matsuno, Mentzer and Özsomer 2002). The unit-weighted factor involves creating averages that yield aggregate or composite values of the measurement items. This is done by summing up the values of items under each construct and dividing the sum by the exact number of items summed up. Grice (2001) further suggest that this reduces a model’s complexity a great deal and improves overall model fit.

Thus, applying the unit-weighted factor modeling approach to our final validated research model resulted in reducing the 27-indicator CFA (21 indicators from six exogenous latent constructs and six indicators from two endogenous latent constructs) to a 12-indicator model comprising of 6 exogenous indicators: PU, PEOU, SE, SI, FC and PDS, 3 endogenous indicators from PGHDUSB and 3 endogenous indicators from PGHDBI. Figures 7.6 and 7.7 show both the unstandardised and standardised final PGHD acceptance model (aggregated exogenous latent constructs) with an overall improved fit measure. Also, through the application of the unit weighted factor, the PGHDAM model complexity reduced tremendously.
and the number of parameter estimates in the Patient-generated Health Data Acceptance Model (after aggregating the exogenous constructs) reduced from 113 parameters in Table 7.7 to 50 parameters in Table 7.8. The final SEM analysis yielded the PGHDAM output called the “Patient-generated Health Data Acceptance Model” (see Figures 7.6 and 7.7), and will have the ability to explain usage behaviour and predict Lagosians diabetic patients’ intention to use PGHD at present and even in the future.

**Table 7.8 Parameter Summary for Final PGHD-AM**

<table>
<thead>
<tr>
<th></th>
<th>Weights</th>
<th>Covariances</th>
<th>Variances</th>
<th>Means</th>
<th>Intercepts</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>Labelled</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Unlabelled</td>
<td>11</td>
<td>15</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>15</td>
<td>14</td>
<td>0</td>
<td>0</td>
<td>50</td>
</tr>
</tbody>
</table>

**Figure 7.6 PGHD Acceptance Model with Unstandardised Estimates**

Patient-generated Health Data Acceptance Model Unstandardised Estimates: Chi-square = 40.103, Degree of Freedom = 38, Probability = .377, CMIN/DIF = 1.055, RMSEA = 0.033, PCLOSE = 0.587, TLI = 0.982, CFI = 0.990, NFI = 0.853, GFI = 0.903, AGFI = 0.801, SRMR = 0.06

**Six Aggregated Exogenous Latent Constructs:** PU = Perceived Usefulness, PEOU = Perceived Ease of Use, SE = Self-Efficacy, SI = Social Influence, FC = Facilitating Conditions, PDS = Patient Data Security

**Two Endogenous Latent Constructs:** PGHDUSB = Patient-generated Data User Behaviour, PGHDBI = Patient-generated Data Behavioural Intention
Figure 7.6 is the Patient-generated Health Data Acceptance Model (general path diagram – demonstrating regression weights, covariances and variances) after re-specification with unstandardised estimates for all 53 diabetic patients.

![Diagram of Figure 7.6]

**Figure 7.7 PGHD Acceptance Model with Standardised Estimates**

Patient-generated Health Data Acceptance Model Standardised Estimates: Chi-square = 40.103, Degree of Freedom = 38, Probability = .377, CMIN/DIF = 1.055, RMSEA = 0.033, PCLOSE = 0.587, TLI = 0.982, CFI = 0.990, NFI = 0.853, GFI = 0.903, AGFI = 0.801, SRMR = 0.06


Figure 7.7 is the Patient-generated Health Data Acceptance Model (general path diagram – demonstrating standardised regression weights, correlations and squared multiple correlations) with standardised estimates for all 53 diabetic patients. Arbuckle (2005) suggests that the standardised regression weights, correlations and squared multiple correlations are all independent of the units measured, and as such will not be limited by the choice of identification constraints.

The aggregated final model (see Figures 7.6 and 7.7) offers the best fit when compared with the initial model (see Figures 7.4 and 7.5), with a $\chi^2$ (chi-square) of 40.103, degree of freedom =
38, and p value = .377 that is not significant at the 0.05 level indicating the model fits well with the data. In support of the Chi-square that is very sensitive to sample size, it is necessary to consider other fit measures (CMIN/DIF = 1.055, RMSEA = 0.033, PCLOSE = 0.587, TLI = 0.982, CFI = 0.990, NFI = 0.853, GFI = 0.903, AGFI = 0.801, SRMR = 0.06). When cross-checked with reference of fit measure (see Table 7.6), the fit measure indicated goodness of fit of the model to the data.

The final aggregated model shows all paths, but only four paths between the predictors and usage behaviour were statistically significant at the 0.05 level of significance (see Table 7.9), also the path between usage behaviour and behaviour intention was statistically significant.

| Table 7.9 Regression Weights Patient-generated Health Data Acceptance Model |
|---------------------------------|-------|-------|-------|
| Patient-generated Health Data Acceptance Model | Estimate | S.E. | C.R. |
| PGHDUSB <-- PU                 | -.130 | .041 | -3.193 | .001 |
| PGHDUSB <-- PEOU               | .057  | .057 | 1.006  | .314 |
| PGHDUSB <-- SE                 | .079  | .040 | 1.960  | .050 |
| PGHDUSB <-- SI                 | -.236 | .057 | -4.178 | *** |
| PGHDUSB <-- FC                 | .072  | .052 | 1.365  | .172 |
| PGHDUSB <-- PDS                | .232  | .056 | 4.115  | *** |
| PGHDBI <-- PGHDUSB             | .187  | .047 | 3.938  | *** |

***p value, statistically significant at the 0.01 level (two-tailed)
*p value, statistically significant at the 0.05 level (two-tailed)

Results shown in Table 7.10 imply that several reasons could justify usage behaviour and behaviour intention of the respondents as seen from the varying levels of significance obtained. Furthermore, it is important to consider how the determinants/predictors (PU, PEOU, SI, FC, SE and PDS) impact on the variance of the two dependent variables. The squared multiple correlation results in Table 7.10 show quite a reasonable explanation to the level of variance from the six predictors on the two dependent variables, as they accounted for 12.6% of variance on PGHDUSB and 4.8% of variance on PGHDBI.
Table 7.10 Squared Multiple Correlations for PGHD-AM

<table>
<thead>
<tr>
<th></th>
<th>SMC Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGHDUSB</td>
<td>.120</td>
</tr>
<tr>
<td>PGHDBI</td>
<td>.048</td>
</tr>
</tbody>
</table>

Given that the standardised regression weight (see Table 7.12) allows for direct comparison between the relative effects of each independent variables on the dependent variable (Hair et al. 2006), the proposed research hypotheses are explained. Four (H11a, H14a, H15a and H16a) out of the 6 research hypotheses between the predictors and PGHD usage behaviour (PGHDUSB) are accepted, while the remaining 2 (H12a and H13a) are rejected. In other words, PU, SI, SE and PDS significantly influenced the respondents’ PGHD usage behaviour just as PEOU and FC did not.

Further inferring from the relative effect (standardised regression weights in Table 7.11) between predictors and PGHDUSB reveals strong paths with statistical significance between PU and PGHDUSB (-0.197), SE and PGHDUSB (0.102), SI and PGHDUSB (-0.225) and PDS and PGHDUSB (0.232), while PEOU and PGHDUSB (0.053) and FC and PGHDUSB (0.071) exhibit weaker relative effect with non-statistical significance. Interestingly, the result in Table 7.11 also hints that PU and SI are negatively associated with PGHDUSB, and this implies that PU and SI are negative predictors of PGHDUSB within the studied population.

Table 7.11 Standardised Regression Weights PGHD-AM

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGHDUSB &lt;- PU</td>
<td>-.179</td>
</tr>
<tr>
<td>PGHDUSB &lt;- PEOU</td>
<td>.053</td>
</tr>
<tr>
<td>PGHDUSB &lt;- SE</td>
<td>.102</td>
</tr>
<tr>
<td>PGHDUSB &lt;- SI</td>
<td>-.225</td>
</tr>
<tr>
<td>PGHDUSB &lt;- FC</td>
<td>.071</td>
</tr>
<tr>
<td>PGHDUSB &lt;- PDS</td>
<td>.232</td>
</tr>
<tr>
<td>PGHDBI &lt;- PGHDUSB</td>
<td>.220</td>
</tr>
</tbody>
</table>
The implication of the proposed research hypotheses is that while PU (perceived usefulness, SE (self-efficacy), SI (social influence) and PDS (patient data security) might significantly influence their PGHD usage behaviour, PEOU (perceived ease of use) and FC (facilitating conditions) do not influence their PGHD usage behaviour. This may suggest why the study participants, knowing fully well the questionable quality of the health service delivery in the State, were still: (a) positive to try and adhere to the compliance of the PGHD sharing platform (Internet-based diabetes management system) provided for the study, regardless of how easy they perceived the user interface of the platform or how involved processes seemed and, (b) positive to try and adhere to compliance regardless of the perceived impediments from facilitating (FC) conditions such as the not too affordable data service for PGHD communication, disparities in ownership of internet-enabled mobile devices for PGHD correspondence and limited but dedicated medical support from doctors involved in the study. It is to be reminded though that the reason behind the respondents’ perceptions of the PGHD platform, as it relates to PEOU and FC might have been influenced by the design of the study. There were multiple means for communicating with their healthcare provider, such as via SMS and phone calls, and this might have influenced their perception of constructs measuring PEOU and FC.

Given that the study achieved a 68.2% compliance from the participants, it implies that their level of perceived usefulness, self-efficacy, social influence and patient data security towards using PGHD translate to their willingness to PGHD usage and compliance. The hypothesis testing the usage behaviour and behavioural intention was accepted, and this suggests that usage behaviour significantly influences behavioural intention toward PGHD. Evidence in support of the association with a causal relationship between usage behaviour and behaviour intention as seen from the standardised regression weight (see Table 7.12) shows that PGHDUSB and PGHDBI (0.220) are positively associated at a higher level.

7.5 Chapter Summary

This chapter has comprehensively presented all the SEM steps taken to arrive at the final Patient-generated Health Data Acceptance Model for the 53 diabetic patients (participants) studied. This entailed presenting a justified construct for the research model based on underpinning theories, carrying out an all-inclusive reliability and validity analysis of the
research model via exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). The EFA and CFA analyses exhaustively ensured parsimony of the measurement items and improved their fit to data as seen from the measures of fitness indices obtained.

While caution is required when generalising the findings due to the sample size used in the SEM analysis, there remains to be a consensus in literature on what should the ideal sample size be, considering the complexity of the model generated, normality of the data, missing patterns and number of variables involved (Hoyle 1999; Hoyle and Kenny 1999; Marsh and Hau 1999; Sideridis et al. 2014). Necessary steps were taken to ensure there was no missing data, skewness or kurtosis in the collected data during the scale validation phase. Furthermore, to reduce model complexity, the unit weighted factor of the exogenous latent constructs was used and this reduced immensely the model complexity and number of variables involved in the final SEM analysis.

Table 7.12 details the summary of the influence of determinants on usage behaviour, as well as usage behaviour on behaviour intention. Out of the six direct-path hypotheses raised, only two were rejected (H12a and H13a). While a similar study by Kripanont (2007) showed that PEOU and FC were both rejected when examining TAM of Internet usage by academics within Thai Business Schools, it is quite interesting to see that though obvious impediments to technology usage by patients within the study area exists (Idowu, Cernord and Bastin 2008), this had no significant influence towards their PGHDUSB. The hypotheses result obtained from this chapter also support the findings made in Study-1 (PGHDTR), which segmented the Lagos State residents as technology explorers based on their TR score (Parasuraman 2000). The Study-1 explorers’ attribute of the 1,443 participants showed that they were positively predisposed to adopting new technology (PGHD) based on their high optimism and innovativeness PGHD-TR score, with a corresponding low discomfort and insecurity PGHD-TR score. Mirroring this to the hypotheses result obtained in this chapter, the 53 respondents showed from the obtained data that, while their present environment offers little support (FC) both to HIT in the hospital settings and outside the hospital settings for an improved HIMS, they are still keen to adopt and continually use PGH as a means for health communication with their healthcare provider.
Table 7.12 Summary of the Influence of Determinants on Usage Behaviour, and Usage Behaviour on Behaviour Intention

<table>
<thead>
<tr>
<th>$H_0$ No:</th>
<th>Exogenous Latent Construct</th>
<th>Endogenous Latent Construct</th>
<th>Hypothesis Result</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_{1a}$</td>
<td>Perceived usefulness (PU)</td>
<td>Usage in PGHD (PGHD)</td>
<td>Accepted</td>
<td>Participants PU of the internet-based diabetes management system (IBDMS) significantly influenced their usage behaviour (PGHDUSB) to correspond PGHD with their healthcare provider</td>
</tr>
<tr>
<td>$H_{2a}$</td>
<td>Perceived ease of use (PEOU)</td>
<td>Usage in PGHD (PGHD)</td>
<td>Rejected</td>
<td>Participants PEOU of the IBDMS did not significantly influence their PGHDUSB to correspond PGHD with their healthcare provider</td>
</tr>
<tr>
<td>$H_{3a}$</td>
<td>Facilitating Conditions (FC)</td>
<td>Usage in PGHD (PGHD)</td>
<td>Rejected</td>
<td>Participants perceived influence of FC towards IBDMS did not significantly influence their PGHDUSB</td>
</tr>
<tr>
<td>$H_{4a}$</td>
<td>Social Influence (SI)</td>
<td>Usage in PGHD (PGHD)</td>
<td>Accepted</td>
<td>Participants perceived influence of SI towards IBDMS significantly influenced their PGHDUSB</td>
</tr>
<tr>
<td>$H_{5a}$</td>
<td>Self-efficacy (SE)</td>
<td>Usage in PGHD (PGHD)</td>
<td>Accepted</td>
<td>Participants perceived influence of SE towards IBDMS significantly influenced their PGHDUSB</td>
</tr>
<tr>
<td>$H_{6a}$</td>
<td>Patient data security (PDS)</td>
<td>Usage in PGHD (PGHD)</td>
<td>Accepted</td>
<td>Participants perceived influence of PDS towards IBDMS significantly influenced their PGHDUSB</td>
</tr>
<tr>
<td>$H_{1a}$</td>
<td>PGHD usage behaviour (PGHDUSB)</td>
<td>Behaviour intention towards PGHD (PGHDBI)</td>
<td>Accepted</td>
<td>Participants actual PGHDUSB of the IBDMS significantly influenced their PGHDBI correspond PGHD with their healthcare provider</td>
</tr>
</tbody>
</table>

PU, SE, SI PDS were all accepted and this informs on the need to consider how these constructs will be integrated to the PGHD adoption framework. The influence of usefulness (PU), individual competence (SE), social influence (SI), and data confidentiality/privacy and data security (PDS) is integral for the successful adoption and continuous use of PGHD as shown by the accepted hypotheses. Also, as predicted, PGHDUSB showed statistical evidence
of significance to PGHDBI. While no emphasis was laid on impact of demographics on the determinants of PGHD usage and behaviour intention due to the sample size inability to allow for multi-group analysis, the empirical evidence established from this study will go a long way towards informing on the technological requirements and considerations to be made while conceptualising (before domain experts validation), the PGHD adoption framework in the next Chapter. Figure 7.8 illustrates the PGHD acceptance model with only significant paths linking, and the hypotheses testing provided strong evidence for the PGHDAM generated.

In reference to Figure 7.8, the generated model is very capable of explaining the variances in two latent constructs by examining the SMC and according to Sharma (1996); SMC is similar to the R2 statistic. It should be noted that the study was carried out in a voluntary setting.
CHAPTER 8: DEVELOPMENT OF THE PGHD ADOPTION FRAMEWORK AND VALIDATION

This chapter presents the Patient-generated Health Data adoption framework that has been developed as a blueprint towards the adoption and usage evaluation of PGHD by diabetic patients and their healthcare providers in Lagos State Nigeria. To achieve this, this chapter is divided into two parts. Chapter 8 Part 1 discusses the development and implementation of the framework (which is founded upon the relevant literature and empirical evidence from the two independent studies carried out in the previous Chapters). In chapter 8 Part 2, the proposed PGHD adoption framework developed is then presented to carefully selected domain experts and stakeholders to be validated through critique. Also, this section comprehensively details the framework method of validation and the domain expert feedback that offered improvement and legitimacy to the PGHD.
CHAPTER 8, PART 1: FRAMEWORK CONCEPTUALISATION

8.1 Fundamentals of the Framework

According to Blumenthal (1969); Gorry and Scott Morton (1971); Sprague Jr (1980); Lu et al. (2005); Yusof et al. (2008); Omachonu and Einspruch (2010); Oliveira and Martins (2011), the uniqueness of any framework can be argued such that it is designed to fit the requirements it is expected to deliver. While there is no one absolute framework design methodology, having the correct synergy of people, processes and technology is vital in order to achieve a holistic view of a framework or system within its intended environment (Davenport 1993). If such standard is to be conceived for this proposed PGHD adoption framework for diabetes management in Lagos State Nigeria, it is imperative to conceptualise its design from a sociotechnical approach, considering its novelty within the environment it is being considered. While drawing experience from an electronic patient record (EPR) in an Intensive Care Unit, Berg et al. (1998: 243) stresses the need to understand the process of IT design as the development of sociotechnical configurations. This further supports the notion that, while PGHD implementation and adoption for diabetic patients within the study area require structure on the premises of existing local organisational belief, it is pertinent that any framework guiding PGHD actual usage is derived from detailed empirical knowledge of all actors and practices involved (evidence-based). Also, it is widely acknowledged that adopting a socio-technical approach to an IT framework development will deliver systems that are more acceptable to end users (patients and healthcare providers) and yields better value to stakeholders (Clegg 2000). Finally, the emphasis on sociotechnical approach is that it offers an alternative to the technology-centred and top-down approaches that usually dominate IT framework development and deployment (Berg 1999; Kaplan 2001).

8.1.1 Sociotechnical Principles of the Framework Conceptualisation

The notion that every characteristic of a system (technical and social) are interdependent, and that none should take logical superiority over the other, reflects what a sociotechnical principle of system design embodies (Klein 1994). By embracing a user-oriented concept (patient-centred), the sociotechnical approach rationalises the need for thorough continuous understanding of all networks and actors before the start of conceptualisation, during design and implementation, and after eventual adoption of an IT system (Berg 1999: 89). The underlying concept of PGHD introduction within the subject area was to empower the patients...
to become proactive and improve self-management of their diabetes mellitus, enable medical workers and doctors to have continuous flow of patient health information for an improved decision making and to bridge the communication gap between the patient and their healthcare provider. By mirroring a sociotechnical approach for the PGHD adoption framework design, the researcher aimed to put all the actors’ (patients, doctors, medical workers, policy formers and patient carers/proxies), PGHD supporting technology and their working relationships in centre stage. This is because the exclusive focus on any one component during design, for example on technology, will be sub-optimal.

Miles, Huberman and Saldana (2013) posit that a conceptual framework can be used to explain, either narratively or schematically, system components, key factors, variables or constructs and the prevailing relationships they possess. With a core focus on the diabetic patient, the healthcare providers’ (medical doctors and medical workers), involved PGHD processes required technology, PGHD usage evaluation and PGHD accountability mechanism, the conceptual framework is used to aggregate the researcher’s thoughts towards PGHD adoption in the study area. This is then linked to the key themes of interest from the literature review, empirically-driven research and data analysis that took place subsequently.

This part of the framework development consists of 3 major sections:

i. Section A describes the elicited requirements for PGHD technology readiness, impact from actual PGHD capture and correspondence for both patient and healthcare provider organisation, all processes identified and supporting technology.

ii. Section B further expands on each aforementioned component in section A by identifying elements prerequisites for the adoption of PGHD practice by diabetic patients within the study area, and indicators that could help evaluate each of the components.

iii. Section C details a method for implementation that is underlined by sociotechnical principles. Since the sociotechnical approach puts the users (diabetic patients and their healthcare providers) at the core, on this basis will the phases, sub-phases, components and subcomponents be identified and iteratively mapped onto the essential requirements for the adoption of PGHD in Lagos State Nigeria.
To deliver the aforementioned, this chapter is subsequently presented in six main sub-sections:

- Sub-section 8.2 discusses the PGHD adoption framework development for diabetes mellitus management within the context of the environment under study, and the core components identified both from the literature and empirical investigation from Study-1 (PGHD-TR) and Study-2 (PGHD-TAM).
- Sub-section 8.3 discusses a possible method for implementation based on the conceptualised framework developed.

### 8.2 A PGHD Adoption Framework for Diabetes Mellitus: Conceptualisation

Applying the empirical evidence from both Study-1 and Study-2, as well as information from relevant theoretical underpinnings gathered up to this point, the underlying components to be considered towards the adoption of PGHD in Lagos State Nigeria are presented. The presentation is as follows: first, the environment, identifying components within it, requirements gathering for the components within it (conceptual mapping of the components to their accompanying requirements gathered from Study-1 and Study 2) and finally, how these components interact with each other.

#### 8.2.1 The Lagos State PGHD Environment

Irrespective of the components or factors that played major roles towards the identification and engagement of all resources, networks and stakeholders involved in the actual PGHD usage in Study-2, three interdependent environments were identified and they include the external environment, the patient’s environment and the hospital environment. Figure 8.1 illustrates the three environments and the flow of interaction across them.
Figure 8.1 The Conceptual Lagos State PGHD Environment

1. **The External Environment**: Also referred to as the oversight environment as it offers support both in policy and facilitation to the two internal, yet interdependent environments that complete the PGHD environment. In other words, the factors and actors within this environment are responsible for PGHD capacity development in the State. The need for the existence of this environment stems from the feedback retrieved from the respondents in *Study-I* (1,443 Lagosians and 47 Medical doctors across all local government areas in the State) concerning how assured they will feel towards eventual PGHD adoption, if issues surrounding PGHD ownership, access, meaningful use, privacy, data security and other concerns raised are addressed beforehand. To achieve this level of confidence prior to the adoption of PGHD in the State, the actors in the external environment should ideally be unbiased towards capacity building of an environment that could support PGHD adoption for both the patients/Lagosians (PGHD primary stakeholders) and their healthcare providers. Though the actual use of PGHD by the diabetic patients studied was voluntary and consensual between patients and their healthcare providers, its regulation should be obligatory and ought to be the responsibility of actors in the external environment. A common hindrance observed during *Study-2* was the absence of native knowledge regarding PGHD use or practice from both the diabetic patients studied and the collaborating medical doctors. While this could be as a result of a non-existent PGHD framework, the external
environment should champion capacity developments that are readily available, if needed, in the event a patient or healthcare provider decides to adopt PGHD. Based on the issues and concerns identified from Study-1 and Study-2, these capacity developments should specifically target the patient:

i. Defining within a local context what meaningful use of PGHD entails for patients/Lagosians
ii. Offer avenue for patients/Lagosians to be educated on how they can benefit from the use of PGHD both for personal health management and when shared responsibly with their healthcare provider.
iii. Establish who should absolutely own the ‘PGHD’
iv. Establish who should have access to patients’ ‘PGHD’
v. From a patient’s perspective, address, document and continually update solutions to concerns relating to PGHD security, privacy, patient-doctor relationship, ethics, legal issues, cost, technical and operational issues, usage evaluation and accountability.
vi. Facilitate and incentivize patients who are willing, but not financially able, to purchase equipment or devices needed for the capture, storage and share of their PGHD with their healthcare provider.
vii. Make readily available the aforementioned information via multiple channels when requested by any Lagosian.
viii. Consider developing a legal framework, backed with policies that will support PGHD, other forms of patient electronic information and digital health services both at the state and federal levels. Aside from being consistent in the two levels, this legal framework must be specific to the health sector, as most data acts in existence remain generic, and with core emphasis on the communication sector (Akinsuyi 2015; United Nations Foundation 2015).

For the healthcare provider:

i. Defining within a local context what meaningful use of PGHD entails for the healthcare providers in the State.
ii. Establish who should absolutely own the ‘PGHD’.
iii. Define how levels of responsibility alter when dealing with patients’ data captured within clinical environments and from external data.
iv. Encourage and enforce responsible use of PGHD for accountability. Consider enforcement of access signature on all contacts between healthcare provider and PGHD.

v. Provide human resource support in form of PGHD data analysts who would work in tandem with medical doctors so that the extra information gained via PGHD is integrated into patients’ formal care without frustrating medical doctors’ workflows.

vi. From a healthcare providers’ perspective, address, document and continually update solutions to concerns relating to PGHD security, privacy, patient-doctor relationship, ethics, legal issues, cost, technical and operational issues, usage evaluation and accountability.

vii. Equip and incentivize medical centres and healthcare providers with health information technology facilities that are needed for supporting the huge amount of data that will be generated via PGHD correspondence with patients.

viii. Make readily available the aforementioned information via multiple-channels when requested by healthcare providers.

ix. Start deliberation on the need for health information exchange standardisation and interoperability of health information management systems across medical centres within the State. This will in no small measure make PGHD generated anywhere within Lagos State readable, reusable and secured. Also, it will contribute towards strengthening the overall eHealth systems and services at local and national levels.

Finally, both formal and informal interactions within this environment and the micro-environment they encapsulate will generate both explicit and tacit knowledge. It is of the greatest importance that actors in this environment be responsible for capturing this new knowledge for future use and reference through a sound PGHD knowledge management practice.

2. The Patient/Lagosian Environment: This refers to the immediate environment and factors that influence the patients’ disposition towards the use of PGHD and is independent of the hospital environment. Actors within this environment include the patient and their proxies. This is the environment where PGHD is captured, saved, shared with the patient’s healthcare provider and feedback retrieved prior to any data generated within the hospital environment.
While actions within this environment are voluntary as desired by the patient, external influences from both the hospital and external environment are fundamental for the overall success of PGHD adoption in this environment. In other words, the key effort of the adoption framework is focused on this environment as it is the epicentre of the PGHD journey into (a) the hospital environment for an improved care decision (as in the case of Study-2 - PGHD diabetes management) and seamless communication between patient and doctor, (b) the external environment where much needed information as could be obtained through PGHD is used for reaching decisions on how to allocate resources and plan health interventions for public health.

3. The Hospital Environment: this refers to the environment where the shared PGHD is received, analysed, feedback to patients sent out and relevant patient health information from the PGHD integrated into patient hospital record. Factors influencing this environment include: the willingness of the medical doctors and other healthcare providers to engage patients while they are not within this environment, adequate health information technology hardware to support feedback and integration of data deemed relevant from shared PGHD, how policy makers and hospital administration would cater for the possible disruption to medical doctors’ workflows as a result of inflow of PGHD to this environment, absence of defined ethics regarding PGHD use and health information exchange (HIE) standardisation, disparate health information system interoperability and finally, the absence of a PGHD framework.

Actions by actors within this environment should be borne out of policy instituted by the actors in the external environment, as passed unto hospital administration. This will ensure HIE standardisation, proper definition of roles and allocation of needed resources and PGHD usage responsibility and accountability across the State.

8.2.2 Identification of Core Components

Components are an inherent part of any system or framework, and they are the core features that need to be present and functioning together effectively if value is to be created and sustained (Gann and Salter 2000). To further comprehend the actions and reactions within the three-highlighted environments while adhering to the sociotechnical principle guiding the
framework conceptualisation, the major components in play at all times within each of the respective environment aforementioned are: *people, processes* and *technology*. These triumvirate components over time have been established as key components in play within any information technology-modelled system (Heeks 2002; Phaal, Farrukh and Probert 2004; Walsham and Sahay 2006; Avgerou 2008). These components were identified to be in play during *Study-1* and *Study-2*.

Orlikowski and Robey (1991) opine that while the sequence of relevance of each component is mapped to the system it exists within, the principle guiding the sociotechnical approach to system design espouses building and developing systems around the human component (people) within the system. Figure 8.2 illustrates how the PGHD environment and components at play in the environment converge.

**Figure 8.2 The PGHD Components**

*NOTE* *The flow path between the patient and hospital environment indicates the active loop of the three components in effect – as information and other forms of interactions travel between the environments. The processes and technology components overlap the loops existing across the entire environments.*

**The arrow direction from the external environment towards the two internal environments indicates the influence it has on these environments and on the existing components.*
1. **People:** As a component, the human factor (people) exists across the entire PGHD environment identified, and is the basis upon which all other components and subcomponents are modelled. The PGHD environment as a sociotechnical system would naturally involve interactions between people, processes, and technology. To attain joint optimisation across all environments and components, Ropohl (1999: 186) suggests shaping both the social and technical conditions of the system in a way that efficiency and humanity would not contradict each other. To understand the complexity of any system mostly implies understanding the complexity of the human factor in the system. In relation to the adoption of PGHD for diabetes management within the study area, this study categorises the people factor on the premises of their environment as illustrated in Figure 8.3.

![Figure 8.3 The People Component in each PGHD Environment](image)

The interactions within and between these environments (both to and fro, shown by the arrow direction) as a result of the people component are the core upon which processes are identified, defined and enabled by the corresponding technology. This reaffirms the sociotechnical approach taken in developing the framework - as primarily the patient, their healthcare provider
and policy makers are central to all other components. Insight on the impact of the people component as it relates to another component across each respective environment was gained during both Study-1 and Study-2. Furthermore, the insight gained formed the basis for the indicators identified as metrics for this component evaluation. As informed by Study-1 and Study-2, Table 8.1 identifies the entire people (stakeholder) component in the framework chain of adoption and details how they interact and impact on each other.
### Table 8.1 People Component Analysis – (Stakeholders Analysis)

<table>
<thead>
<tr>
<th>Environment</th>
<th>People</th>
<th>Actions within environment</th>
<th>Interactions between environment</th>
<th>Existing risk &amp; Contingencies</th>
</tr>
</thead>
</table>
| 1. Patient Environment | 1a. The diabetic patient | -Diabetic patient consensually captures the agreed data (fasting blood sugar level, postprandial blood sugar, dietary & exercise data, blood pressure, hyper/hypoglycaemic episodes and any symptoms observed while out of clinic or before next doctor’s appointment) periodically, having decided with whom (healthcare provider) PGHD is shared with. Periodically receives feedback from healthcare provider, and acts | -Correspondence between healthcare providers (medical doctors & nurses) as agreed upon (time, frequency of correspondence, medium of PGHD share and feedback. | **Risk 1**. Patient data usage & accountability breach.  
**Contingency.** Since the patient absolutely owns the data at all point, regardless in what form (in-storage, in-usage & during various data transfer stages); in the event of breach, a sanction as prescribed by policies from policy makers in the external environment should kick-in. This robust safeguarding mechanism, with proper legal backing will serve as a deterrent, punitive and reassuring measure to all stakeholders. At present, this contingency remains undefined in the study area, due to the absence of a dedicated health data act. |
| Risk | 1<sup>st</sup> | Patient over-dependence on feedback from PGHD practice might dissuade them from keeping hospital appointment. **Contingency.** Patient’s healthcare provider must always remind the patient as a *subtext* after each correspondence that; PGHD only serves the purpose of complementing & not replacing the care they already receive - by making available more health information for decision making concerning their health.  
**Risk 2<sup>nd</sup>.** Inability to cope with PGHD process & supporting technology. **Contingency.** PGHD usage education. |
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<tbody>
<tr>
<td>1b. Patient proxy <em>(personal caregivers or designees)</em></td>
<td>upon it.</td>
<td>-Being the formal designated carer, in the event the diabetic patient is unfit (physically or technically) to capture and share their PGHD, ensures PGHD capture, share and response to feedback continues. Might serve as next of kin to patient.</td>
</tr>
<tr>
<td>1c. Patient’s other immediate or extended family</td>
<td>-Supports patient with their diabetic condition by reminding patient to medicate, diet, exercise and make healthy lifestyle choices. Helps patient with the capture and share of their PGHD.</td>
<td>-Plays the same role as the patient proxy; only difference being that care rendered isn’t paid for as in the case with professional personal caregivers.</td>
</tr>
</tbody>
</table>

was fundamental during the recruitment phase for Study-2. This ensures patient competency is established prior to PGHD adoption, and PGHD activities modelled around established patient technical, literacy and cognitive competency. Also, the support of patient proxy, family and friends contains this risk.

*Risk 1<sup>st</sup>.* Patient likelihood of providing false information via PGHD

*Contingency.* Health information from PGHD ideally should remain consistent with patient historical data captured within hospital environment, though there might be likelihood of error or forged data from the patient ‘PGHD’, collaborating medical doctors treated
PGHD collected as supplementary information that enhanced their decision making, and without precedence to actual primary data collected during patient hospital visit.

<table>
<thead>
<tr>
<th>People</th>
<th>Actions within environment</th>
<th>Interactions between environment</th>
<th>Existing risk &amp; Contingencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Hospital Environment</td>
<td>2a. Medical Doctors</td>
<td>- As observed in Study-2; aside from periodic face-to-face appointments with the diabetic patients, they also reminded the patients to (a). Capture their PGHD as agreed upon, (b). Reviewed the captured PGHD, (c).</td>
<td>Risk 2. Disruption of doctors formalised existing workflow. Contingency. There is a need for a dedicated staff (PGHD-analyst or nurse) to preview sent in PGHD from patients’ in order to assess if urgent action is needed before the doctor eventually reviews the data. This was</td>
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<td><strong>primary stakeholders, but not as central like the patient is to other stakeholders.</strong></td>
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<td></td>
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<tr>
<td><strong>2b. Nurses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supports medical doctor within the hospital environment by preparing the patients before they meet the doctor. They also handled and retrieved patients’ hospital folders during the Study-2 period.</td>
<td></td>
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<td></td>
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<tr>
<td>Gave feedback through agreed electronic medium, (d). Raised escalation if need be - from the PGHD received, and (e). Decide vital information from PGHD to be integrated into patients’ hospital folder.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>For Study-2, only the medical doctors interacted with the 53 diabetic patients’ that were involved with the study. Ideally, the nurse and other staff PGHD role would be to act as doctors’ proxy if need be.</td>
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<td></td>
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</tr>
<tr>
<td>suggested in Study-1 via survey response from medical doctors in Lagos State.</td>
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</table>

**Risk 2**. Patient data usage & accountability breach

**Contingency.** Refer to contingency in Risk 1.

**Risk 2.** Inadequate HIT facility to support PGHD from patients.

**Contingency.** At the moment, this remains one of the most inhibiting factors towards patients’ health information digitisation in Nigeria. To overcome this, the Study-2 PGHD capture and correspondence was
| 2c. Medical director | Performing oversight functions as regards entire hospital operation. In the case of Study-2, the medical director in the General Hospital the actual study took place was responsible for approving the study ethics. | For Study-2, only the medical doctors interacted with the 53 diabetic patients’ that were involved with the study. Ideally, the medical director PGHD overarching role would be to oversee operation and ensure standards are met. | designed around the sociotechnical ability of the patient and available enabling technologies within the medical doctor hospital environment. Risk 2. No existing PGHD legal framework. Contingency. Refer to Risk 3.

| 3. External Environment | Lagos State Health Service Commission (LSHSC) | Asides from approving the Study-1 & Study-2 ethics (LSHSC), this actor’s statutory obligations should include but not limited to; (a). PGHD facilitation for both patients and their healthcare providers. (b). Define and regulate HIE standards, (c). Monitor interactions across patient | As observed from study LSHSC should provide oversight functions such as; facilitation (PGHD capacity development), monitoring and regulation of interactions between and across the patient and healthcare providers environment. | Risk 3. As observed during the study; at present, there is no robust legal framework specific to PGHD ownership, usage, privacy and security definitions (United Nations Foundation 2015: 18). The current laws applicable to the health sector do not contain robust safeguards for the processing of patients’ information, and to address the deficiencies in the laws applicable to the protection of |
healthcare providers. However, this doesn’t imply actors in this environment were oblivious to the actions between the environments with primary impact.

| and hospital environment in order to ensure meaningful use of PGHD, (d). Develop best practices based on its oversight capacity, and externalise knowledge gained via multiple channels for the benefit of all People component the Lagos State PGHD environment. Overall, the actors should lead the capacity development of PGHD in the State. | patient information would require both short and long-term actions (United Nations Foundation 2015: 19). |
2. **Processes:** As a component, ‘processes’ are the systematic actions and interactions within and between the three PGHD aforementioned environments. These processes include all series of actions taken within the patients’ environment, and how these actions link up with the actions taken in the hospital environment and overseen by the external environment in order to successfully capture, store, share, healthcare provider review and offer feedback correspondence with his or her patient. The processes were identified at various phases (PGHD pre-usage phase and PGHD actual-use phase) of the *Study-2*. The PGHD pre-usage phase and actual-use phase processes observed were mapped around the people component within their environment and during their interactions with actors in other environments as seen in Figure 8.4.

![Figure 8.4 The Process Components in each PGHD Environment](image)

For the patient actor, the observed processes involved actions taken towards consenting to engage in PGHD practice, PGHD literacy preparation, capturing, storing sharing and PGHD feedback correspondence with healthcare provider.

For the healthcare provider, the observed processes involved actions taken towards informing, engaging, empowering, partnering and supporting patients PGHD practice.
The processes observed for the actors in the external environment, include all actions that support the regulation, facilitation and monitoring of PGHD in Lagos State.

Figure 8.5 illustrates the PGHD processes observed during pre-usage and actual use phase in Study-2. With the primary users (patients and doctors) at the centre, the actual 3-month PGHD capture, share and feedback correspondence was designed and continually improved upon according to the needs of the users. This user-centric approach that mirrors principles of sociotechnical system design ensured the users, and not processes or technology, influenced every input made towards achieving the Study-2 objective. For the study, actors in the external environment approved the study ethics, while playing their default oversight role throughout the study duration.

Figure 8.5 The Process Map for actual 3-Months PGHD exercise in Study-2

All the PGHD processes identified revolved around the sociotechnical ability of the main primary user (patient). This was achieved by naturally observing and responding to the recurring demands of the 53 diabetic patients studied. Also, these observations made enabled the medical doctors (healthcare providers) to ascertain the level of technical and non-technical support needed by each diabetic patient, thus iteratively
informed on the best approach for improving the PGHD experiences of the 53 diabetic patients studied.

3. **Technology:** While PGHD practice involves a series of actions that result in the creation of data that benefit all involved stakeholders, the capture, share, storage, integration and feedback correspondence rely on various technologies that serve as PGHD enablers. Often, the usual misconception as regards health interventions focusing on patients is that it is primarily all about technology (Sassman 2014: 117). This is not true; technology is a necessary enabler of PGHD actual use as it assists in linking the primary stakeholders with information and with each other, but not the overarching solution. It was pertinent that the required technology for PGHD practice in Lagos State “fits” the people and process components, otherwise it defies the sociotechnical concept underpinning the framework development. (See Figure 8.6)

![Figure 8.6 The Three Components in the PGHD Environment](image)

Each of the three components is seen respectively from the perspective of the environment they impact upon, as well as from the interactions they have on the other two environments. Within each of the components are attributes unique to them, and with far reaching impacts
on other components and environments. It is to be noted that given the differences in level of health literacy and disparity in tech-savviness within the studied population, it was inherent that the prescribed technology for each individual fit with their sociotechnical ability (Sawyer and Jarrahi 2014). Based on observation made during Study-2, the listed enabling technology in the patient and hospital environments as shown in Table 8.2 played significant roles in actualising the PGHD exercise that has informed this framework development.
Table 8.2 PGHD Technology Requirement Analysis

<table>
<thead>
<tr>
<th>PGHD Environment</th>
<th>Enabling Technology</th>
<th>Purpose</th>
<th>Potential Risks</th>
<th>Contingency</th>
<th>Level of Expertise Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patient Environment</td>
<td>• Gluometer (blood glucose monitoring device)</td>
<td>To monitor and capture blood glucose level</td>
<td>1a&lt;sup&gt;1&lt;/sup&gt;. Patient not being able to use the device or capture readings</td>
<td>Patients were educated by the involved doctors on proper use of glucometer. Patients that required extra support were offered further support on the device operation and blood glucose level capture.</td>
<td>It was observed that all the study participants had previous experience of glucometer usage. This previous knowledge implied that they only required a bit brush-up on how to operate the device for those who had forgotten how to use the device. The patients exhibited self-efficacy of device use as a result of pre-existing knowledge on their device choice. Most of the patients had smart mobile</td>
</tr>
<tr>
<td></td>
<td>• Mobile phone</td>
<td></td>
<td>1b&lt;sup&gt;1&lt;/sup&gt;. Patient running out of test-strips</td>
<td>More than enough test-strips were provided for the 3 months study duration.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Smart phone</td>
<td></td>
<td>1c&lt;sup&gt;1&lt;/sup&gt;. Device malfunction or loss</td>
<td>There was extra glucometer to give out in the event of malfunction or during the study duration.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Email account</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Tablet/iPad</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>For PGHD Storage, Sharing and feedback correspondence with care provider. Also as a device that</td>
<td>1a&lt;sup&gt;2&lt;/sup&gt;. Not having mobile phone/device or not able to use one of the listed devices.</td>
<td>This requirement needed to be met by the consenting patients as a precondition for study inclusion criteria.</td>
<td></td>
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</table>

Note: 
- **1a** refers to the potential risk of the patient not being able to use the device or capture readings.
- **1b** refers to the potential risk of the patient running out of test-strips.
- **1c** refers to the potential risk of the device malfunction or loss.
### 2. Patient Environment and Hospital Environment

- **Actors uploading:**
  - Patient
  - Patient’s Family or Proxy
- **Actors reviewing and giving feedback:**
  - Medical doctors
  - Healthcare provider

<table>
<thead>
<tr>
<th>Actors uploading</th>
<th>Actors reviewing and giving feedback</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient</td>
<td>Medical doctors, healthcare provider</td>
<td>Served as a repository platform for all the PGHD collected during the 3-months study. This was the platform the Internet-based diabetes management system (IBDMS) connected.</td>
</tr>
<tr>
<td>Patient’s Family or Proxy</td>
<td>Patient</td>
<td>connect enables the patients to access the internet-based diabetes management system (IBDMS)</td>
</tr>
</tbody>
</table>

**1b.** Loss of mobile phone/device, not having airtime or data bundle for accessing communication network. The consenting patients were asked to list all mediums suitable for PGHD practice. Report loss of the device they use for PGHD correspondence, and continue correspondence with their next of kin or proxy device. In the event of no-airtime or data bundle, such patients were contacted by their assigned doctors to collect their weekly PGHD.

**2a.** Patients unable to upload their PGHD on the IBDMS. Alternatives such as upload via SMS, phone calls or emails were made available for the patients.

Patients received adequate instruction on how to access and upload PGHD unto the IBDMS during recruitment phase. Those who showed little competencies on how to complete this task were asked to have their proxy or family members help them.

**2b.** Loss of mobile phone/device, not having airtime or data bundle for accessing communication network. The consenting patients were asked to list all mediums suitable for PGHD practice. Report loss of the device they use for PGHD correspondence, and continue correspondence with their next of kin or proxy device. In the event of no-airtime or data bundle, such patients were contacted by their assigned doctors to collect their weekly PGHD.

- **Laptop/PC**
- **Internet-based diabetes management system (IBDMS)**
<p>| | | |</p>
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<tr>
<td></td>
<td>collaborating medical doctors used for analysing the uploaded PGHD before giving feedback and for monitoring participating patients’ upload compliance.</td>
<td><strong>2b</strong>. Loss of data uploaded on the IBDMS. The system administrator (the researcher), ensured duplicate backup of the IBDMS was regularly made and stored remotely offline.</td>
</tr>
<tr>
<td></td>
<td><strong>2c</strong>. Data breach: Privacy, security and responsible use issues. All patients’ identifications were coded and anonymised. The researcher and healthcare providers were the only actors’ privy to the coded participating patient identification. As regards responsible use, each actor with access to the IBDMS was required to provide an assigned access code before accessing the IBDMS. This access code also served as a means for monitoring use and ensuring usage accountability of the data on the repository platform.</td>
<td></td>
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</tbody>
</table>
8.2.3 Identification of Phases and Indicators

Over time, the reference to the word “indicator” has gained wide use in documents from international agencies and scientific groups (Kjellstrom and Corvalán 1995: 144). Investments made in the form of targeted health interventions can be measured for value through a series of pre-set indicators that are methodically and periodically applied as instruments of a framework evaluation (Handler, Issel and Turnock 2001; WHO 2010: 29). Sassman (2014: 140) suggests that indicators function as metrics that monitor and measure progress in meeting expectations and standards for each component or element within phases of a framework. Sassman (2014: 140) further argues that these metrics ought to be efficient, effective and impacting on the expectations set to be met by any framework, if progress is to be achieved.

Having founded this adoption framework on pre-established readiness and acceptance information system theories (Technology Readiness and Technology Acceptance Model) and the internal PGHD actual use indicators such as PGHD upload compliance, glycated haemoglobin baselines (pre HbA1c and post HbA1c) and pre- and post- administered questionnaires, these formed the basis of the indicators integrated at various phases of the PGHD adoption framework (See Figure 8.7).

![Figure 8.7 Schematic of proposed PGHD Adoption Framework & Evaluation Phases](image)

As seen in Figure 8.7, the indicators form the basis of the framework evaluation within the PGHD-readiness phase and PGHD actual-use phase. These two phases are further broken down to give a total of five sub-phases as informed by the literature and primary observations during Study-1 and Study-2 (See Figure 8.8).
8.2.3.1 PGHD-Readiness Phase

This phase was informed by the information gained during Study-1 technology readiness. Also, information gained during Study-2 was very vital in identifying a series of indicators used in monitoring and measuring this PGHD-readiness phase. From the reviewed literature and similar frameworks on patient engagement with healthcare providers, the pre-study phase was designed and modified to fit the study environment. The iterations made in order to accommodate and respond to all issues observed during the actual PGHD study informed on three sub-phases in the PGHD-readiness phase that lasted for 2 weeks of prior to the 3 months of Study-2. These sub-phases include:

- **Phase 1.** Inform diabetic patient of PGHD and request for their consent:
  - If consent is not given, the responsible healthcare provider (HCP) attempts to understand and resolve the issue while documenting the experience gained from the interaction, as a future knowledge resource.
  - If consent is given, the framework advances to Phase 2.

- **Phase 2.** Engage Diabetic Patient:
  Having gained the diabetic patient’s consent, this phase involved HCP ascertaining the patient’s health literacy level for PGHD from the consensual interaction. The HCP educated and tailored PGHD care plan to fit the patients’ sociotechnical
ability as informed by the patient’s pre-existing hospital record and other psychographic attributes observed. It was important that the bespoke PGHD care plan was mutually arrived at in order to benefit both the patient and HCP. This meant that the HCP workflow didn’t suffer as a result of the extra attention needed by patients as a result of PGHD practice. The HCP captured the patient’s pre-HbA1c level and BMI as initial baseline for subsequent HbA1c and BMI monitoring and evaluation, then the framework advances to Phase 3.

- **Phase 3.** Empower Diabetic Patient:

From observations made in Study-2, most of the participating diabetic patients required some form of empowerment and this was met via the incentives that mirrored the facilitation expected from the external environment. Though actual facilitation is lacking at the moment, the observation made in this phase implies that there is a need for the external environment and hospital environment to mutually facilitate patients’ PGHD practice via tailored incentives, provide responsible PGHD usage, safeguarding policy on data ownership, security, privacy and unique issues emerging over time. This sub-phase completed the PGHD-readiness phase, after which the framework advances to Phase 4.

### 8.2.3.2 PGHD Actual-Use Phase

Having confirmed that, at this point, the patient met all inclusion criteria from the PGHD-readiness phase, the PGHD actual-use phase takes off. Recommendations made were informed by the actual PGHD practice undertaken during the Study-2 duration and this resulted in identifying the two sub-phases that made up this phase. These two sub-phases include:

- **Phase 4: Partner with Diabetic Patient:**

  Having informed, engaged and empowered, where necessary, the diabetic patient, this sub-phase observed and executed the following actions in order to deliver its set objectives.

  ✓ The healthcare provider (HCP) regularly reminded their assigned patients to adhere to their tailored PGHD care plan via periodic Email, SMS and Phone calls.

  ✓ The HCP integrated relevant shared data into the patient’s hospital record.

  ✓ The HCP gave prompt feedback via a pre-agreed correspondence medium.
Based on the level of PGHD compliance, follow-up patients who aren’t complying as agreed.

Capture of post-HbA1c level and BMI results for monitoring and evaluation of diabetic patients’ progress. This was compared with the baseline pre-HbA1c level and BMI results.

**Phase 5: PGHD Practice Sustainability through Continuous Support:**

As informed from the post-study experience responses garnered from the 53 diabetic patients studied and from the collaborating medical doctors, the following recommendations were unanimously reached as a practical guide that would ensure sustainability of the PGHD practice in Lagos State Nigeria.

Building on Phase 4 evaluation and subsequent re-evaluation:

- Incorporate local measures that would support and respond to patient-HCP data flow dynamics; although at present, there is absence of a well-defined health information exchange standard.

- There is a need for the continuous incentivisation of willing participants in order to limit costs and encourage PGHD usage sustainability. Although the study was incentivised by the researcher (making glucometers available to participating diabetic patients who needed them), actors in the external environment need to play a major role in PGHD use facilitation in the State.

- For sustainability of the practice, both the actors in the external environment and hospital environment should continuously sustain Phase 4 actual use re-evaluation as this will offer insight on how beneficial or disruptive the PGHD practice is to stakeholders.

- In no small measure, PGHD practice will yield a huge amount of data and lessons for the State on how best to scale the practice for other health interventions that have patients at its core will be learnt. Therefore, there is a need for proper management of knowledge and lessons learnt for continuous PGHD capacity development and intervention replication.

From the empirical evidence obtained in **Study-1** and **Study-2**, Table 8.3 provides a comprehensive picture, of the relevant indicators and the environment in which they function.
Table 8.3 Proposed Indicators for PGHD Adoption Framework

<table>
<thead>
<tr>
<th>PGHD Environment</th>
<th>Phase</th>
<th>Sub-Phase</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hospital Environment</td>
<td>• PGHD-Readiness Phase</td>
<td>Phase 1: Inform Diabetic Patient of PGHD</td>
<td>1a. Patient consent status: this indicator tells if the patient is consenting to participate in the PGHD practice with his healthcare provider.</td>
</tr>
<tr>
<td></td>
<td>• <strong>Frequency</strong>: Ideally should take place within the first two weeks and the indicators for this readiness phase</td>
<td>Phase 2: Engage Diabetic Patient</td>
<td>1b. As observed; either by doctor or nurse during phases 1, 2 &amp; 3 contact. Administer PGHD-Readiness (PGHD-R) questionnaire. This will help to establish the level of patient ‘PGHD’ propensity. Based on their degree of; (1). Optimism (2). Innovativeness (3). Discomfort (4). Insecurity The four aforementioned readiness constructs were informed from PGHD-TR Study-1 findings.</td>
</tr>
</tbody>
</table>
|                    |                                      |                                                                           | It is important that the content of the PGHD-R questionnaire is designed to mirror hospital environment fitness of practice (this was
informed from the advice given by the collaborating medical doctors). This will ensure nothing overwhelms the existing available resources in the hospital environment while making clear expectations expected from both parties (patient and healthcare provider respectively).

<table>
<thead>
<tr>
<th>Phase 3: Empower Diabetic Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>1c. The initial baseline vitals are captured; Pre-HbA1c test and BMI for subsequent HbA1c level and body mass index (BMI) monitoring. If indicators <strong>1b</strong> and <strong>1c</strong> are achieved, then Phase 2 and Phase 3 are successful.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2. Hospital Environment and Patient Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>PGHD</strong> Actual-use Phase</td>
</tr>
<tr>
<td>• <strong>Frequency</strong>: During face-to-face hospital appointment and in the advised order from the involved</td>
</tr>
<tr>
<td>Phase 4: Partner with Diabetic Patient</td>
</tr>
<tr>
<td>2a. As observed; either by doctor or nurse during periodic phase 4 contact; the perceived level of patient actual PGHD usage:</td>
</tr>
<tr>
<td>(1). Usefulness,</td>
</tr>
<tr>
<td>(2). Ease of use,</td>
</tr>
<tr>
<td>(3). Facilitating condition,</td>
</tr>
<tr>
<td>(4). Social influence,</td>
</tr>
<tr>
<td>(5). Self-efficacy</td>
</tr>
<tr>
<td>(6). PGHD security and privacy</td>
</tr>
<tr>
<td>Medical Doctors</td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>1. Evaluate diabetic patient ‘PGHD’ actual-use after first 3-months of PGHD-Readiness phase evaluation.</td>
</tr>
<tr>
<td>2. Evaluate diabetic patient ‘PGHD’ actual-use after 6 months of PGHD-Readiness phase evaluation.</td>
</tr>
<tr>
<td>3. Subsequently re-evaluate actual use after every 3/6 months (applicable to Phase 5)</td>
</tr>
</tbody>
</table>
8.3 Implementation Method

While framework development could be linear or iterative (Knight, Steinbach and Kellen 2001; CMS 2008; Fisher, McDaniel and Hughes 2008), the proposed framework has reflected the observations made from the actual actors in the environment studied. The processes within the PGHD-readiness phase (phases 1, 2 and 3) are linear, but have been refined after several iterations made during Study-2. Likewise, the PGHD actual-use phase comprising of sub-phases 4 and 5 have been refined after several iterations made during Study-2. In order words, in keeping with the sociotechnical principles of system/framework design, the proposed phases have been founded on empirical evidence from PGHD primary users in both Study-1 and Study-2. Figure 8.9 illustrates the sequence of the proposed framework phases and stages of evaluation. Applying the indicators identified, the first PGHD-readiness (PGHD-R) phase evaluation is concluded at the end of phase 3, within the first two weeks of phase 1. The PGHD actual-use (PGHD-AU) phase evaluation is the second evaluation of the framework and was conducted at the end of the first three months, as advised by the medical doctors. The evaluation processes executed in phase 4 are repeated in phase 5 in order to sustain the PGHD practice in Lagos State Nigeria. See Table 8.4 for step-by-step details of the proposed PGHD adoption framework.

![Figure 8.9 Proposed PGHD Adoptions Phases with Evaluation Sequence](image-url)
Having identified and defined all the environments and core components observed and recommended by the actors involved in Study-1 and Study-2 (PGHD actual-use study), Table 8.4 details comprehensively how all the components (people, processes and technology) within their respective environment (external environment, patient environment and hospital environment) form a synergy that functions to realise the framework implementation goal. The six columns represented in Table 8.4 include:

- **Implementation Phase;** with environment, each phase is detailing across the row,
- **People;** with all respective actors and their expected responsibility in the environment and respective phase,
- **Processes;** with all sequentially observed findings and activities undertaken over the course of the two studies that have informed the proposed framework,
- **Enabling technology and Data Generated;** with all the technology and the data generated as a result of using that technology,
- **Indicator;** with all metrics, evaluation technique and frequency for monitoring and measuring each phase that makes up the proposed framework,
- **Potential Knowledge Gained;** with all possible knowledge expected to be realised within each phase and synergy of the three core components (people processes and technology) of the proposed framework.

Table 8.4 also illustrates how the external environment surrounds the internal environment that consists of the patient environment and hospital environment, with its oversight functions.

<table>
<thead>
<tr>
<th>Table 8.4 Legend:</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI = Body Mass Index</td>
</tr>
<tr>
<td>External Environment = E.E</td>
</tr>
<tr>
<td>Hospital Environment = H.E</td>
</tr>
<tr>
<td>Patients Environment = P.E</td>
</tr>
<tr>
<td>Diabetic Patient = D. Patient</td>
</tr>
<tr>
<td>Internet-Based Diabetes Management System = IBDMS</td>
</tr>
<tr>
<td>Lagos State Health Service Commission = LSHSC</td>
</tr>
<tr>
<td>Lagos State Ministry of Health = LSMH</td>
</tr>
<tr>
<td>PGHD-R = Patient-generated Health Data Readiness</td>
</tr>
<tr>
<td>PGDH-AU = Patient-generated Health Data Actual-Use</td>
</tr>
</tbody>
</table>
## Table 8.4 Proposed PGHD adoption framework implementation phases detailed

<table>
<thead>
<tr>
<th>Implementation Phase</th>
<th>People</th>
<th>Processes</th>
<th>Enabling Technology &amp; Data generated</th>
<th>Indicators</th>
<th>Potential knowledge Generated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 1.</strong> Doctor informs diabetic patient of PGHD during regular patient-doctor appointment in the hospital.</td>
<td>Championed by: Doctor, Nurses For: Patient &amp; Patient proxy and family.</td>
<td><strong>1.1</strong> Doctor informs patient of PGHD and what it entails. Asks patient for consent.</td>
<td><strong>Technology:</strong> Since contact is face-to-face, within H.E, paper document signed. If H.E supports computer access during patient interaction, patient signs soft copy of consent document.</td>
<td><strong>Patient PGHD consent status.</strong> If consent is granted by patient at first, this signifies their interest and willingness to hear and learn about PGHD (Phase 1 successful). If consent not given at first, but given after further enlightenment, then Phase is deemed successful.</td>
<td><strong>For H.E (Doctor and Hospital administration):</strong> (a). Gains insight on patients concerns and disposition to PGHD. (b). Based on insight gained via PGHD-R evaluation, improve as an organisation on how to respond to patients demands, and on how to offer tailored support for patients based on their psychographics.</td>
</tr>
<tr>
<td><strong>Environment:</strong> H.E</td>
<td></td>
<td></td>
<td><strong>Data generated:</strong></td>
<td></td>
<td><strong>For Patients:</strong> (a). Becomes aware of PGHD and how it could benefit their diabetes management &amp; health.</td>
</tr>
</tbody>
</table>

PGHD-Readiness Phase (First 2 weeks)
| Phase 2. Patient is Engaged. | Championed by: Doctor, Nurses For: Patient & Patient proxy and family relatives. | 1.2 Patient either gives consent directly or through proxy/family to try out PGHD. If consent is not gained, doctor makes note of reason why, and try to resolve reason. If consent is gained, consent document is signed & document added to patient’s hospital record. Consent document should details patient’s right to; PGHD usage accountability, refuse 3rd party access to PGHD, privacy and security, ownership, and withdrawal from PGHD sharing if so desired. Also alternate contact details in the event patient cannot be reached at any point. | 1.3 If consent is not gained, doctor makes note of reason why, and try to resolve reason. 1.4 If consent is gained, consent document is signed & document added to patient’s hospital record. Consent document should details patient’s right to; PGHD usage accountability, refuse 3rd party access to PGHD, privacy and security, ownership, and withdrawal from PGHD sharing if so desired. Also alternate contact details in the event patient cannot be reached at any point. | 1.4 If consent is gained, consent document is signed & document added to patient’s hospital record. Consent document should details patient’s right to; PGHD usage accountability, refuse 3rd party access to PGHD, privacy and security, ownership, and withdrawal from PGHD sharing if so desired. Also alternate contact details in the event patient cannot be reached at any point. | 2.1 Educate the consenting diabetic patient on required PGHD care instructions based on their health literacy, cultural values, technical & financial | Technology: Contact still within H.E, hence HbA1c analyzer, height and weight measurement scales. (In ³Captured Pre-HbA1c test and body mass index (BMI) serves as initial baseline for | Administer PGHD-Readiness (PGHD-R) Questionnaire to establish the level of patient ‘PGHD’ propensity. Based on their degree of; (a). Optimism (b). Innovativeness (c). Discomfort (d). Insecurity Design of PGHD-R questionnaire items and administration technique should mirror H.E fitness of practice. (b). Becomes aware of their right to PGHD ownership, privacy, security & other unique issues observed. For E.FLSMH/LSHSC: (a). Gains better and continuous insight on concerns (i.e. PGHD usage responsibility, accountability, privacy, security and ownership) that might impede patients’ readiness to adopt PGHD. (b). Identifies challenging aspects in both H.E & P.E that requires facilitation. ³Captured Pre-HbA1c test and body mass index (BMI) serves as initial baseline for (c). Based on insight gained via PGHD-R evaluation, identify areas of facilitation that would enhance H.E capacity to better support patients. |
(a). Decide with involved actors, types of PGHD to be captured (e.g. preprandial & postprandial glucose level, dietary, medication and exercise information, blood pressure level, symptoms and episodes of hypo/hyperglycaemia etc.).

(b). Decide on PGHD capture medium & frequency of capture (e.g. Mondays, Wednesdays, Fridays and upload over the weekend via agreed secure channel).

(c). Educate patient on various means to store and retrieve copies of captured PGHD (e.g. in accompanying glucometer logbook, on their personal electronic device using dedicated mobile applications, etc.).

(d). Based on evidence, design capacity development programmes for PGHD primary actors.

(e). Creates body of knowledge that has the ability of harnessing grassroots patients’ information towards planning of subsequent patient-centric health interventions that might rely on PGHD.

Data generated:

2a. Data on patient’s PGHD readiness (e.g. level of health literacy, financial ability to purchase glucometer, test strips, internet-enabled device for PGHD recording, uploading, share and feedback retrieval with doctor).

2b. Tailored care instruction data – as informed by patient’s ‘PGHD’ sociotechnical ability (or as agreed with their proxy/family). This includes:

- Data on level and BMI indicators achieved, then Phase 2 and 3 successful.
- Design capacity programmes for PGHD primary actors.
- Form policies around both best & poor practices observed.
- Creates a body of knowledge that has the ability of harnessing grassroots patients’ information from patients towards planning of subsequent patient-centric health interventions that might rely on PGHD.

3a. Data on patient’s PGHD readiness (e.g. preprandial & postprandial glucose level, dietary, medication and exercise information, blood pressure level, symptoms and episodes of hypo/hyperglycaemia etc.).

3b. Data on patient’s PGHD readiness (e.g. preprandial & postprandial glucose level, dietary, medication and exercise information, blood pressure level, symptoms and episodes of hypo/hyperglycaemia etc.).

4a. Data on patient’s PGHD readiness (e.g. preprandial & postprandial glucose level, dietary, medication and exercise information, blood pressure level, symptoms and episodes of hypo/hyperglycaemia etc.).
or over a dedicated IBDMS.

(d). decide on best practical medium for PGHD share (e.g. via secured email, SMS, phone call, dedicated mobile app or over a secured online diabetes management web app.)

(e). doctor/nurse enlightens patient on how PGHD is used to benefit patient’s diabetes self-management and as well improve doctor-patient shared decision making.

2c. Data on Patient’s pre-HbA1c test & BMI – this will serve as baseline for monitoring and evaluating patient’s progress.

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>3.1 E.E, in partnership with the H.E should empower patient through: (a). incentives such as free or discounted HbA1c test, glucose monitoring supplies and education/enlightenment programmes to improve patient</td>
<td>Technology: Contact still within H.E. Doctor/nurse records observations and integrate relevant information to patient’s hospital record.</td>
</tr>
</tbody>
</table>
health literacy. (As informed by instances of some patients’ inability to afford cost of HbA1c test, purchase glucose monitoring supplies or not literate enough and without adequate social support during Study 2).

(b). regular awareness that their consent to share PGHD is safeguarded by law.

3.2 Championing stakeholders should support diabetic patients’ by ensuring their tailored PGHD care plan is supported by other hospital staff across other departments. This will guarantee patient’s share of PGHD is not affected in the event their doctor leaves the hospital, or if patient is referred to other department within same hospital.

Data generated:
3a. data on level and area of facilitation needed by each patient.
3b. Overall data on patient’s PGHD care plan.
**PGHD-Readiness Phase Evaluation:** Evaluate diabetic patient PGHD-Readiness – Based on indicators $\frac{1}{2}$ and $\frac{3}{2}$ (PGHD-R Questionnaire)

<table>
<thead>
<tr>
<th>Implementation Phase</th>
<th>People</th>
<th>Processes</th>
<th>Enabling Technology &amp; Data Generated</th>
<th>Indicators</th>
<th>Potential knowledge Generated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 4.</strong> Partner with diabetic Patient. <strong>Environment:</strong> P.E and H.E</td>
<td>Championed by: Doctor/Nurses. For: Patient &amp; Patient proxy and family</td>
<td>4.1 Irrespective of individual patient’s PGHD care plan or level of compliance: (a). regularly remind patients either via automated SMS, Email or phone calls to capture, store and share PGHD. (b). care provider (doctor/nurse) reviews PGHD share frequency, as already agreed during Phase 2, Process 2.1.b. (c). as enabled by respective H.E, integrate relevant PGHD to patient’s hospital record (d). give PGHD feedback to patients or their proxies/family weekly, every fortnight, monthly or as agreed. This will</td>
<td>Technology: Contact between patient and doctor/nurse within their respective environment. In P.E: Glucose monitoring kit, internet-enabled device for PGHD share and feedback correspondence over a secured internet-based diabetes management system (IBDMS), mobile phone (SMS, calls) if patient cannot afford internet connected device and a PGHD logbook for patients who cannot upload their PGHD to the IBDMS (logbook.</td>
<td>4.1a As observed; either by doctor or nurse during periodic phase 4 contact; the perceived level of patient actual PGHD usage: (a). Usefulness, (b). Ease of use, (c). Facilitating condition, (d). Social influence, (e). Self-efficacy (f). PGHD security and privacy</td>
<td>For H.E (Doctor and Hospital administration): (a). Gains insight on the additional cost of PGHD care as seen from labour time required to review and communicate with patients on shared PGHD, cost incurred from data usage or mobile phone air time during PGHD correspondence with patients’. Based on insight gained via periodic PGHD-AU evaluation, continually improve as an organisation on tailored support offered to patients.</td>
</tr>
</tbody>
</table>
4.2 Consistent follow-up:
Likelihood of some patients’ not complying due to loss of interest, cost of PGHD care or as a result of personal reasons abound. Indication from patients’ level of compliance will inform on how often follow-up is done. Understand what the impeding factor could be, and partner with patient to resolve it.

Knowledge gained from this interaction is passed on to hospital administration and E.E for PGHD capacity development.

Data generated:
- 4a. Weekly (Mon, Wed, Fri or as agreed) diabetes management related PGHD.
- 4b. PGHD capture and share compliance rate data.
- 4c. Patient’s subsequent post-HbA1c test & BMI.

For Patients:
(a). possibly becomes better informed on their self-diabetes management,
(b). continually seek out means to overcome cost incurred due to PGHD care
(c). Improved self-efficacy on health literacy and gains knowledge on how to self-manage health data electronically

For E.E LSMMH/LSHSC:
(a). Cost from diabetes PGHD care incurred by both H.E and P.E informs policy makers on how much budgeting PGHD based interventions will require if it is to be replicated for other chronic disease management.

<table>
<thead>
<tr>
<th>4.3 During next patient’s face-to-face hospital appointment - post-HbA1c test &amp; BMI is carried out and result included to patient’s hospital record. (Refer to phase evaluation 4).</th>
<th>Improve shared decision making.</th>
<th>Consistent follow-up: Usually accompanies glucometer device).</th>
</tr>
</thead>
<tbody>
<tr>
<td>In H.E: Supporting computing facilities for received PGHD, internet access to the IBDMS, mobile phone correspondence for patients who can only be reached via phones or SMS.</td>
<td>4.2b Observed difference in baseline (pre-HbA1c) and post HbA1c and BMI levels after every 3 months.</td>
<td>Data generated:</td>
</tr>
<tr>
<td>4.3c PGHD captures and share compliance rate.</td>
<td>Design of PGHD-AU questionnaire items and administration technique should mirror H.E fitness of practice.</td>
<td>For Patients:</td>
</tr>
<tr>
<td>For E.E LSMMH/LSHSC:</td>
<td>(a). possibly becomes better informed on their self-diabetes management,</td>
<td>(b). continually seek out means to overcome cost incurred due to PGHD care</td>
</tr>
<tr>
<td>(a). Cost from diabetes PGHD care incurred by both H.E and P.E informs policy makers on how much budgeting PGHD based interventions will require if it is to be replicated for other chronic disease management.</td>
<td>(c). Improved self-efficacy on health literacy and gains knowledge on how to self-manage health data electronically</td>
<td></td>
</tr>
</tbody>
</table>
(b). Knowledge gained through process documentation, observation, facilitation of H.E and P.E contributes towards PGHD capacity development within Lagos State. This makes available relevant information for future patient-centred health interventions.

(c). Insight is gained on factors that influence patients’ ‘PGHD’ capture and share compliance.

### Phase 4 Evaluation

- Based on *Indicators 4.1a, 4.2b and 4.3c* (during face-to-face hospital appointment):
  1. Evaluate diabetic patient ‘PGHD’ actual use after first 3 months of Readiness Phase Evaluation
  2. Evaluate diabetic patient ‘PGHD’ actual use after 6 months of Readiness Phase Evaluation
  3. Subsequently re-evaluate actual use after every 3/6 months (applicable to Phase 5)

### Implementation Phase

<table>
<thead>
<tr>
<th>People</th>
<th>Processes</th>
<th>Data generated &amp; enabling technology</th>
<th>Indicators</th>
<th>Potential knowledge Generated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Phase 5.</strong></td>
<td>Championed by: LSHSC, Doctor, Nurses. For: Patient &amp; Patient proxy and family</td>
<td>5.1 Based on feedback from actual PGHD usage evaluation and re-evaluation, continually; (a). improve measures that</td>
<td>Refer to <em>Indicators</em> section; 4.1a, 4.2b &amp; 4.3c</td>
<td><strong>For H.E (Doctor and Hospital administration):</strong> (a). Native knowledge gained on measures to</td>
</tr>
</tbody>
</table>
**Environment:** E.E, P.E and H.E

would sustain data management: Data generated from both ends will become bulkier, and consideration should be made on how existing system can support data flow, security threats to data, access requirement and usage definition as data evolves. Health information exchange standardisation.

(b). E.E (LSHSC) improve measures to reduce cost of PGHD care i.e. incentives to hospitals supporting PGHD and patients using PGHD.

5.2 E.E and H.E continuously reassure patients on benefits of responsible use of PGHD. This will assuage possible patients’ discontent from PGHD use costs incurred as a result of PGHD capture (personal storage or upload to

**In H.E:** survey/data collection tools such as online questionnaire, hardcopy questionnaire during periodic hospital face-to-face meeting with patient.

**Data generated:** Refer to data generated in section Phase 4.

(b). Ability to replicate or adapt from experience to other chronic conditions that might benefit from PGHD.

**For Patients:**

(a). Patients acquires skills on self-management of their chronic condition via PGHD

(b). Possibility of patients overall health literacy being improved from PGHD captured. Also, the tacit actions and explicit exchange between doctor and patient as a result of PGHD will definitely generate knowledge within

manage inflow of PGHD, and on how to support/educate patients to manage their PGHD
IBDMS), share and feedback correspondence with care provider.

5.3 E.E and H.E sustains Phase 4 subsequent actual-use re-evaluation; by formally incorporating it to patient chronic care self-management plan.

For E.ENLSMH/LSHSC:
(a). knowledge gained on various cost reduction measures and how it impacts on both H.E and P.E towards sustaining the adoption and continuous use of PGHD in Lagos State.

External Environment continuously provides oversight functions (regulate, monitor & facilitate) on H.E and P.E
Figure 8.10 Schematic of the PGHD Adoption Framework - initial version

PKGE* = Potential Knowledge Generated Exchanged
Table 8.4 and Figure 8.10 have presented in detail the implementation phases of the proposed PGHD adoption framework. All aspects of the proposed framework are based on the evidence obtained by triangulating data from the reviewed literature, PGHD Study-1 and Study-2. Chapter 8 part 2 reports the framework validation processes in detail; starting from the approach, strategy adopted, findings made from the external domain expert evaluators, and concludes with what these findings imply for the proposed PGHD adoption framework.
CHAPTER 8, PART 2: PROPOSED PGHD ADOPTION FRAMEWORK
VALIDATION

This part reports on the framework validation processes and further revisions made to arrive at the final validated framework. This section includes:

- Section 8.4 discusses how the framework was validated
- Section 8.5 presents and discusses the outcomes of the validated framework and the researcher’s reflection on the quality of findings underlying the PGHD adoption framework.
- Section 8.6 discusses the ethical issues considered during the development and validation of the PGHD adoption framework.
- Section 8.7 gives conclusion of the key issues reported in this chapter.

8.4 PGHD Adoption Framework Validation: Triangulation Approach

Having ensured that the users were at the centre of every decision made during the conceptualisation of the framework, the next stage involved validating the proposed evidence-based PGHD adoption framework. Research validation is undertaken in order to check, offer validity, accuracy and declare legitimacy of a scientific process and its proposal (Johnson, Onwuegbuzie and Turner 2007; Webb et al. 1966). Webb et al (1966: 3) further suggest that “if a proposition (in this case, the PGHD adoption framework) can survive the onslaught of a series of imperfect measures, with all their irrelevant errors, confidence should be placed in it”. To increase the chance of minimizing error during the PGHD adoption framework conceptualisation, the entire study was based on pure evidence. Evidence-based research, particularly in public health, involves making decisions on ways to promote health or provide care by incorporating the best available proof with practitioner expertise and other resources, and with the characteristics, states, needs, values and preferences of those who will be affected (Pravikoff, Tanner and Pierce 2005; Jacobs et al. 2012; Brownson 2017). All the aforementioned as defined by evidence base have been demonstrated to be integral to the conceptualisation of this framework.

From an information technology viewpoint, the evidence-based research approach could be argued to mirror sociotechnical principles of system design where the actions, processes, technology and other contexts revolve around the users (people component). Since evidence is, in essence, research findings obtained as a result of the systematic collection of data
through formulation of questions, observations and testing of hypotheses (PGHD Study-1 and Study-2), validation intends to add a degree of authenticity to all the processes and findings made while developing this proposed PGHD adoption framework. Therefore, the objective of the validation is to test the proposed framework usefulness, while allowing room to critique possible bias that could be inherent in the conceptualised framework through the perception of health information technology experts and various diabetic patient management stakeholders in Lagos State Nigeria.

In line with existing research work by Denzin (2011); Apena (2012) and Sassman (2014), the overall approach adopted in testing this framework meets the requirements of the triangulation method. This triangulation validation approach was done in order to add rigour and depth to the PGHD adoption framework in Lagos State Nigeria. Data has been triangulated from the literature, fieldwork in PGHD Study-1 and Study-2 (internal validation), as well as from data from the external validation carried out by domain experts (investigator triangulation) while evaluating the feasibility of the conceptual framework.

### 8.4.1 Framework Validation - Strategy Adopted

The strategy taken towards validating the proposed framework involved having each phase of it internally validated as seen from the findings reported in (PGHD Study-1 and Study-2), as well as having each phase of the proposed framework externally validated by domain experts. This double strategy ensured that the proposed framework would exhibit comprehensiveness, clarity, rigour, conciseness and correctness (Webb et al. 1966; Kerlinger and Lee 1999). Figure 8.11 illustrates the validation strategy applied in this research, with the four parameters that were used to internally validate the proposed framework. All the findings reported from the four parameters that constitute the internal framework validation have strongly informed the proposed framework and served as the premise for the domain expert evaluation.

For the external validation (investigator triangulation), the domain experts reached their conclusion after having carefully gone through the written output of PGHD Study-1 and Study-2, followed by the proposed conceptual framework. The item used in eliciting their response was a questionnaire that was designed and pretested for both content and construct validity. For the external validation questionnaire item, see research instrument section.
Internal PGHD Adoption Framework Validation

Throughout the development phase, this proposed framework was evaluated against predefined criteria drawn from literature and evidence-based research. These criteria were influenced by elements from:

1. **Study 1**: PGHD-Technology Readiness (established the Lagos State population readiness to PGHD as explorers. This implied that the State residents had high degree of motivation and low degree of resistance). The four TR-dimension constructs used in this study has been integrated as an indicator for evaluating diabetic patients PGHD-Readiness. This has been highlighted in the implementation Phases 1, 2 and 3 of the proposed framework.

2. **Study-2** achieved 68.2% PGHD capture and upload compliance. The senior consultant physician/endocrinologist that oversaw other collaborating doctors confirmed that this was an exceptional compliance level, given that this was novel in his practice and environment. The capture compliance has been integrated as an evaluation indicator in the proposed framework implementation Phases 4 and 5.

3. **Study-2** also showed a remarkable reduction in the participants’ HbA1c level from an average mean count of 8.84% (pre-study level) to 7.39% (post-study level). Although the 53 participants’ post-study mean HbA1c level didn’t meet the stipulated 6.5% level for diabetic patient with good glycemic control (Diabetes UK 2016), the senior consultant physician/endocrinologist admitted that a 1.45% reduction from the initial level is a good improvement after three-months of PGHD practice by the patients. There was no significant improvement on the participants body mass index (BMI) as the initial mean BMI of 28.5 (kg/m²) was no different with the mean post study BMI 28.4 (kg/m²) result. The HbA1c and BMI (pre and post levels) have been integrated as an actual use evaluation indicator in the proposed framework implementation Phases 4 and 5.

4. Findings from the structural equation modelling in **Study-2** PGHD-Acceptance Model (PGHD-AM) showed that 5 out of the 7 proposed hypotheses were accepted (see Table 7.14). The six exogenous PGHD-AM constructs used in this study has been integrated as an indicator for evaluating diabetic patients PGHD Actual-Use. This has been highlighted in the implementation Phases 4 and 5 of the proposed framework.

External PGHD Adoption Framework Validation

The external validation required the critical evaluation of the entire study output and the proposed framework by domain experts. This validation by domain experts has been extensively informed by PGHD **Study-1** and **Study-2**.

Figure 8.11 Proposed PGHD Adoption Framework Validation Strategy
8.4.2 External Validation – Domain Experts Evaluation

The two key objectives set out to be met through the external validation were:

1. To identify any disagreement on the conceptualised framework.

2. To identify changes or improvements that could be made in the application of the framework, specific to the primary users (patients and healthcare providers/medical doctors) in Lagos State Nigeria.

The domain experts, after consenting to participate in the proposed framework evaluation exercise, responded to an online survey link provided by the researcher. Prior to responding to the survey link, they carefully assessed a written output that contained findings from PGHD Study-1 and Study-2, and the proposed PGHD adoption framework document. The domain experts then gave their feedback regarding the comprehensiveness, correctness, conciseness and clarity of the proposed framework. They were also asked for their input towards improving the proposed framework.

The external framework evaluation process entailed collating and analysing the online administered questionnaire feedbacks from the domain experts. The analysed feedbacks were then integrated in the proposed framework, and the framework updated. The domain experts were also pre-informed that they would be required to re-evaluate the proposed framework in the event their feedback implied the need for fundamental rework of the conceptualised proposed framework.

Justifying the need for the external validation by domain experts, it immensely served the purpose of:

1. Allowing for critique and gathering perspectives of domain experts as regards the PGHD adoption framework for Lagos State Nigeria.

2. Availing an opportunity to have independent organisations and professionals review and assess the quality and depth of PGHD Study-1 and Study-2; and how the study findings informed the proposed framework.

Figure 8.12 illustrates the triangulation research process undertaken to carry out both the internal and external validations of the proposed PGHD adoption framework.
The Framework Validation Process - Triangulation

**INTERNAL VALIDATION**

**Reviewed Literature**

**PGHD Study-1**

Based on the findings made from the patient generated health data-technology readiness (PGHD-TR), established the State residents propensity as explorers (under the TR segmentation) to accept PGHD. See PGHD Study-1 for more detail.

**PGHD Study-2**

Based on the findings made from the 53 diabetic patients studied for the PGHD-acceptance model study, developed PGHD acceptance model (PGHD-AM). See PGHD Study-2 for more detail.

**FRAMEWORK CONCEPTUALISATION AND DEVELOPMENT**

**PGHD-Readiness Phase**

**Phase 1**

**Phase 2**

**Phase 3**

**Phase 4**

**Phase 5**

1. 1

2. 2

3**

**PGHD-Readiness Phase Evaluation**

**PGHD Actual-Use Phase Evaluation**

**EXTERNAL VALIDATION**

**Domain Experts Evaluation**

1. If none/minor suggestions: Integrate suggestions to framework and framework validation completed

2. If major suggestions: Rework framework and send to domain experts again for evaluation

3. If minor suggestions (refer to step 1.), if major (refer to step 2.)

**Final Framework Version**

Figure 8.12 The Framework Validation Process - Triangulation
8.4.3 Selection of Evaluators – The domain experts

Having attempted to reflect on the design - a PGHD adoption framework that is comprehensive, concise, practical and realistic to the study environment, Day and Bobeva (2005) argue the need for having a quality, independent and unbiased critique of the framework, and that this would strongly hinge on the calibre of experts carrying out the evaluation. This implies that quality of the domain experts selected would significantly reflect on the quality of evaluation feedback.

For the domain selection criteria, three major domains were highlighted based on the nature of the study and the research field. The three selected domains included:

- Healthcare delivery/provider domain: The domain experts’ inclusion criteria entailed the expert(s) being either a practising healthcare provider in Nigeria or, at a point, practiced medicine in Nigeria, and with experience in treating diabetic patients. They also served as patient representatives for the framework validation as they had huge experience from their interactions with diabetic patients within the study area.

- Local government/policy makers’ domain: The inclusion criteria for the experts contacted in this domain entailed the expert(s) currently being responsible for health policy formation and supervision in Lagos State or Nigeria as a whole.

- Health information management domain: The criteria for inclusion under this domain entailed the expert(s) either being an academic with sound knowledge in health information management or an information technology expert with relevant experience in health informatics.

Sun, Li and Li (2013) stressed the importance of ensuring that actors participating in the evaluation process are true “experts” in the field under evaluation. The initial challenge during the domain expert selection process concerned how best to suitably define an “expert” within the context of this particular study. According to Liu and Zeng (2014: 153) experts in professional fields are either domain experts or general experts, and they suggested that domain experts must be familiar with the background, reason, destruction and development of the object they are evaluating, as well as effectively participated in the past in evaluating the same or similar subject.
As regards the number of experts to be included, Kreber (2002) opines that there is no generic benchmark for what constitutes the ideal number of domain experts to be included in the evaluation process. Liu and Zeng (2014: 154) suggested that the experts’ selection criteria should be based on the eventual selected experts meeting both necessary and sufficient conditions.

- Necessary conditions entail: (a) professional demand - the expert meeting requirements of knowledge and experience in the field under evaluation, (b) time demand - the expert must have enough time as demanded by his or her participation in the evaluation.

- Sufficient conditions entail: (a) group demand - the expert must consent to participate and support the evaluation process, (b) type demand - the expert in all trueness must be a domain expert, (c) return demand - at the end of the evaluation process, the expert must have contributed value.

After ensuring all the aforementioned conditions were met, a total of 35 consenting domain experts participated in the external framework evaluation exercise. Table 8.5 provides details of the domain experts (participants) who were selected as evaluators for the proposed framework. As seen in Table 8.5, some of the domain experts met criteria for inclusion in more than one specific domain. The domain experts were first asked about their opinion regarding the strength and depth of PGHD Study-1 and Study-2, followed by, their evaluation of the proposed framework. The question items consisted of multiple-choice (single answer and multiple answers) questions. Based on their response, they had the choice to express their feedback by selecting the corresponding answer options in form of a 5 point Likert-scale (from strongly disagree: 1 to strongly agree: 5), multiple answers response option (starting from: well defined, important, useful, comprehensive irrelevant) and (vital, important, useful and irrelevant) for other questions. In the event any of the domain experts disagreed with aspects of the proposed framework, they had the option to fully express their opinion; as each question offered the option for an open-ended response. The questionnaire design enabled the domain experts to provide responses that either served as a confirmation of the proposed framework or served as a suggestion of their beliefs during the evaluation process.
### Table 8.5 Domain Experts Profile

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Organisation(s) affiliated with</th>
<th>Expert Domain:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Health care delivery/providers/patient rep Domain</td>
</tr>
<tr>
<td>1. Medical doctor</td>
<td>Medical and Dental Council of Nigeria (MDCN)</td>
<td>✓</td>
</tr>
<tr>
<td>2. Medical doctor</td>
<td>Medical and Dental Council of Nigeria</td>
<td>✓</td>
</tr>
<tr>
<td>3. Medical doctor</td>
<td>Nigeria Medical Association (NMA)</td>
<td>✓</td>
</tr>
<tr>
<td>4. Medical doctor</td>
<td>Medical and Dental Council of Nigeria, Cavesbury Hospital Lagos</td>
<td>✓</td>
</tr>
<tr>
<td>5. Medical doctor, Senior Lecturer</td>
<td>MDCN, University Health Centre</td>
<td>✓</td>
</tr>
<tr>
<td>6. Medical doctor</td>
<td>Medical and Dental Council of Nigeria, First City Hospital Lagos</td>
<td>✓</td>
</tr>
<tr>
<td>7. Medical doctor</td>
<td>NMA, MDCN, Federal Medical Centre Abuja, Nigeria</td>
<td>✓</td>
</tr>
<tr>
<td>8. Medical doctor</td>
<td>Lagos State Health Service Commission (LSHSC), NMA, MDCN</td>
<td>✓</td>
</tr>
<tr>
<td>9. Medical doctor</td>
<td>Nigeria Medical Association</td>
<td>✓</td>
</tr>
<tr>
<td>10. Medical doctor</td>
<td>Nigeria Medical Association</td>
<td>✓</td>
</tr>
<tr>
<td>11. Medical doctor</td>
<td>Nigeria Medical Association, National Health Service (NHS) UK</td>
<td>✓</td>
</tr>
<tr>
<td>12. Medical doctor</td>
<td>Nigeria Medical Association</td>
<td>✓</td>
</tr>
<tr>
<td>13. Medical doctor</td>
<td>Medical and Dental Council of Nigeria</td>
<td>✓</td>
</tr>
<tr>
<td>14. Medical doctor (Consultant Physician and Endocrinologist)</td>
<td>NMA, MDCN, General Hospital Odan, Lagos State, Nigeria</td>
<td>✓</td>
</tr>
<tr>
<td>15. Medical doctor</td>
<td>NMA, LSHC</td>
<td>✓</td>
</tr>
<tr>
<td>16. Medical doctor</td>
<td>NMA, Federal Ministry of Health Abuja, Nigeria</td>
<td>✓</td>
</tr>
<tr>
<td>17. Medical doctor</td>
<td>NMA</td>
<td></td>
</tr>
<tr>
<td>18. Medical doctor</td>
<td>NMA, LSHSC</td>
<td></td>
</tr>
<tr>
<td>19. Medical doctor</td>
<td>NMA, Federal Ministry of Health Abuja, Nigeria</td>
<td></td>
</tr>
<tr>
<td>20. Medical doctor</td>
<td>NMA, Diabetes Association of Nigeria</td>
<td></td>
</tr>
<tr>
<td>21. Medical doctor, Researcher</td>
<td>NMA, Diabetes Association of Nigeria</td>
<td></td>
</tr>
<tr>
<td>22. Medical doctor</td>
<td>NMA, Diabetes Association of Nigeria</td>
<td></td>
</tr>
<tr>
<td>23. Medical doctor</td>
<td>NMA, Diabetes Association of Nigeria</td>
<td></td>
</tr>
<tr>
<td>24. Medical doctor, Senior Lecturer</td>
<td>Warwick Medical School - Warwick University</td>
<td></td>
</tr>
<tr>
<td>25. Medical doctor</td>
<td>NMA, MDCN, eHealth4everyone</td>
<td></td>
</tr>
<tr>
<td>26. Nurse</td>
<td>Nursing and midwifery council of Nigeria (NMCN)</td>
<td></td>
</tr>
<tr>
<td>27. Senior Nurse, Public health expert</td>
<td>NMCN, Federal Ministry of Health, Abuja</td>
<td></td>
</tr>
<tr>
<td>28. Senior Nurse, Public health expert</td>
<td>NMCN, Federal Ministry of Health, Abuja</td>
<td></td>
</tr>
<tr>
<td>29. Lecturer 1 (Health Informatics &amp; Digital Communication)</td>
<td>Department of Electric. &amp; Electronic Engineering; The Federal University of Technology, Akure, Nigeria</td>
<td></td>
</tr>
<tr>
<td>30. IT Security Analyst</td>
<td>Computing Technology Industry Association (COMPTIA)</td>
<td></td>
</tr>
<tr>
<td>31. Assistant Professor in HIM</td>
<td>Higher Colleges of Technology FWC, Fujairah, UAE.</td>
<td></td>
</tr>
<tr>
<td>32. Senior Lecturer in eHealth</td>
<td>Higher Colleges of Technology FWC, Fujairah, UAE.</td>
<td></td>
</tr>
<tr>
<td>33. Senior Lecturer in Cyber Security Management/HIM Researcher</td>
<td>Coventry University, UK</td>
<td></td>
</tr>
<tr>
<td>34. Public Health Researcher, Senior Lecturer - Health and Life Sciences</td>
<td>Coventry University, UK</td>
<td></td>
</tr>
<tr>
<td>35. Professor in Public Health, Researcher</td>
<td>Lagos University Teaching Hospital, Lagos, Nigeria</td>
<td></td>
</tr>
</tbody>
</table>

| Total | 28 (80%) | 15 (43%) | 24 (69%) |
8.5 External Validation Result Analysis
A total of 35 domain experts participated in this exercise and, as seen from Table 8.5, a total of 28 participants (80% of the 35 domain experts) had expert knowledge in the healthcare delivery/providers/patient representatives’ domains. Fifteen participants (43%) had expert knowledge in the government/policy making domains, while 24 participants (69%) had expert knowledge in the health information management/academic/IT domains. Figure 8.13 graphically illustrates the composition of the domain experts who partook in the proposed framework external validation process. It could be seen that from a domain-only point of view, 42% of the entire experts met the criteria for inclusion in healthcare delivery/providers’/patient representatives’ domain, 36% met criteria for inclusion in health information management/academics/IT domain and 22% met criteria for inclusion in government/policy maker domain.

![Expert Domain Compositions](image)

Figure 8.13 Expert Domain Compositions

8.5.1 PGHD Study 1 and 2 Strength and Depth
With the framework conceptualisation and development founded on findings made from PGHD Study-1 and Study-2, the 35 domain experts were asked if the strength and depth of the two respective studies were enough to inform the proposed framework. From the result obtained and as seen from Table 8.6 and illustrated in Figure 8.14, in PGHD Study-1, 17 participants (49%) agreed, while 18 participants (51%) strongly agreed that the strength of Study-1 was enough to inform the proposed framework. As for the depth
of PGHD *Study-1*, 18 participants (51%) agreed while 17 participants (49%) strongly agreed that the depth of *Study-1* was sufficient to inform the proposed framework. Similarly, for PGHD *Study-2*, 21 participants (60%) agreed, while 14 participants (40%) strongly agreed that the strength of *Study-2* was sufficient to inform the proposed framework. For the depth of *Study-2*, 20 participants (57%) agreed while 15 participants (43%) strongly agreed that the depth of *Study-2* was sufficient to inform the proposed framework.

**Table 8.6 Overall result for overall PGHD-Study strength and depth**

<table>
<thead>
<tr>
<th>Options</th>
<th>Overall Study Strength</th>
<th>Overall Study Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Study-1 Strength</td>
<td>Study-2 Strength</td>
</tr>
<tr>
<td>Strongly Disagree</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Disagree</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Indifferent</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Agree</td>
<td>17 (49%)</td>
<td>21 (60%)</td>
</tr>
<tr>
<td>Strongly Agree</td>
<td>18 (51%)</td>
<td>14 (40%)</td>
</tr>
</tbody>
</table>

**Figure 8.14 Overall results for both study strength and depth**

From Figure 8.14, it could be summarised that all the 35 domain experts were affirmative that both studies were strong as well as deep enough to inform the proposed framework. Taking this into consideration, the feedback from this result positively suggests that from the domain expert perspective, the propositions from both studies
were unanimously sufficient to generate the environments, components, phases and indicators seen in the proposed framework.

8.5.2 Validating the Proposed PGHD Environments

From the findings made during both studies, three environments were identified (external, hospital and patient environment) and formed the foundation on which other aspects of the framework were established. In order to ascertain how vital, important, useful or irrelevant these proposed environments were, the domain experts were asked to consider each of the environments. Table 8.7 and Figure 8.15 present the results obtained from the domain experts’ evaluation of this element.

Table 8.7 Domain experts result on the three proposed PGHD environments

<table>
<thead>
<tr>
<th>PGHD Environments</th>
<th>Vital</th>
<th>Important</th>
<th>Useful</th>
<th>Irrelevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Environment</td>
<td>26 (74.3%)</td>
<td>16 (45.7%)</td>
<td>12 (34.3%)</td>
<td>0</td>
</tr>
<tr>
<td>Hospital Environment</td>
<td>30 (85.7%)</td>
<td>16 (45.7%)</td>
<td>11 (31.4%)</td>
<td>0</td>
</tr>
<tr>
<td>Patient Environment</td>
<td>31 (88.6%)</td>
<td>15 (43%)</td>
<td>11 (31.4%)</td>
<td>0</td>
</tr>
</tbody>
</table>

Figure 8.15 Domain experts result on the three proposed PGHD environment

From the presentations above, 88.6% of the domain experts agreed that the patient environment is most vital, followed by the hospital environment (85.7%) and the external environment (74.3%). This implied that, though the three proposed environments were considerably vital, the majority of the domain experts viewed the patient environment as being the most vital in the proposed framework, followed by the hospital and external environments. In terms of importance, the domain experts’
response distribution seemed even, likewise their perception of how useful each of the environments was to the proposed framework. None of the domain experts regarded any of the three environments as irrelevant. This result suggests that the evidence that informed on the integration of these three environments into the framework is justified based on the perspective of the domain experts.

8.5.3 Validating the Proposed Actors in the PGHD Environment

Having shown that the three environments are all valid based on the domain experts’ evaluation, this section reports on the result obtained from the question that asked the domain experts to consider the listed actors within each of the three PGHD environments. They were expected to respond to this item via a multiple answer response as to how vital, important, useful or irrelevant they believe the listed actor or actors are within their identified PGHD environment. Table 8.8 and Figure 8.16 present the results obtained from the domain experts’ evaluation of this element.

Table 8.8 Result on actors in the three proposed PGHD environments

<table>
<thead>
<tr>
<th>PGHD Environments</th>
<th>Vital</th>
<th>Important</th>
<th>Useful</th>
<th>Irrelevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Environment - Lagos State Ministry of Health</td>
<td>20 (57.1%)</td>
<td>19 (54.3%)</td>
<td>12 (34.3%)</td>
<td>0</td>
</tr>
<tr>
<td>Hospital Environment - Medical Doctors, Nurses and other staff privy to patients' 'PGHD'</td>
<td>27 (77.1%)</td>
<td>18 (51.4%)</td>
<td>12 (34.3%)</td>
<td>0</td>
</tr>
<tr>
<td>Patient Environment - The Diabetic Patient, Their Family/Patient Proxy</td>
<td>29 (83%)</td>
<td>14 (40%)</td>
<td>12 (34.3%)</td>
<td>0</td>
</tr>
</tbody>
</table>
From the results obtained, it could be seen that the actors in the patient environment were considered the most vital (83%), followed by actors in the hospital environment (77.1%) and actors in the external environment (57.1%). The distribution of the responses retrieved for this question mirrors the distribution obtained from the domain experts’ evaluation of the three identified environments. This suggests that while they all admit that these actors are vital within their respective environments, the patients and their environment remain most vital. In considering the actors’ level of importance in their respective environments, the result reveals that 54.3% of the domain experts believe the external environment actors were important, followed by 51.4% in the hospital environment and 40% in the patients’ environment. In terms of actors’ usefulness in their respective environments, the domain experts’ response distribution seemed even and none of their responses implied to show that any of the actors is irrelevant. These results from the domain experts support the inclusion of the identified actors in the three proposed PGHD environments.

In addition to the feedback obtained from this question, one of the domain experts referred to the actor in the external environment. This particular expert stated that: “The external environment required in this framework is the Health Service Commission. It has a direct supervisory role over the General Hospitals in Lagos State”. This suggestion was noted as minor; as it was due to a difference in nomenclature from some documents and literature that were yet to be updated to reveal the suggested actor (Lagos State Health Service Commission). The suggested correction was effected in the final version of the framework.

8.5.4 Validating the Roles and Responsibilities of the Proposed Actors in the PGHD Environment

In order to evaluate if the roles and responsibilities of the actors identified within their respective environments were valid, the domain experts were asked to evaluate this item. Their feedback was gauged based on how defined, important, useful, comprehensive or irrelevant each respective actor or actors’ roles and responsibilities have been described. The description of the actors’ roles and responsibilities included:

- External Environment Actor: Providing oversight functions and chiefly responsible for PGHD capacity development in the State.
- Hospital Environment Actors: Responsible for informing, engaging, empowering, partnering and supporting patients’ PGHD practice while liaising with the external environment.

- Patient Environment: Consensual participation with their health care provider through all the identified phases in the proposed framework.

Table 8.9 and Figure 8.17 present the results obtained from the domain experts’ evaluation of this element.

Table 8.9 PGHD Framework identified actors’ roles and responsibility (R&R)

<table>
<thead>
<tr>
<th>R&amp;R of actors in PGHD Environments</th>
<th>Well defined</th>
<th>Important</th>
<th>Useful</th>
<th>Comprehensive</th>
<th>Irrelevant</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Environment</td>
<td>20 (57.1%)</td>
<td>25 (71.4%)</td>
<td>8 (23%)</td>
<td>3 (8.6%)</td>
<td>0</td>
</tr>
<tr>
<td>Hospital Environment</td>
<td>21 (60%)</td>
<td>27 (77.1%)</td>
<td>10 (28.6%)</td>
<td>8 (23%)</td>
<td>0</td>
</tr>
<tr>
<td>Patient Environment</td>
<td>22 (63%)</td>
<td>26 (74.3%)</td>
<td>12 (34.3%)</td>
<td>9 (25.7%)</td>
<td>0</td>
</tr>
</tbody>
</table>

Given that this was a multiple answer question, a quick glimpse into the graph illustrating the result shows that the majority of the domain experts concurred towards the actors’ roles and responsibilities being well defined and important. On the weight of their overall percentage, the result distribution shows that 63% of them believed the actors in patient’s environment roles and responsibilities were well defined, 60% agreed on the same for the actors in the hospital environment, while 57.1% agreed that the roles and responsibilities of actors in the external environment were well defined. In terms of importance of the actors’ roles and responsibilities in their respective environment as
shown in the proposed framework, 77.1% of the experts agreed that the roles and responsibilities of actors in the hospital environment were the most important, followed by that of the patients’ environment (74.3%), and that of the external environment (71.4%).

These results show that in terms of clarity and relevance of the roles and responsibilities of all the identified actors, the majority of the domain experts believed that their roles and responsibilities have been well defined and important in the proposed framework. Responses retrieved for usefulness and comprehensiveness of the actors’ roles and responsibilities revealed that just few of the experts responded to this option. None of the domain experts regarded the roles and responsibilities of any of the actors within the three environments as irrelevant. Overall, the domain experts’ evaluation feedback positively supports the roles and responsibilities of the actors in the proposed framework and further gives credibility to the core foundation upon which other aspects of the proposed framework relied upon.

8.5.5 Domain Experts Perception of the Overall Features of the Proposed Framework

Having showed that the three environments, the actors, their roles and responsibilities in the proposed framework were valid from the responses of the domain experts, this question asked the experts of their perceptions concerning the overall framework, based on the items shown in Table 8.10.

Table 8.10 Perception on the Overall Features of the Proposed Framework

<table>
<thead>
<tr>
<th>Domain Experts perception on:</th>
<th>S. Disagree</th>
<th>Disagree</th>
<th>Indifferent</th>
<th>Agree</th>
<th>S. Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processes identified in the Processes 'column'</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21 (60%)</td>
<td>14 (40%)</td>
</tr>
<tr>
<td>The overall framework comprehensiveness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21 (60%)</td>
<td>14 (40%)</td>
</tr>
<tr>
<td>Data generated and enabling technology 'column'</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>18 (51.4%)</td>
<td>17 (48.6%)</td>
</tr>
<tr>
<td>Potential knowledge gained 'column'</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>18 (51.4%)</td>
<td>17 (48.6%)</td>
</tr>
<tr>
<td>The overall framework practicality</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>16 (45.7%)</td>
<td>19 (54.3%)</td>
</tr>
<tr>
<td>The overall framework applicability</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>17 (48.6%)</td>
<td>18 (51.4%)</td>
</tr>
<tr>
<td>The overall framework conciseness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21 (60%)</td>
<td>14 (40%)</td>
</tr>
<tr>
<td>The overall framework correctness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>22 (62.9%)</td>
<td>13 (37.1%)</td>
</tr>
<tr>
<td>The indicators for PGHD-Readiness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20 (57.1%)</td>
<td>15 (42.9%)</td>
</tr>
</tbody>
</table>
The result presented unanimously shows that all the items measuring various features of the framework in general were deemed valid from the domain experts’ perspective. This feedback in Table 8.10 adds credence to the synergy observed between the three components (people, processes and technology) during the actual PGHD exercise in Study-2, and which has been integrated into the proposed framework. Also, this result wholly endorses the indicators and sequences proposed for PGHD-Readiness and PGHD actual-use phase evaluations in the framework. Given the composition of the domain experts, it was interesting to see from the aggregated result that their individual perceptions of the overall aspects of the proposed framework were in agreement.

8.5.6 Validating the Implementation Phases of the proposed framework

The last part of the proposed framework evaluation process entailed the domain experts giving their feedback on the five implementation phases described in the document they assessed. In line with previous questions, each of the five proposed framework phases was to be evaluated based on: practicality, applicability, clarity, conciseness and correctness. It was necessary to have each phase independently evaluated in order to have an in-depth feedback from the domain experts regarding the framework implementation. Also, the intentional rephrasing of some aspects and items initially evaluated by the domain experts was done so as to ensure there was consistency in their beliefs. The findings made from their evaluation of each implementation phase of the framework are summarised and presented in Table 8.11.
As seen from Table 8.11, the overall result indicates that the practicality, applicability, clarity, conciseness and correctness of the five implementation phases of the proposed framework were wholly and affirmatively agreed upon by the 35 domain experts. This result is also consistent with the result obtained and presented in Table 8.10.

The result also implies that the proposed framework’s initial version is fit for adoption and that the only minor correction to be made is substituting the Lagos State Ministry of Health with Lagos State Health Service Commission as the only actor in the external environment. This correction has been effected in the final framework schematic version in Figure 8.19.

<table>
<thead>
<tr>
<th>Domain Experts perception on:</th>
<th>S. Disagree</th>
<th>Disagree</th>
<th>Indifferent</th>
<th>Agree</th>
<th>S. Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase 1: Practicality</td>
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<td>18</td>
<td>17</td>
</tr>
<tr>
<td>Phase 1: Applicability</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>17</td>
<td>18</td>
</tr>
<tr>
<td>Phase 1: Clarity</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>14</td>
</tr>
<tr>
<td>Phase 1: Conciseness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Phase 1: Correctness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Phase 2: Practicality</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>Phase 2: Applicability</td>
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<td>0</td>
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<td>13</td>
</tr>
<tr>
<td>Phase 2: Clarity</td>
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<td>0</td>
<td>22</td>
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<tr>
<td>Phase 2: Conciseness</td>
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<tr>
<td>Phase 2: Correctness</td>
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<tr>
<td>Phase 3: Practicality</td>
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<td>Phase 3: Applicability</td>
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<td>21</td>
<td>14</td>
</tr>
<tr>
<td>Phase 3: Conciseness</td>
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<tr>
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<td>12</td>
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<tr>
<td>Phase 4: Practicality</td>
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<td>0</td>
<td>0</td>
<td>21</td>
<td>14</td>
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<tr>
<td>Phase 4: Applicability</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>23</td>
<td>12</td>
</tr>
<tr>
<td>Phase 4: Clarity</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Phase 4: Conciseness</td>
<td>0</td>
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</tr>
<tr>
<td>Phase 4: Correctness</td>
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<td>23</td>
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<tr>
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<td>21</td>
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</tr>
<tr>
<td>Phase 5: Applicability</td>
<td>0</td>
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<td>22</td>
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<tr>
<td>Phase 5: Clarity</td>
<td>0</td>
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<td>22</td>
<td>13</td>
</tr>
<tr>
<td>Phase 5: Conciseness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>Phase 5: Correctness</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>25</td>
<td>10</td>
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</table>
The steps adopted to arrive at the conceptualisation stage, as seen in Figure 8.18, illustrate the triangulation method adopted in validating the PGHD adoption framework.

As illustrated in Figure 8.18, the reviewed literature informed (→) all stages of this research. The direct outcome of Study-1 influenced and informed (→) Study-2. Overall, the reviewed literature, Study-1 and Study-2 informed (→) the framework conceptualisation and development, after which the domain experts evaluated the conceptual framework. Since the overall suggestions made during the external validation required a minor correction, the PGHD adoption framework at this point was deemed both internally and externally validated and fit for use within the study area.

Figure 8.19 presents the final schematic version of the updated framework showing the Lagos State Health Service Commission (LSHSC) as the only actor in the external environment. Other features of the framework remained unchanged based on the unanimous feedback retrieved from the domain experts’ evaluation.
Figure 8.19 Schematic of the Validated PGHD Adoption Framework Final version

**EXTERNAL ENVIRONMENT (E.E)**
- Actor: Lagos State Health Service Commission (LSHSC)
- Provides oversight functions:
  1. Regulate
  2. Facilitate
  3. Monitor

**INTERNAL ENVIRONMENT (I.E)**

**PATIENT ENVIRONMENT (P.E)**
- Actors: Diabetic Patient, Diabetic Patient Proxy and family

**HOSPITAL ENVIRONMENT (H.E)**
- Actors: Health care provider (HCP) - doctors, nurses and other privy hospital support staff

**Phase 1: Inform Diabetic Patient of PGHD**
- Seek Patient’s consent;
- Consent not given (HCP tries understand issue, and resolve issue);
- Consent given (advance to phase 2)

**Phase 2: Engage Diabetic Patient**
- HCP ascertains patient health literacy level for PGHD, educate and tailor PGHD care plan to fit patient and HCP workflow;
- Capture patient’s pre HbA1c level & BMI as initial baseline for subsequent HbA1c and BMI monitoring (advance to Phase 3).

**Phase 3: Empower Diabetic Patient**
- E.E and H.E mutually facilitates patient PGHD practice via tailored incentives, provide responsible PGHD usage safeguarding policy on data ownership, security, privacy & unique issues emerging overtime (advance to Phase 4).

**Phase 4: Partner with Diabetic Patient**
- Regularly remind patient to adhere to their tailored PGHD care plan (periodic email, SMS, Phone call);
- Integrate relevant shared data into patient’s hospital record;
- Prompt feedback via pre-agreed correspondence medium;
- Based on level of PGHD compliance, follow-up patients who aren’t complying as agreed;
- Periodic capture post HbA1c level & BMI.

**Phase 5: PGHD Practice Sustainability through Continuous Support**
- Based on Phase 4 evaluation and subsequent re-evaluation;
- Respond to patient-HCP data flow dynamics (Need for health information exchange standardisation);
- Continuously incentivise willing participants in order limit costs;
- E.E and H.E continuously sustains Phase 4 actual use re-evaluation.

**Colour Legend:**
- E.E
- I.E
- P.E
- H.E

PKGE* = Potential Knowledge Generated Exchanged
8.6 Ethical Issues Considered

Be it quantitative or qualitative, research in general is bordered with a series of moral and ethical considerations. To assuage this potential issue, the necessary ethical approval and consent were given by all collaborating organisations and participants involved in various stages of this study. Such approval and consent were given after the researcher had already considered the following ethical principles recommended by Gray (2013); and Miles, Huberman and Saldana (2013).

The guiding ethical principles pre-considered included:

1. *Project Worthiness:* From the earlier literature search on this topic, there was paucity of relevant and related empirical research on patient-generated health data (PGHD) within the study area. A literature search revealed that there was no framework that could guide stakeholders in implementing the PGHD practice in Nigeria or nations with similar social determinants of health like Nigeria. Most literature obtained from the vast search showed results for developed nations with improved differences in factors that influence social determinants of health. This implied that having to adopt tested PGHD practices from these developed nations, without first considering how these will impact on users within the subject area, is not only unethical, but unwise. This lack of primary evidence on actual PGHD usage or practice justified the need for an investigation in order to establish all involved stakeholders’ propensity and disposition to adopt PGHD in Nigeria. Thus, the need for this PGHD adoption framework to be developed, as evidenced by the case study carried out on diabetic patients in Lagos State Nigeria.

2. *Competence:* This denotes whether the researcher was fully sound and prepared to undertake the research while being supervised. From the onset, this research was supervised throughout the PGHD Study-1 and Study-2, framework conceptualisation, development, evaluation and final stages. The feedback from the supervisory team after each stage has also been documented.

3. *Informed Consent:* All involved participants were always and fully aware of the nature and expectation from them regarding the project. These have also been documented. Their free will to participate meant that they also had the right to withdraw at any point of the project.
4. **Harm and Risk:** At no point in the project did the researcher undertake any action that could result in damaging the organisations or harming the involved participants.

5. **Benefits, Costs and Reciprocity:** This signifies what each participant in the various stages of this research stood to gain from their respective participation. All through the project stages, the researcher clearly outlined the benefits of this research to the participants and made it clear that there will be no financial inducement.

6. **Privacy, Confidentiality and Anonymity:** With patient-generated health data and other participants’ data being the key elements that have informed each stage of this project, the issue of privacy, confidentiality and making sure all data obtained remained anonymised and discarded properly wasn’t taking lightly. There was no revealing personal data collected at any stage of the research. All the health data obtained were conveyed to the researcher through the collaborating medical doctors. All involved participants were pre-informed that at the end of the study, publications made would be made available to them and correctly acknowledge their input as an organisation, without revealing their personal identities. Finally, every data stored on any storage device used during the project was be properly deleted.

7. **Honesty and Trust (deception):** This particular principle was key in this project; given the great amount of time required from the participants’ (diabetic patients’ and medical doctors) in PGHD Study-2, as well as the domain experts and their busy schedules. From the onset, the researcher was honest with the organisations and participants during the entire stages of the project. They (participants) were all aware of the researcher’s role as a postgraduate student at Coventry University and also knew that the collaboration was of benefit to all parties involved in the project.

**8.7 Chapter Summary**

This chapter has reported on the development, evaluation and findings made in order to produce a validated PGHD adoption framework for Lagos State Nigeria. Given the nature of this chapter, it was necessary to have it presented in two parts.
The key summary from chapter 8 part 1 includes:

- Presenting the fundamentals of the PGHD adoption framework, which have been built upon the sociotechnical principles of framework conceptualisation where every technology input and designed processes revolves around the people component.
- Identifying the three PGHD environments based on empirical evidence obtained from the two independent studies carried out, with their accompanying core components (people, processes and enabling technology) described in detail.
- Identifying and describing the five implementation phases of the framework with the corresponding indicators that would assist in evaluating the five implementation phases.
- Describing in detail, a method for the implementation of the validated PGHD adoption framework.

For chapter 8 part 2, the key summary includes:

- Presenting a validation approach and strategy that meets the requirement of triangulation, as well as the domain experts who carried out the external evaluation of the framework.
- Reporting on the entire results of the internal and external validation (data triangulation) carried out in this research.
- Finally, the conclusion from the framework evaluation carried out deemed the framework fit for use within the Lagos State Nigeria.

It is to be noted that the findings made from this research are not absolute; as the researcher has only approached the study from the perspective of patients and medical doctors in State-owned hospital (public hospital). The findings made in this study might be different within the context of private hospital settings. This research has established, with evidence, the hidden intricacies and consideration to be made when adopting PGHD for diabetes management in Lagos State. Though aspects of this framework could be scaled and integrated to fit other chronic care management within the subject area, it is important to note that health-driven interventions heavily rely on empirical evidence, thus the need to investigate how PGHD adoption would impact the primary users for that specific chronic condition. All ethical considerations made have been reported in this chapter. The next Chapter presents the unique contributions this research has made, as well as suggests the areas that would benefit from further research.
CHAPTER 9: CONCLUSION AND RECOMMENDATIONS

The purpose of this research was to investigate how PGHD can contribute towards improving Nigerian patients’ diabetes mellitus management and subsequently develop a validated PGHD adoption framework for patients and healthcare providers within the Nigeria health care sector. In achieving the overall purpose, the research was carried out in phases consisting of two interdependent studies that have informed in realising a tailored PGHD validated framework for the management of diabetes mellitus within Lagos State Nigeria.

Prior to the furtherance of this research, there was paucity of empirical evidence or frameworks that could have informed the potentials and challenges of PGHD usage within the study area. Having considered the population dynamics (social determinants of health) and existing inadequacies within the Nigerian healthcare sector, and how this impacts precisely on patients’ chronic care management, it was viable to rethink and attempt a patient-centric approach towards improving this ongoing problem.

9.1 Research Summary

This chapter brings to conclusion the aim and objectives achieved by this research, with recommendations made from the unique contributions identified in this research. The study set out to answer four research questions, through data triangulation of methodologies that consisted of extant literature and qualitative and quantitative research methods. Using a sub-population of Lagos State residents in two different study phases, the researcher was able to establish their propensity towards the PGHD concept and secondly, develop a PGHD acceptance model via structural equation modelling of justified determinants that influence the consenting studied diabetic patients’ behavioural intention to use PGHD for their diabetes care management. All the observations made and results collected and analysed immensely informed the conceptualisation and development of the PGHD adoption framework for diabetes management in Lagos State, prior to the external validation carried out on the framework. Findings made from the domain experts’ evaluation of the framework
gave credence to the environments, components, processes and implementation phase evaluation indicators suggested in the framework.

In delivering the validated framework, this research has answered the initially set out research questions.

1. How can the present health information management system (HIMS) structure in Lagos State support health information exchange (HIE) from patients?

2. How enlightened are the involved stakeholders toward the potentials of PGHD?

3. What policies and resources would be most useful to help Nigerian patients adopt and effectively use eHealth tools that generate PGHD?

4. If PGHD is to be considered, how can an all-inclusive solution be created to provide guidance to all stakeholders?

9.2 Research Questions Answered

**RQ1: How can the present health information management system (HIMS) structure in Lagos State support health information exchange (HIE) from patients?**

From the initial stage, the research was spurred by the need to rethink healthcare interventions that wouldn’t solely rely on the poor and sometimes non-existing HIMS in most healthcare establishments in Nigeria. With a key focus on how this inadequacy impacts on patients’ diabetes management and HIE with their healthcare providers, the research proposed PGHD as a viable solution. Reviewed literature in Chapter 2 emphasised the need for an evidence-based approach when developing healthcare interventions, and this justified the need to investigate PGHD within the study area. Findings made in PGHD-TR2 in Study-1 (medical doctors’ survey) unanimously showed that there was no PGHD practice or existing frameworks in Lagos State. This finding, amongst many other unique findings made from Study-1, justified the need to develop an applicable PGHD adoption framework in Nigeria (Lagos State).

While it was safe to say that the present HIMS in Nigeria cannot fully enhance or support HIE from patients with their healthcare providers, this research has demonstrated, with evidence, the potentials accruable from PGHD and its unique existing challenges in the management of diabetes in Nigeria. The validated framework has identified achievable processes that could help diabetic patients in Lagos State exchange relevant health data as
agreed with their healthcare providers. PGHD adoption, in no small measure, could improve HIE between patients and healthcare providers in the study area, and benefit diabetic patients.

Figure 9.1 illustrates how the reviewed literature and Study-1 and Study-2 aims and objectives contributed to answering this research question and the original contribution of the researcher after answering this research question.

![Diagram of Research Question 1](image)

**Figure 9.1 Addressing Research Question 1 in this thesis**

**RQ2: How enlightened are the involved stakeholders toward the potentials of PGHD?**

This research question was the core investigation carried out by Study-1 which aimed ‘to undertake a preliminary feasibility study in order to establish Lagosians’ and medical doctors’ in Lagos State propensity to accept the PGHD concept’. Having justified the information system theory adopted for Study-1, the findings made shed light on the technology readiness (TR) score and TR segmentation that best described the surveyed population (Lagosians). In reference to section 4.5.6, the aggregated mean score of the TR four dimensions gave the 1,443 PGHD-TR1 a TR score of 3.08, and this represented a positive inclination of their propensity to accept and adopt PGHD. Study-1 PGHD-TR1 TR-segmentation also established that the surveyed population were mostly explorers based on their overall mean score under each TR-dimension. This scoring is in line with the recommendations provided by Parasuraman 2000; Parasuraman and Colby 2001 and 2015.

Still towards their enlightenment on PGHD potentials, the issue of PGHD ownership, privacy and security remained a critical PGHD concern for the surveyed population. This study has recommended how these concerns can be addressed, and by whom.
The hypothesised relationships in the Study-1 PGHD-TR1 survey showed that demographically, age and level of education would influence patients’ attitude towards PGHD and self-medication, whereas gender wouldn’t. Interestingly, the surveyed population would naturally self-medicate, and high amongst their justification to self-medicate was the difficulty in communicating with their healthcare provider. The analysed result showed that their attitude to self-medication would change if they had an alternative means to reach their healthcare providers while away from the hospital environment.

Still on Study-1, the PGHD-TR2 survey, which focused on medical doctors in Lagos State, informed on their predisposition and disposition towards PGHD. In reference to section 4.6 to 4.6.5, the results analysed showed that though they admitted being positively disposed to PGHD in Lagos State, there was need for PGHD inclusion into formal care to be driven by evidence and government support. Their unanimous admittance that no PGHD practice or guidelines exist in the State further justified the need for one to be investigated and developed. Figure 9.2 illustrates how the reviewed literature and Study-1 aim and objectives contributed to answering this research question and the original contribution of the researcher after answering this research question.

![Figure 9.2 Addressing Research Question 2 in this thesis](image)

**RQ3: What policies and resources would be most useful to help Nigerian patients adopt and effectively use eHealth tools that generate PGHD?**

In section 2.2 to 2.2.2 of this thesis, the literature review of the current state of electronic health policy in Nigeria showed that, currently, there are no dedicated policies or laws that afford absolute control or ownership of patient’s information by the patient. While this
remains an existing gap that could portend misuse of patients’ electronic health information, various non-health related policies, acts and laws govern the use of personal information in Nigeria and these have been adopted into practice within the health sector. As regards PGHD usage in Nigeria, the researcher has demonstrated in practice how both patients and their healthcare providers could generate PGHD with the existing gaps in policies and resources infringing on the patients’ needs to capture, share and correspond feedback with their healthcare providers. The 53 consenting diabetic patients, throughout the 3-month PGHD capture and share with their assigned medical doctors, kept copies of their PGHD. This enabled them to become even more proactive towards decision making as it relates to their health outcomes, while affording their medical doctors to keep oversight on their progress while they were away from the hospital environment.

Regardless of all identified obstacles to PGHD and disparities in affordability and ability to use electronic health tools within the study area (policies and inadequate infrastructures), this research has shown that if system design is modelled around the capability of the primary users, the chance of success is high, as evidenced by 68.2% PGHD capture and upload compliance achieved in Study-2. The technology media (for PGHD capture, share and uploads) and types of data shared between the patients and their medical doctors were reached by a consensus and this enabled the participating medical doctors to tailor each diabetic patient’s care plan to fit the two parties. Whether through internet enabled mobile device, email, SMS or phone calls, the diabetic patients chose media they were capable to afford and operate after reaching agreement on what type of PGHD and how frequent they should capture, share and correspond feedback with their respective medical doctors. This could be credited more to the willingness of the consenting diabetic patients and collaborating medical doctors to fully engage and follow-up their patients through a pre-agreed communication frequency, and less on advanced technology. While technology and processes remain relevant to the success of PGHD and various forms of electronic health information dissemination, the people (human factor) component remain central for information system success.

The structural equation modelling carried out in order to determine the core determinants that would most likely influence the 53 studied diabetic patients’ intention to adopt PGHD revealed that perceived usefulness, social influence, self-efficacy and patient data security were amongst the exogenous constructs that influenced PGHD actual use while perceived
ease of use and facilitating conditions weren’t. Also, their personal experience via PGHD actual use positively influenced their intention towards PGHD.

Figure 9.3 illustrates how the reviewed literature and Study-2 aim and objectives contributed towards answering this research question and the original contribution of the researcher after answering this research question.

**Figure 9.3 Addressing Research Question 3 in this thesis**

**RQ4: If PGHD is to be considered, how can an all-inclusive solution be created to provide guidance to all stakeholders?**

This research question has been addressed through the series of Studies (reviewed literature, Study-1 and Study-2) that informed on the conceptualisation and development of the PGHD adoption framework prior to its external validation. The validated framework has identified three environments: external, hospital and patient environments with their respective actors and defined processes and enabling technologies for the realisation of PGHD in Lagos State. The framework went further to identify potential data generated and how these data can benefit the three environments and their respective actors. In detailing a method for implementation, the framework has also identified indicators that would serve as metrics of evaluating how successful each phase is during implementation and continuous PGHD usage by the involved stakeholder in the State (See Chapter 8 Part 1).
Having internally validated every aspect of this research, the proposed framework was sent to consenting domain experts who critically evaluated the framework on the basis of its significance, practicality, applicability, clarity, conciseness and correctness. Their unanimous feedback implied that the framework was valid and could deliver. The researcher has ensured depth in the population of the domain experts by drawing feedback from an array of policy makers, health information technology academics, medical professionals and IT experts while validating the framework.

Figure 9.4 illustrates how the reviewed literature, Study-1 and Study-2 aim(s) and objectives contributed towards answering this research question and the original contribution of the researcher after answering this research question.

![Diagram showing the relationship between reviewed literature, study aims, and objectives, leading to RQ4]

**Figure 9.4 Addressing Research Question 4 in this thesis**

### 9.3 Research Contribution

1. **Established Lagos State PGHD technology readiness (Study-1):** Prior to the commencement of this research, there was paucity of empirical evidence on the State’s propensity to consider PGHD as a contributing alternative for generating and sharing patient health information. Also, there was little or no knowledge on how the identified concerns (PGHD ownership, privacy, security, provenance, defined usage responsibility, health
literacy, types of PGHD relevant to patient and practice, what supporting medium could enable PGHD capture and share and medical practitioners’ concerns) regarding PGHD would impact on medical doctors’ practice in Lagos State Nigeria. This research has been able to investigate PGHD technology readiness (PGHD-TR1 and PGHD-TR2 surveys) and present original findings from the general populace (consisting of 1,443 Lagosians: TR-Segmentation - explorers), as well as that of the 47 medical doctors across the 20 LGA in the State. Overall evidence garnered and presented from Study-1 has filled the pre-existing gap as it related to the population propensity towards PGHD. This original contribution would also serve as a reference point when subsequent need arises in the literature, research or HIT interventions that seek to understand Lagos State’s and Nigeria’s population inclination and technology readiness for health information dissemination championed by the citizens. It is important to note that, as technology evolves with time, population propensity through related technology usage and social influence evolves along. Therefore, this finding remains most relevant within the time period was realised in, and would serve as a historical baseline when investigating in the future how the population technology readiness has evolved with time. Study-1 findings further informed the design of Study-2.

2. Developed a PGHD acceptance model (Study-2): The findings made from Study-2 originally offer an insight through an actual 3-month PGHD exercise involving 53 consenting diabetic patients, that PGHD responsible use and adherence can influence their diabetes management. This has been evidence in Chapter 6 Study-2 preliminary analysis report. Also, the SEM analysis carried out shed light on the determinants that were most likely to influence PGHD usage and adoption in the State. These findings are novel within the study area and would immensely contribute to literature, research and HIT interventions for patients, their healthcare providers and policy makers. Uniquely, the findings made from the two studies hugely informed the framework conceptualisation prior to validation. This is in line with the need to ensure healthcare intervention design remains evidence based.

3. A validate PGHD adoption framework for diabetes management in Lagos State Nigeria: In collaboration with the Lagos State Health Service Commission (LSHSC), the aim of this research was to design (as informed from the two inter-dependent studies) and validate (both internally and externally through domain experts) a PGHD adoption framework, applicable for diabetes management in Lagos State Nigeria. With the intention that this framework becomes a reference point or blueprint whenever the need arises for
PGHD introduction into formal care in Nigeria, it is hoped that the framework will start a discourse within relevant sectors on how present and affordable technology could be channelled to meet the everyday health needs of the Nigerian patients. The framework has been designed in such a way that it could be replicated for other chronic care conditions, by making sure all identified environments, processes and enabling technologies were built around the primary stakeholder – the Nigerian patient. The framework has also shown that with dedication from both the patients and their medical doctors, PGHD can be captured, shared and fed back according each patient’s health literacy and capability. Also, stakeholders’ roles and phase evaluation identified in the framework have been led by evidence currently existing within the study environment. This framework is the first of its kind within the study area, and would massively contribute to literature, research and HIT interventions for patients, their healthcare providers and policy makers in the Nigerian health sector.

9.3.1 Implication for Stakeholders

1. Implication for Lagos State Health Service Commission (LSHSC): As the first of its kind, this research offers with evidence the potentials accruable from PGHD actual use in Lagos State Nigeria. The framework has also defined the roles and impact from the external environment as championed by the LSHSC. The need for PGHD facilitation and oversight has been demonstrated to be lacking within the study environment, and it falls on the LSHSC to fill this gap. While policies surrounding patient health information remain vaguely defined in Nigeria, the patients are left at risk of their health data being misused. The fast adoption of everyday technology such as mobile devices that generate huge amounts of data implies that there is a need for policy makers, like the LSHSC, to provide policies applicable to patient health data generated across multiple electronic media. This will in no small way benefit electronic health information exchange between all relevant parties in Nigeria. Finally, this framework has demonstrated that regardless of the existing poor health information management system in Nigeria, which impacts even more on the management of chronic care ailment like diabetes, public health policy makers should consider health intervention approaches like PGHD that are patient-centric, as it stands to benefit the patients better and directly.
2. Implication for Healthcare Practice in Nigeria: The implementation phases and evaluation indicators proposed in the framework have been drawn from evidence. In the event any medical practitioner or practice in Nigeria wishes to draw reference for PGHD usage, this framework intends to serve as a guideline. The framework has demonstrated that though there were concerns shared by medical doctors as regards PGHD impact on their workflow and practice in general, a healthy synergy between patient and doctor is vital towards PGHD success. The unique nature of Lagos State as a microcosm that best depicts the complex socio-cultural composition of Nigeria implies that healthcare providers across the country can draw from the lessons learnt and contribute to the development of this validated framework. This framework gives viability that the Nigerian diabetic patient, if properly engaged, regardless of their vast psychographic attributes, can contribute towards their health outcomes and be proactive in shared decision making with their healthcare providers.

3. Implication for Lagosians, Nigerians and similar developing Nations
This framework stands to benefit the average Nigerian through giving credence to PGHD potentials within their immediate environment. It provides guidelines as it concerns each stakeholder’s roles and responsibilities for PGHD actual use in Nigeria. In the event any developing nation like Nigeria seeks to draw reference on PGHD usage, this framework offers a relatable guideline by serving as a focal point.

4. Implication for Academics: all first-time evidence and knowledge captured in the course of this research will fill the pre-existing gap in the literature as it relates to PGHD in Nigeria and similar developing nations. By addressing research questions 2, 3 and 4 with the applied information system theories, adds to the literature; the vast applicability and validity of the technology readiness and technology acceptance model within the health sector and health informatics in general.

9.4 Research Limitations
The sample size for the PGHD-TR survey (Study-1) comprised of 1,443 participants and could be considered being sufficient to yield a stronger insight on their propensity to adopt PGHD, compared to the Study-2’s population comprising 53 diabetic patients. While factors such as cost, study duration and distance
(travelling between The UK and Nigeria) affected reaching a larger sample size for Study-2, the findings made cannot be easily generalised without caution, considering study’s sample size.

Most of the research participants required different forms of incentives in order to participate in the 3-month PGHD actual-use study. While enabling them through various incentives such as the provision of pre- and post-HbA1c tests, free glucometers and test-strips, as well as regular follow-ups from the collaborating medical doctors, the outcome of this study could have been different if the participants were not offered any form of support.

9.5 Further Research Opportunities

Hopefully, this research will spur further investigations with even a larger population on the technology readiness of more Nigerians as it relates to numerous health interventions that are patient centred. Though scalable, the framework has been designed with patient-doctor diabetes management in mind. Yet, it will be beneficial to all involved stakeholders to see how the replication of this study with other chronic conditions impacts on the framework. It is undeniable that the personalisation of everyday mobile devices and wide availability of affordable internet connections in Nigeria and other developing nations will transcend beyond social media, e-Commerce, mobile banking, and personal entertainment use into health-related purposes. This implies that there is a need to investigate how affordable and personalised healthcare services should be offered and delivered across digital media to the populace. This will be of immense benefit to all in Nigeria, but still requires evidence-based investigation to be realised. Technology leapfrog in Nigeria is no longer a question of how, but when. Therefore, there is a need for native knowledge within the Nigerian health sector and this can be realised through further research.

9.6 Conclusion

Researcher’s reflection: This thesis has comprehensively delivered the research aims and objectives by answering the research questions set as back as September 2013. Over the course of the four-year period this research lasted, the learning curve that yielded the validated framework has been humbling and yet inspiring.
This research has investigated how PGHD can contribute towards improving Nigerian patients’ diabetes mellitus management, and by so doing developed a validated PGHD adoption framework for Patients and healthcare providers within the Nigeria health care sector. It is intended that this framework benefits all relevant stakeholders by providing guidance, while spurring the zeal to even improve upon the findings presented in this thesis.
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APPENDICES

Appendix 1: Ethical Approval from Coventry University

19th December 2014.

Dr. A.O. Laketu
Ag. Medical Director,
Lagos State Government General Hospital, Lagos (ODAN)
1/3, Broad Street,
Lagos.
P.M.B 12526, Marina,
Lagos.

Your Ref No. SUB/GHL/1276/19

Dear Sir,

**Re: Provisional Approval to Commence Research**

With reference to your letter dated 14th of October 2014 to Mr Ikechukwu C. Maduka on the above, I am pleased to inform you that Mr Maduka’s ethical application has been approved by the Faculty of Engineering and Computing, Coventry University.

On behalf of myself, Mr Maduka and his supervisory team, I wish to use this opportunity to thank you, your Management team and the Lagos state Government for granting Mr Maduka the permission to carry out his research in your hospital.

Yours faithfully,

Dr. Michael O. Odetayo
Director of Studies of Mr Ikechukwu C. Maduka

Cc. Mr Ikechukwu C. Maduka
Appendix 2: Lagos State Health Service Commission Ethical Approval

LAGOS STATE GOVERNMENT
HEALTH SERVICE COMMISSION
1, Ganiu Smith Street
Lagos Island
Lagos.

Date: 14th October, 2014

The Medical Director,
General Hospital,
Lagos.

PERMISSION TO CONDUCT A RESEARCH STUDY
(MR. IKECHUKWU, C. MADUKA)

I have been directed to convey the approval of the Permanent Secretary, Lagos State Health Service Commission and to introduce the above named who intends to carry out a study in your hospital.

The title of his study is “DIABETES MANAGEMENT IN LAGOS STATE GENERAL HOSPITAL”. A copy of your findings should be forwarded to the Health Service Commission.

Kindly accord him all necessary assistance.

DR. (MRS.) A.M. ONAYIGA
Director Medical Services

Cc:
DR. M. O. ODETAYO
Department of Computing,
Coventry University.
Appendix 3: General Hospital Odan, Lagos State Ethical Approval

LAGOS STATE GOVERNMENT
GENERAL HOSPITAL, LAGOS (ODAN)
(Established - 1893)

1/3, Broad Street,
Lagos Island,
Lagos.
P.M.B. 12526, Marina, Lagos.

Ref No. SUB/GHL/1276/19

Date: 4th OCTOBER, 2014

MR. IKECHUKWU C. MADUKA

PROVISIONAL APPROVAL TO COMMENCE RESEARCH

I wish to inform you that you are hereby given a provisional approval to commence the research. This approval is based on your earlier request to carry out research in the hospital.

However, you should note that this is only a Provisional Approval, pending the time that you will present the Ethics Approval from your school.

Please, note that failure to present the Ethics Approval from your school will mean that the provisional approval will be withdrawn.

Meanwhile, have a fruitful research!

Dr. A. O. Laketu
Ag. Medical Director

MISSION STATEMENT: To Provide Prompt and Affordable Health Care Services to all Patients in a Clean, Friendly and Healthy Environment
Appendix 4: Author’s Permission to Adapt the TRI Framework for this research

Thank you so much for the permission to adopt the four dimensional TRI framework. I shall correctly cite its usage and if need be will communicate further. Once more, thank you so much.

Scholar: Ikechukwu C. Maduka (PhD candidate in Health informatics)
Faculty of Engineering and Computing
Coventry University UK.
email: madukai@coventry.ac.uk
DOS (Director of Studies/Supervisor): Dr. Michael O. Odetayo
Principal Lecturer
Faculty of Engineering and Computing, Coventry University
Gulson Road, Coventry
CV1 2JH, UK
email: csx190@coventry.ac.uk

On 3 Jul 2015, at 16:35, Parasuraman, A <aparasur@bus.miami.edu> wrote:
Hi Iyne,

Based on your email I am assuming that you are seeking permission to use the four dimensional TRI framework to structure and interpret your analyses of data that you have already collected. If my assumption is correct, you have our permission to use the TRI framework, with the understanding that you will appropriately cite our work. On the other hand, if you plan to collect additional data using the TRI scale (or the more recently published TRI 2.0 scale), you would need to complete some paperwork to obtain formal permission to use the scale. Please let us know if you would like to use the actual TRI scale items in any additional research. Thanks.

Best wishes,

A. "Parsu" Parasuraman
Professor of Marketing & Holder of the James W. McLamore Chair
Director of Doctoral Programs
Chair, Marketing Department
School of Business Administration
University of Miami
Coral Gables, FL 33124-6554
Tel: 305-284-5743/Fax: 305-284-5326
parsu@miami.edu
http://www.bus.miami.edu/faculty-and-research/faculty-directory/marketing/parasuraman/index.html

From: Ikechukwu Maduka [mailto:madukai@uni.coventry.ac.uk]  Sent: Thursday, July 02, 2015 1:46 PM To: ccolby@rockresearch.com; Parasuraman, A Ce: Michael Odetayo (Principal Lecturer in Computer Science); Dianabasi Nkantah (Lecturer in Computer Networking) Subject: Scholarly application for the use of TRI in my research
Appendix 5: Item Thematic Analysis –

**Legend:**  
PP = Positively Predisposed; PPS = Positively Predisposed, but Sceptical; NP = Negatively Predisposed

4.6.2: Patient-generated health data (PGHD) are health-related data such as symptoms, biometric data, lifestyle choices, treatment history, health history and other information created, recorded, gathered from patients or their designee (i.e. care partners or those who assist them) to help address a health concern (Deering 2013: 13). PGHD are different from data generated within clinical settings and through meetings with care providers in two important ways. First, patients, not providers, are chiefly responsible for capturing or recording these data and secondly, patients direct the sharing or distribution of these data to health care providers and other stakeholders. *With this stated, what is your disposition to PGHD as a medical practitioner in Lagos State Nigeria?*

<table>
<thead>
<tr>
<th>Respondents (n=47)</th>
<th>Result Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Legend:</strong></td>
<td></td>
</tr>
<tr>
<td>PP</td>
<td></td>
</tr>
<tr>
<td>PPS</td>
<td></td>
</tr>
<tr>
<td>NP</td>
<td></td>
</tr>
</tbody>
</table>

1. “I think it’s a good idea, and will complement the existing data generated in clinical setting”. **PP**
2. “It is very much welcomed. Great innovation and first-hand information”. **PP**
3. “I am positively disposed to it”. **PP**
4. “Great tool in patients’ management”. **PP**
5. “Not currently practised in Lagos State to the best of my knowledge. I think that until the whole system is computerised, it isn't going to be as effective”. **PPS**
6. “I don’t agree such patients’ information should be handled by electronic means because of its safety”. **NP**
7. “I'm positively disposed to it, as it will help improve patient care outcomes and help get patients’ actively involved in his or her care”. **PP**
8. “I believe it’s going to be a good approach from patients toward complementing existing data generated within clinical setting”. **PP**
9. “It is an interesting concept towards patient engagement and pro-activeness concerning their health”. **PP**
10. “It is a welcomed idea”. **PP**
11. “I am positively disposed to the PGHD concept for Lagos State”. **PP**
12. “It is a great approach towards empowering patients”. **PP**
13. “I am positively disposed to PGHD for Lagosians and for Lagos State medical practitioners”. **PP**
14. “It has quite a promising potential to benefit patients’ health outcome and support data generated within clinical settings”. **PP**
15. “It’s a welcomed approach towards supporting clinical generated data for enhancing patients’ treatment”. **PP**
16. “Although promising, it is not novel. It will be a massive addition towards healthcare provision in Lagos State if it can be widely implemented and adopted”. **PPS**
17. “Great concept as a diagnostic tool and patient inclusiveness if successfully implemented in the state”. **PPS**
<table>
<thead>
<tr>
<th></th>
<th>Response</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>“It sounds great but a lot of challenges if it is to be achieved in Lagos State”.</td>
<td>PPS</td>
</tr>
<tr>
<td>19</td>
<td>“Not a bad idea”.</td>
<td>PP</td>
</tr>
<tr>
<td>20</td>
<td>“Great approach to patient centred care”.</td>
<td>PP</td>
</tr>
<tr>
<td>21</td>
<td>“I have my doubts giving the various obstacles that might limit its adoption, though it seems promising”.</td>
<td>PPS</td>
</tr>
<tr>
<td>22</td>
<td>“It’s a good concept if it can be successfully implemented”.</td>
<td>PPS</td>
</tr>
<tr>
<td>23</td>
<td>“A good supportive diagnostic tool that can complement doctors’ decision making”.</td>
<td>PP</td>
</tr>
<tr>
<td>24</td>
<td>“Portends great possibility if successfully implemented”.</td>
<td>PPS</td>
</tr>
<tr>
<td>25</td>
<td>“Promising”.</td>
<td>PP</td>
</tr>
<tr>
<td>26</td>
<td>“I am positive about PGHD in the State”.</td>
<td>PP</td>
</tr>
<tr>
<td>27</td>
<td>“As a doctor in Lagos State, it sounds good if it can work”.</td>
<td>PPS</td>
</tr>
<tr>
<td>28</td>
<td>“I am ok with the concept”.</td>
<td>PP</td>
</tr>
<tr>
<td>29</td>
<td>“Not bad”.</td>
<td>PP</td>
</tr>
<tr>
<td>30</td>
<td>“I am ok with it”.</td>
<td>PP</td>
</tr>
<tr>
<td>31</td>
<td>“Not a bad attempt to engage even more the patient”.</td>
<td>PP</td>
</tr>
<tr>
<td>32</td>
<td>“It needs to be thoroughly investigated initially”.</td>
<td>PPS</td>
</tr>
<tr>
<td>33</td>
<td>“It is a good one, but will demand a lot of effort to work on a State scale in Lagos”.</td>
<td>PPS</td>
</tr>
<tr>
<td>34</td>
<td>“Difficult to say, but it is not a bad idea for the state health delivery practice”.</td>
<td>PPS</td>
</tr>
<tr>
<td>35</td>
<td>“It could work if highly researched and invested in”.</td>
<td>PPS</td>
</tr>
<tr>
<td>36</td>
<td>“Filled with doubts on its success in the state as a result of several inadequacies in the health system”.</td>
<td>PPS</td>
</tr>
<tr>
<td>37</td>
<td>“It can work for both doctors and patients”</td>
<td>PP</td>
</tr>
<tr>
<td>38</td>
<td>“It’s worth a try in the state if the challenges that are likely to impede it could be addressed”.</td>
<td>PPS</td>
</tr>
<tr>
<td>39</td>
<td>“It can be a supportive medium for keeping up with patients monitoring but needs to be studied first within the state populace and health sector”.</td>
<td>PPS</td>
</tr>
<tr>
<td>40</td>
<td>“No such practice functioning at the moment on a state level, but I see it has potentials and believe it can be tried out for chronic care patient management”.</td>
<td>PP</td>
</tr>
<tr>
<td>41</td>
<td>“It’s a new concept to patient centered care if tried out in the state”.</td>
<td>PPS</td>
</tr>
<tr>
<td>42</td>
<td>“I am positively disposed to adopting PGHD”.</td>
<td>PP</td>
</tr>
<tr>
<td>43</td>
<td>“I am positive about it; it will be a good addition to improving patient monitoring even when not in clinical environment”.</td>
<td>PP</td>
</tr>
<tr>
<td>44</td>
<td>“A good one”.</td>
<td>PP</td>
</tr>
<tr>
<td>45</td>
<td>“Promising and I can see its potential but requires a great research in order to define limits of meaningful use”.</td>
<td>PPS</td>
</tr>
<tr>
<td>46</td>
<td>“It’s a nice concept and I would be willing to try it out in my place of work”.</td>
<td>PP</td>
</tr>
<tr>
<td>47</td>
<td>“Cool with the idea”.</td>
<td>PP</td>
</tr>
<tr>
<td>Respondents (n=47)</td>
<td>Appendix 6: Item Thematic Analysis –</td>
<td></td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> Significant = Response meaningful to measured item; Insignificant = Response not relevant/meaningful to measured item</td>
<td><strong>Result Summary</strong></td>
<td></td>
</tr>
<tr>
<td><strong>4.6.2: In your own words, what will you regard/describe as meaningful use of PGHD in Lagos State Nigeria?</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Patients' and/or caregivers' record of treatment and health history, biometric data including weight, blood pressure and blood sugar monitoring, lifestyle choices e.g. diet/food chart, weight, exercise record drug history with side-effects chart</td>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>2. Use of PGHD to know common symptoms associated with a particular disease condition or side effects of drugs/complications of treatment.</td>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>4. Enhance patients’ management</td>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>5. Easy transfer of patients records across government-owned hospitals in the state. Applying the data base per patients in his/her own management.</td>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>6. No idea</td>
<td>Insignificant</td>
<td></td>
</tr>
<tr>
<td>7. Prompt intervention in resolving issues without patients needing to wait for their appointment dates or frequenting hospitals for minor (or even some serious) issues</td>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>8. I believe PGHD meaningful use should encapsulate an all-inclusive stakeholder input in identifying and agreeing on the best set of patient health data that can be generated and communicated to their care providers. This practice should ensure utmost care in the management of the generated data in order to impact positively on the patients’ health outcome while improving decision making effort of the care provider (medical doctor).</td>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>9. A concept that empowers the patient and informs the medical practitioner even better</td>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>10. A situation whereby PGHD empowers the patient and informs more the physician</td>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>11. A concept that will benefit both the patients’ health and improve doctors’ diagnosis and treatment</td>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>12. Ensuring that committed patient on the PGHD scheme get the best values out of the data they share with their physicians while guaranteeing privacy, security and responsible use and safe keeping of the data.</td>
<td>Significant</td>
<td></td>
</tr>
<tr>
<td>13. A concept that can make patients more proactive concerning their health and improve decision making for physicians.</td>
<td>Significant</td>
<td></td>
</tr>
</tbody>
</table>

340
<table>
<thead>
<tr>
<th></th>
<th>If PGHD can be properly researched in Lagos State so that it is fit and suitable for adoption by the state residents, with evidence of its positive impact clearly evaluated over a period of time, that I will assume as a meaningful use of PGHD in Lagos State</th>
<th>Significant</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.</td>
<td>Optimising the use of the data provided by the patient, for the patient, within tenets of best practice to improve the patients’ health outcome.</td>
<td>Significant</td>
</tr>
<tr>
<td>16.</td>
<td>Meaningful use of PGHD in my opinion should depict a practice that ensures secured but flexible transfer, retrieval and storage of PGHD for improving patient health while supporting physicians’ diagnostic decision making</td>
<td>Significant</td>
</tr>
<tr>
<td>17.</td>
<td>If it improves my patients’ management culture</td>
<td>Significant</td>
</tr>
<tr>
<td>18.</td>
<td>If the potential impact of PGHD can improves the state health service delivery, then it should be assumed as meaningful</td>
<td>Significant</td>
</tr>
<tr>
<td>19.</td>
<td>If it positively impacts my practice and my patient health then it is meaningful</td>
<td>Significant</td>
</tr>
<tr>
<td>20.</td>
<td>Although subjective, I guess this will entail using the shared data from the patient in supporting their medical treatment while ensuring best practice in managing the PGHD</td>
<td>Significant</td>
</tr>
<tr>
<td>21.</td>
<td>Adopting its use with utmost responsibility</td>
<td>Significant</td>
</tr>
<tr>
<td>22.</td>
<td>If it can improve my practice and my patients ease of access to</td>
<td>Significant</td>
</tr>
<tr>
<td>23.</td>
<td>If it works well for all involved</td>
<td>Significant</td>
</tr>
<tr>
<td>24.</td>
<td>Responsible usage of PGHD by all involved stakeholders to benefit as evidenced, the patient</td>
<td>Significant</td>
</tr>
<tr>
<td>25.</td>
<td>If PGHD works for my practice then it is meaningful</td>
<td>Significant</td>
</tr>
<tr>
<td>26.</td>
<td>Until after the evaluation of how it has benefited me and my patients, I can ascertain how meaningful it is</td>
<td>Significant</td>
</tr>
<tr>
<td>27.</td>
<td>If it becomes a supporting diagnostic tool then it is meaningful</td>
<td>Significant</td>
</tr>
<tr>
<td>28.</td>
<td>If it is in any way gainfully effective to my practice</td>
<td>Significant</td>
</tr>
<tr>
<td>29.</td>
<td>If it is successfully adopted and contributes towards care delivery, then it is meaningful</td>
<td>Significant</td>
</tr>
<tr>
<td>30.</td>
<td>Responsible adoption of PGHD by patient and responsible utilisation by the doctor</td>
<td>Significant</td>
</tr>
<tr>
<td>31.</td>
<td>I believe if it works then it’s meaningful</td>
<td>Significant</td>
</tr>
<tr>
<td>32.</td>
<td>If it is useful to my work and benefits my patient</td>
<td>Significant</td>
</tr>
<tr>
<td>33.</td>
<td>A case whereby both patients and physicians witness an improvement in health and in practice thanks to PGHD</td>
<td>Significant</td>
</tr>
<tr>
<td>34.</td>
<td>Responsible use of the generated sent in data from the patient by the doctor</td>
<td>Significant</td>
</tr>
<tr>
<td>35.</td>
<td>If it helps my work and my patient then its meaningful</td>
<td>Significant</td>
</tr>
<tr>
<td>36.</td>
<td>Good data handling of PGHD to improve service</td>
<td>Significant</td>
</tr>
<tr>
<td>37.</td>
<td>Good use of PGHD by the doctor and proper management and safeguarding of the data for the records</td>
<td>Significant</td>
</tr>
<tr>
<td>38.</td>
<td>Proper usage and manage of the data shared with patients supported by strict guidelines and regularly evaluated</td>
<td>Significant</td>
</tr>
<tr>
<td></td>
<td>If it helps my work and health outcomes of my patients</td>
<td>Significant</td>
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</tr>
<tr>
<td>40.</td>
<td>For the state, I think the Lagos State ministry of health</td>
<td>Significant</td>
</tr>
<tr>
<td>41.</td>
<td>When PGHD helps all involved in administering and receiving the care, then it is meaningful</td>
<td>Significant</td>
</tr>
<tr>
<td>42.</td>
<td>Good usage of PGHD to the benefit of all involved in giving and receiving care</td>
<td>Significant</td>
</tr>
<tr>
<td>43.</td>
<td>If it works for my practice and my patient with good data management then it should be regarded as meaningfully used</td>
<td>Significant</td>
</tr>
<tr>
<td>44.</td>
<td>If it works for my patient and I</td>
<td>Significant</td>
</tr>
<tr>
<td>45.</td>
<td>Responsible utilisation of PGHD from the patient who shares the data, the doctor who uses the data and the structure that stores and allows access to the data</td>
<td>Significant</td>
</tr>
<tr>
<td>46.</td>
<td>Good use of PGHD by doctor and evidenced proof its supporting patient care delivery</td>
<td>Significant</td>
</tr>
<tr>
<td>47.</td>
<td>When all process involved in the capture, sharing and usage of PGHD is done responsibly</td>
<td>Significant</td>
</tr>
</tbody>
</table>
### Appendix 7: Item Thematic Analysis –

**Legend:**  
- **CCC =** Complexity, cost, competency and Commitment of medical practitioners towards PGHD practice  
- **PSHI =** Privacy and security of health information  
- **PLCEI =** Patient literacy, commitment and ethical issue  
- **IPGS =** Inadequate policy and government support  
- **ITLS =** Inadequate technology and Logistical support

#### 4.6.2: From your own perspective, what concerns regarding PGHD practise do/would you share considering all stakeholders involved?

<table>
<thead>
<tr>
<th>Respondents (n=47)</th>
<th>Result Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Legend:</strong> CCC, PSHI, PLCEI, IPGS, ITLS</td>
<td></td>
</tr>
<tr>
<td><strong>1.</strong> My concern is that patients’ record may not be completely reliable; Problems may include error in recording, illiteracy, falsifying record to make it look good or bad deliberately depending on the situation.</td>
<td>![●] ![●]</td>
</tr>
<tr>
<td><strong>2.</strong> Sincerity and honesty on the part of patients concerning their report.</td>
<td>![●]</td>
</tr>
<tr>
<td><strong>4.</strong> Sincerity. Commitment</td>
<td>![●]</td>
</tr>
<tr>
<td><strong>5.</strong> Privacy and security of the data base.</td>
<td>![●]</td>
</tr>
<tr>
<td><strong>6.</strong> Security issues with the patient information in question</td>
<td>![●]</td>
</tr>
<tr>
<td><strong>7.</strong> Whether Nigeria's weak IT infrastructure and literacy level can support such a concept now?</td>
<td>![●] ![●]</td>
</tr>
<tr>
<td><strong>8.</strong> Issues such as technology readiness of all involved stakeholders needs to be addressed. There is a need to identify the most ubiquitous technology and data format most practical for actualizing the PGHD practice. Privacy and Security concerns of PGHD. Patient participation and engagement will require lots of patience and enlightenment effort which medical doctors might not be willing to provide</td>
<td>![●] ![●] ![●]</td>
</tr>
<tr>
<td><strong>9.</strong> Security and privacy concern relating to the generated data. Ownership of the data. Technology issues that might surround the adoption of the practice</td>
<td>![●] ![●]</td>
</tr>
<tr>
<td><strong>10.</strong> Summoning all involved stakeholder will be a herculean task from the onset given the terrain. The issue of commitment and sincere reporting of data by patient is a great concern. This is because a dishonest data report will mislead physicians’ decision making.</td>
<td>![●] ![●]</td>
</tr>
<tr>
<td><strong>11.</strong> Trust and commitment issue from all involved. Identifying how best to determine what sort of data needed and who should have access, own it and redistribute the generated data.</td>
<td>![●] ![●] ![●]</td>
</tr>
<tr>
<td><strong>12.</strong> Security and privacy of data. The technicality involved in the whole process. Defining standards and best practice. How will such scheme be monitored and evaluated?</td>
<td>![●] ![●] ![●]</td>
</tr>
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</tr>
<tr>
<td>13.</td>
<td>Logistics concerns for dealing with the generated data. Privacy, security, distribution and liability of PGHD</td>
</tr>
<tr>
<td>14.</td>
<td>Complexity in defining standards for PGHD best practice policies, adoption, evaluation and quality control</td>
</tr>
<tr>
<td>15.</td>
<td>To start with, awareness and guidelines on what PGHD is all about needs to be embarked upon. Giving its novelty in Lagos State, issues on privacy, distribution and control of PGHD requires great deal of detailing for all involved persons. Also supporting technological platforms and what to be included and excluded is PGHD exchange requires great discourse</td>
</tr>
<tr>
<td>16.</td>
<td>I fear that PGHD may not be completely relied upon as errors in data recording, forged data to make patient situation appear nice or worse intentionally. Secondly, literacy gap, and financial implications of PGHD might be a great issue when considering its adoption in the state</td>
</tr>
<tr>
<td>17.</td>
<td>Regulating PGHD usage is very necessary. Security of the shared data. Willingness from all involved</td>
</tr>
<tr>
<td>18.</td>
<td>Will patient commit to such practice? Will doctors be willing to accept PGHD? Will there be need to regulate PGHD and by who?</td>
</tr>
<tr>
<td>19.</td>
<td>Getting all involved stakeholders on board will be very difficult from the onset</td>
</tr>
<tr>
<td>20.</td>
<td>The logistics needed to kick-start such practice needs to be defined if all stakeholders are to come on board</td>
</tr>
<tr>
<td>21.</td>
<td>Concerns relating to security, cost, technical requirements and usage guidelines needs to be pre-defined from the onset</td>
</tr>
<tr>
<td>22.</td>
<td>Implementation bottle necks.</td>
</tr>
<tr>
<td>23.</td>
<td>Security of PGHD shared. Inadequate Supporting network and structure at the moment</td>
</tr>
<tr>
<td>24.</td>
<td>Educational and technological literacy divide across the state</td>
</tr>
<tr>
<td>25.</td>
<td>Cost. Security and privacy issues. Ethics and need for regulatory arm of the health ministry in the state to develop policies if PGHD will be adopted into formal care</td>
</tr>
<tr>
<td>26.</td>
<td>Logistics concerns on piloting its implementation. Awareness greatly needed. Cost of financing such scheme on a state level. Government willingness and the populace readiness towards PGHD</td>
</tr>
<tr>
<td>27.</td>
<td>Poor implementation and lack of continuity of such programmes might dissuade its adoption</td>
</tr>
<tr>
<td>28.</td>
<td>If all the stakeholders will share same interest on the adoption of PGHD</td>
</tr>
<tr>
<td>29.</td>
<td>Selling such idea across all involved will require lots of convincing</td>
</tr>
<tr>
<td>30.</td>
<td>Poor planning</td>
</tr>
<tr>
<td>31.</td>
<td>Insufficient planning will limit the exchange of ideas from the onset as what will be required from each stakeholder might not be properly communicate</td>
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<tr>
<td>32. The patient: need for a patient engagement effort as this is lacking at the moment. The doctor, nurses and other medical staff: support from the government in terms of provision of tools to enable PGHD is lacking at the moment. Government: poor commitment from the government on implementing patient centred care is evident and this will impede PGHD implementation until such is addressed. IT/Mobile provider: the cost of data and poor service will likely affect the patient data sharing.</td>
<td></td>
</tr>
<tr>
<td>33. At the moment, there is inadequate support in personnel and in supporting structure for PGHD</td>
<td></td>
</tr>
<tr>
<td>34. Doctor; commitment may vary individually. Patients; technological gap and education might determine who adopts such practice. Government; willingness to fund and support PGHD e-community</td>
<td></td>
</tr>
<tr>
<td>35. Privacy, security, accessibility and management of the generated data needs to be considered from all stakeholder point of view</td>
<td></td>
</tr>
<tr>
<td>36. Cost concern. Security, ethics, liability and privacy and accessibility of PGHD amongst all involved. Education gap amongst several patients and doctors’ commitment concerns. Government support is uncertain</td>
<td></td>
</tr>
<tr>
<td>37. Implementation concerns as it involves all concerned</td>
<td></td>
</tr>
<tr>
<td>38. Commitment from all involved stakeholder will likely vary and this might hinder PGHD acceptance in the state</td>
<td></td>
</tr>
<tr>
<td>39. Implementation concerns such as who should regulate PGHD, privacy and security, control of the dissemination of PGHD, the patient educational level and how targeted response can be elicited from patient given their uniqueness etc.</td>
<td></td>
</tr>
<tr>
<td>40. Patient-doctor relationship will play a crucial role to PGHD success</td>
<td></td>
</tr>
<tr>
<td>41. Convincing all involved to partake in such a practice will be difficult. Some doctors might see it as a disruption. Some patients might not be ready or willing to adopt PGHD as a result of literacy, cost, privacy of health data and legal concerns in the case of PGHD misuse</td>
<td></td>
</tr>
<tr>
<td>42. Bad implementation concerns</td>
<td></td>
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<tr>
<td>43. Cost and privacy for users. Commitment and authenticity of shared data for doctor</td>
<td></td>
</tr>
<tr>
<td>44. Bringing all involved on board is a complex task</td>
<td></td>
</tr>
<tr>
<td>45. Identifying each stakeholder degree of impact is necessary from the onset and will be quite tasking</td>
<td></td>
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<tr>
<td>46. Willingness to try out new approach is usually a hindrance to accepting new technology and this is a concern amongst all stakeholder</td>
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<tr>
<td>47. If poorly conceived, convincing all involved will be difficult</td>
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</table>

<table>
<thead>
<tr>
<th>Total</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>27 (57.4%)</td>
<td>20 (42.5%)</td>
<td>30 (63.8%)</td>
<td>26 (55.3%)</td>
</tr>
<tr>
<td>Respondents (n=47)</td>
<td>Appendix 8: Item Thematic Analysis – 4.6.2: From your own perspective; how can your listed concerns regarding PGHD be addressed?</td>
<td>Result Summary</td>
<td></td>
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<tr>
<td><strong>Legend:</strong></td>
<td><strong>Significant</strong> = Response meaningful to measured item; <strong>Insignificant</strong> = Response not relevant/meaningful to measured item</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Patients’ education on the importance and benefits of PGHD. Education on why and how to fill in the data properly and truthfully. Getting a literate family member to fill in the data. Educating care-givers as well</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Detailed description of symptoms and not misuse of medical terms.</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Extensive publicity and education</td>
<td>Significant</td>
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</tr>
<tr>
<td>4.</td>
<td>Robust enlightenment campaign. Reward for honesty</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>5.</td>
<td>Proper registration of doctors. Identification tags/passwords for the PGHD managing doctors. Using up to date technology for the management of the data.</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>I just followed a normal flow path</td>
<td>Insignificant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>Making the technology as simple as possible and affordable</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>From a head to bottom approach, the Government should be ready to provide incentives for all involved in the practice and a supporting platform for PGHD in Nigeria</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9.</td>
<td>It is a consensus that should be discussed amongst all involved stakeholders</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10.</td>
<td>By good education of the patient and awareness programme for all involved</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11.</td>
<td>Through the involvement of all stakeholders in designing a functional PGHD project in Lagos State</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>12.</td>
<td>Via proper research prior to PGHD adoption</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Defining a clear policy on PGHD use by the state medical board</td>
<td>Significant</td>
<td></td>
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<tr>
<td>14.</td>
<td>Through proper planning and carrying along all involved stakeholders in each step of such scheme</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>15.</td>
<td>Through proper research on PGHD in Lagos State and then build upon from the lessons learnt for a wider implementation if need be</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Via proper research prior to pilot testing</td>
<td>Significant</td>
<td></td>
<td></td>
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<tr>
<td>17.</td>
<td>Through proper consideration and resolution of the highlighted concerns</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>18.</td>
<td>Simply by piloting the concept first and picking from the lessons learnt</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>19.</td>
<td>Government support is crucial</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Good planning and research will set the wheel rolling</td>
<td>Significant</td>
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</tr>
<tr>
<td>21.</td>
<td>If they can be considered and resolved then it will be great</td>
<td>Significant</td>
<td></td>
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<tr>
<td>22.</td>
<td>Through proper studying and research</td>
<td>Significant</td>
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</tr>
<tr>
<td>23.</td>
<td>By planning ahead</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>24.</td>
<td>Good education programs</td>
<td>Significant</td>
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</tr>
<tr>
<td>25.</td>
<td>Tackling the various concerns individually in order to resolve them</td>
<td>Significant</td>
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</tr>
<tr>
<td>26.</td>
<td>Good planning and research will identify several best practices that can help address these concerns</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>27.</td>
<td>Good implementation practice</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>28.</td>
<td>Through meeting and exchanging ideas on the pros and cons of PGHD adoption and how to approach solving such concerns</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>29.</td>
<td>Investment through funding, government support and research</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>30.</td>
<td>Good planning and logistics</td>
<td>Significant</td>
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</tr>
<tr>
<td>31.</td>
<td>Adequate planning, research and funding</td>
<td>Significant</td>
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</tr>
<tr>
<td>32.</td>
<td>Well researched planning</td>
<td>Significant</td>
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</tr>
<tr>
<td>33.</td>
<td>By addressing the inadequacies, such as power, affordable internet accessibility, a broad awareness program and government involvement</td>
<td>Significant</td>
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</tr>
<tr>
<td>34.</td>
<td>Good planning and funding for PGHD in Lagos State</td>
<td>Significant</td>
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<tr>
<td>35.</td>
<td>By piloting a study of PGHD in the state</td>
<td>Significant</td>
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<tr>
<td>36.</td>
<td>Through involvement of all in the implementation phase supported with good evidence</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>37.</td>
<td>Good design through research for a successful implementation and adoption</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>38.</td>
<td>Through good integration of all involved from the early research stage</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>39.</td>
<td>By bringing on board all involved during the research phase</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>40.</td>
<td>Good patient and doctor engagement effort is needed</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>41.</td>
<td>A good evidenced research yields great implementation and thus likely good adoption</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>42.</td>
<td>Good research before implementation</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>43.</td>
<td>Good planning and involvement of all involved during framework design</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>44.</td>
<td>Through good research and learning from existing best practices then piloting PGHD in one og the state LGA</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>45.</td>
<td>In-depth research</td>
<td>Significant</td>
<td></td>
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</tr>
<tr>
<td>46.</td>
<td>By patiently introducing the concept to all involved</td>
<td>Significant</td>
<td></td>
<td></td>
</tr>
<tr>
<td>47.</td>
<td>Proper planning and continuous research</td>
<td>Significant</td>
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</tbody>
</table>

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### Appendix 9: Item Thematic Analysis –

Legend:  
EAAI = PGHD education, awareness and adequate information on PGHD usage;  
UDR = User development and reward;  
PPET = Provision of enabling policies, environment and technology;  
IPFC = If integrated into patient formal care;  
EBD = Evidence-based development and implementation of PGHD

| 4.6.2: As a medical practitioner in Lagos State, what incentives do you think would accelerate PGHD acceptance into the State’s medical practice? |
|---|---|---|---|---|
| 1. | Education and awareness program |   |
| 2. | Adequate information on its usefulness. |   |
| 3. | Trainings on the benefit. Education. Provision of software and maybe hardware |   |
| 4. | Don't know |   |
| 5. | It should be a prerequisite for getting medical care. Except emergencies. |   |
| 6. | No idea |   |
| 7. | Education on its importance |   |
| 8. | Adequate information on PGHD usefulness and an educational programme to enlighten patients from the government |   |
| 9. | A far-reaching patient and practitioners’ awareness programme in Lagos State |   |
| 10. | A clear definition of what PGHD entails and evidenced driven proof that it is achievable in Lagos State |   |
| 11. | Government support in the provision of the needed technology and policies for PGHD. Awareness programs sponsored by the government which I believe will be far reaching in educating the state residents |   |
| 12. | Good structure and planning |   |
| 13. | Good policy and planning |   |
| 14. | If the needed supporting structure is provided by the government |   |
| 15. | Simply good planning and provision of what’s inadequate. |   |
| 16. | Proper information on its usefulness. Adequate provision of supporting software and technology. If the impact of PGHD can be assessed, evaluated and reported to show evidence of its usefulness. Government support on legitimizing PGHD policies and provision of supporting infrastructure |   |
17. A good evidence of how the policy is designed to support the practice will be useful

18. Sharing awareness of evidence showing that PGHD really benefits patients’ health outcomes in Lagos State

19. Provision of the inadequate tools

20. Thorough research into PGHD viability in the state

21. Government willingness to support PGHD

22. Through detailed pilot studies and research

23. Evidence-base knowledge on PGHD best practice

24. Setting a state wide standard for PGHD use

25. Government support will help alleviate such hindrance

26. Total involvement of the state government will reassure physicians towards PGHD acceptance

27. Good planning and provision of structure for PGHD

28. Good implementation programme

29. Better provision of supporting structure for PGHD

30. Good planning will go a long way

31. Good implementation policy

32. Good implementation should take note of all requirements from the people involved, process and technological demands of PGHD in the state. If this can be addressed, it will boost PGHD adoption in Nigeria and Lagos State

33. Provision of supporting technology and funding for a good patient engagement program

34. Rewarding medical practitioners that encourage their patients to adopt other means of correspondence such as PGHD

35. Thorough regulation and introducing policies that will protect both doctors and patients from the use of PGHD

36. Good funding and proper planning and sound implementation

37. Good planning

38. Proper planning and support from the Lagos State Ministry of Health

39. Good awareness

40. Getting the implementation right

41. Efficient framework on PGHD integration is needed as this will set out tested guidelines and evaluation

42. Good policy to support its implementation

43. A good supportive exchange medium

---

### Table

<table>
<thead>
<tr>
<th>Number</th>
<th>Step Description</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td>A good evidence of how the policy is designed to support the practice will be useful</td>
<td>✔️</td>
</tr>
<tr>
<td>18</td>
<td>Sharing awareness of evidence showing that PGHD really benefits patients’ health outcomes in Lagos State</td>
<td>✔️</td>
</tr>
<tr>
<td>19</td>
<td>Provision of the inadequate tools</td>
<td>✔️</td>
</tr>
<tr>
<td>20</td>
<td>Thorough research into PGHD viability in the state</td>
<td>✔️</td>
</tr>
<tr>
<td>21</td>
<td>Government willingness to support PGHD</td>
<td>✔️</td>
</tr>
<tr>
<td>22</td>
<td>Through detailed pilot studies and research</td>
<td>✔️</td>
</tr>
<tr>
<td>23</td>
<td>Evidence-base knowledge on PGHD best practice</td>
<td>✔️</td>
</tr>
<tr>
<td>24</td>
<td>Setting a state wide standard for PGHD use</td>
<td>✔️</td>
</tr>
<tr>
<td>25</td>
<td>Government support will help alleviate such hindrance</td>
<td>✔️</td>
</tr>
<tr>
<td>26</td>
<td>Total involvement of the state government will reassure physicians towards PGHD acceptance</td>
<td>✔️</td>
</tr>
<tr>
<td>27</td>
<td>Good planning and provision of structure for PGHD</td>
<td>✔️ ✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>28</td>
<td>Good implementation programme</td>
<td>✔️ ✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>29</td>
<td>Better provision of supporting structure for PGHD</td>
<td>✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>30</td>
<td>Good planning will go a long way</td>
<td>✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>31</td>
<td>Good implementation policy</td>
<td>✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>32</td>
<td>Good implementation should take note of all requirements from the people involved, process and technological demands of PGHD in the state. If this can be addressed, it will boost PGHD adoption in Nigeria and Lagos State</td>
<td>✔️ ✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>33</td>
<td>Provision of supporting technology and funding for a good patient engagement program</td>
<td>✔️</td>
</tr>
<tr>
<td>34</td>
<td>Rewarding medical practitioners that encourage their patients to adopt other means of correspondence such as PGHD</td>
<td>✔️</td>
</tr>
<tr>
<td>35</td>
<td>Thorough regulation and introducing policies that will protect both doctors and patients from the use of PGHD</td>
<td>✔️ ✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>36</td>
<td>Good funding and proper planning and sound implementation</td>
<td>✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>37</td>
<td>Good planning</td>
<td>✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>38</td>
<td>Proper planning and support from the Lagos State Ministry of Health</td>
<td>✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>39</td>
<td>Good awareness</td>
<td>✔️</td>
</tr>
<tr>
<td>40</td>
<td>Getting the implementation right</td>
<td>✔️ ✔️ ✔️ ✔️</td>
</tr>
<tr>
<td>41</td>
<td>Efficient framework on PGHD integration is needed as this will set out tested guidelines and evaluation</td>
<td>✔️ ✔️</td>
</tr>
<tr>
<td>42</td>
<td>Good policy to support its implementation</td>
<td>✔️</td>
</tr>
<tr>
<td>43</td>
<td>A good supportive exchange medium</td>
<td>✔️ ✔️ ✔️</td>
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</tr>
<tr>
<td>44.</td>
<td>Solid government investment on health IT</td>
<td></td>
</tr>
<tr>
<td>45.</td>
<td>Rewarding physicians that support and encourage their patients to share health data electronically</td>
<td></td>
</tr>
<tr>
<td>46.</td>
<td>Provision of what’s lacking such as steady internet at all general hospitals, IT hardware etc.</td>
<td></td>
</tr>
<tr>
<td>47.</td>
<td>Make available adequate HIT environment by the government liability of misuse of PGHD might make some physicians want to stick to traditional face-to-face encounter</td>
<td></td>
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</tbody>
</table>

<p>| | | | |</p>
<table>
<thead>
<tr>
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<tbody>
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<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>26</td>
<td>18</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>(55.3%)</td>
<td>(38.3%)</td>
<td>(63.8%)</td>
</tr>
</tbody>
</table>

350
### Appendix 10: Item Thematic Analysis – 4.6.3: As a medical practitioner in Lagos State Nigeria, what sort of information/data would you consider most valuable to receive electronically from patients?

<table>
<thead>
<tr>
<th>Respondents (n=47)</th>
<th>Item Thematic Analysis</th>
<th>Result Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1.</strong></td>
<td>Clinical wellbeing, symptoms/signs monitoring, Drug administration and side effects, Diet/food charts, BP/Blood sugar/weight records in between appointment dates, exercise records</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>2.</strong></td>
<td>Symptoms and side effects of drugs/treatment procedures</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>3.</strong></td>
<td>Biometric information, Past medical history/treatment history, Medication: current and past, Investigations: current and past, Names of past physicians, Blood group/Genotype</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>4.</strong></td>
<td>Present and past medical history</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>5.</strong></td>
<td>Biodata including current employment status and detailed medical and surgical history.</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>6.</strong></td>
<td>It’s difficult to decide because of confidentiality issues. I don’t see sharing patient’s information electronically safe</td>
<td>Hesitant</td>
</tr>
<tr>
<td><strong>7.</strong></td>
<td>Blood glucose levels, blood pressure results, side effects of medications, weight changes</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>8.</strong></td>
<td>Data on life style habit regarding compliance to medication, exercise, health symptoms, drug reactions and side effects as well as dieting adherence regimen</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>9.</strong></td>
<td>Health related data such as drug regimen, weight, temperature, drug reactions and symptoms and lifestyle data on exercise and chronic care data from monitoring an ongoing ailment like diabetes etc.</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>10.</strong></td>
<td>Health and treatment history Drug regimen and drug reaction Data, Lifestyle choice and dieting</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>11.</strong></td>
<td>Health and medication records, life style choices, drug adherence data</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>12.</strong></td>
<td>1. Life style choice data, 2. Health and medication data, 3. Illness Symptoms, 4. chronic management records</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>13.</strong></td>
<td>Medication regimen adherence. Health symptoms and drug reaction. Chronic care management data etc.</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>14.</strong></td>
<td>Medical treatment symptoms and progress data on lifestyle habits for managing chronic ailing patient</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>15.</strong></td>
<td>Lab results, Symptoms and allergy, Lifestyle habits, Blood sugar level, temperature, weight</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>16.</strong></td>
<td>Exercise and medication records, life style choice information, BP and sugar level for chronic care patients, drug regimen and adherence data, Monitored body temperature and body weight</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>17.</strong></td>
<td>Lab results, blood sugar and BP data, weight and temperature data from my chronic ailing patients</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>18.</strong></td>
<td>Symptoms related data, agreed medication and drug reaction data, chronic care data</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>19.</strong></td>
<td>Information i believe relevant to the type and stage of treatment I am giving to my patient</td>
<td>Forthcoming</td>
</tr>
<tr>
<td><strong>20.</strong></td>
<td>As a specialist in my field, information that I must have decided to communicate with my patient depending on their ability to</td>
<td>Forthcoming</td>
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<tr>
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<tr>
<td>---</td>
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</tr>
<tr>
<td>21.</td>
<td>Depending on which ailment am seeing the patient for at that moment</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>22.</td>
<td>As agreed with my patients</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>23.</td>
<td>Data that I believe will benefit my patient care</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>24.</td>
<td>As agreed with the patient am seeing</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>25.</td>
<td>as agreed with my patient</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>26.</td>
<td>As instructed by me to my patient and as well as capable as my patient can be responsible enough to generate, capture and share such information</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>27.</td>
<td>Information I must have discussed agreed with my patients to share</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>28.</td>
<td>As agreed with my patients</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>29.</td>
<td>Information that will be gainful in understanding my patient health, if such can be collected as a continuous monitoring effort outside clinical environment</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>30.</td>
<td>Relevant data as discussed with my patient</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>31.</td>
<td>Information that will improve my patient diagnosis</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>32.</td>
<td>As agreed with my patient</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>33.</td>
<td>every information relevant to my work and patient care</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>34.</td>
<td>for my chronic ailing patients; vital signs and any resulting complication complaints</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>35.</td>
<td>Vital signs data</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>36.</td>
<td>Continuous data on vital signs for monitoring chronic care patients</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>37.</td>
<td>As relevant to the treatment am giving to my patient</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>38.</td>
<td>Information useful to my work and affects positively my patients’ health outcome</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>39.</td>
<td>As I have recommended to my patient, with suggestions from them as well</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>40.</td>
<td>Vital signs data for chronic patients of mine</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>41.</td>
<td>As agreed with my patient depending on what am treating them at the moment and their ability to capture and transfer such information</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>42.</td>
<td>As agreed with my patient</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>43.</td>
<td>As discussed with my patient pending on what is being treated</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>44.</td>
<td>Based on the ability of my patient to capture and share such data</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>45.</td>
<td>As I see useful to my work and my patient treatment</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>46.</td>
<td>Vital signs data, dieting, drug regimen adherence</td>
<td>Forthcoming</td>
</tr>
<tr>
<td>47.</td>
<td>An observation of an ongoing treatment, vital signs information, exercise result</td>
<td>Forthcoming</td>
</tr>
</tbody>
</table>
### Appendix 11: Item Thematic Analysis –

Legend: Negatively Disposed to PGHD in Lagos State = N. Disposed; Positively disposed but still sceptical = P. Disposed (Sceptics); Fully positively disposed = Fully P. Disposed

#### 4.6.5: Having gone through the questions asked in this survey, what is your disposition now towards PGHD, its likely adoption by Lagosians and acceptance in the Lagos State medical practise? Please also state other insights you have regarding the PGHD concept.

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<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>I believe it’s a novel idea. It will certainly improve the care and management of patients and also, it will surely reduce the bottle-necks at our outpatient clinics. Patients will be confident and happy to be part of their own health decision making.</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>2.</td>
<td>It is a welcomed development and should be encouraged.</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>3.</td>
<td>Positive</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>4.</td>
<td>Great idea but worried about huddles and barriers</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>5.</td>
<td>It’s long overdue. It should be the mainstay of patient management in the 21st century. Compliance would be a big setback to achieving the goals. Full government support would help reduce the probable/inevitable problems of the scheme.</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>6.</td>
<td>Confidentiality issues and cost</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>7.</td>
<td>I'm positively disposed to it</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>8.</td>
<td>It a worthwhile idea and I believe empowering the Patient will impact positively on their health outcome.</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>9.</td>
<td>I have always believed with the proper application of a patient driven technology, health service in Lagos State will benefit a lot - giving the huge population of the State and how this population over-stresses the available resources and manpower. It is a concept worth trying out and I believe with great planning and care, PGHD acceptance and adoption will be successful. This will be evidenced by the population of Lagosians becoming more proactive in their health and the population able and willing to communicate electronically with their doctors.</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>10.</td>
<td>I am positive that if well implemented, PGHD will benefit Lagosians and the state medical practice</td>
<td></td>
<td>●</td>
</tr>
<tr>
<td>11.</td>
<td>PGHD is a promising idea that can benefit both patients, the doctor and the government funded healthcare in</td>
<td></td>
<td>●</td>
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<tr>
<td></td>
<td>Lagos</td>
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<td>---</td>
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</tr>
<tr>
<td>12.</td>
<td>It is a great approach to patient centred care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13.</td>
<td>Patient centred care is here to stay and PGHD is an aspect of it that I believe should be emphatically discussed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.</td>
<td>It will be a good approach to improving the health service delivery in Lagos State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15.</td>
<td>If possibly implemented, it will benefit not just the patients but doctors, and government. I believe with changing times and awareness most Lagosians will see the need to embark upon becoming more proactive in their health choices and PGHD will eventually sprout up as an additional health care tool</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16.</td>
<td>Any input from the patient to support their health outcome is a welcome effort but stringent guidelines should be applied at all times so as to ensure PGHD isn’t misused/abused</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17.</td>
<td>It is going to benefit both medical practitioners and Lagosians if implemented. Although its adoption might be unpredictable at this stage, uncertainties surrounding its success cannot be foretold without trying it out. Good luck in your research!!!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18.</td>
<td>I have always been positively disposed to any effort that impacts in good light my patients health, and with this in consideration, I believe PGHD will benefit all stakeholders involved</td>
<td></td>
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</tr>
<tr>
<td>19.</td>
<td>It’s a good attempt that will help both patients and practitioners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.</td>
<td>Thumbs up, very promising</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21.</td>
<td>It’s a welcome idea, and I think it will be adopted by at least a good majority of the state population</td>
<td></td>
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</tr>
<tr>
<td>22.</td>
<td>Yes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23.</td>
<td>It's still an idea, but with great potential.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24.</td>
<td>It will work if the will from government, medical practitioners and the state populace decides to give it a unanimous try</td>
<td></td>
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</tr>
<tr>
<td>25.</td>
<td>For me, it is a good and promising concept to involve patients even more with their health.</td>
<td></td>
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</tr>
<tr>
<td>26.</td>
<td>It’s a wonderful approach to patient centred care</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27.</td>
<td>It’s a good one</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28.</td>
<td>It is a very good effort</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.</td>
<td>It is a good concept</td>
<td></td>
<td></td>
</tr>
<tr>
<td>30.</td>
<td>I am positively disposed to its adoption in the state</td>
<td></td>
<td></td>
</tr>
<tr>
<td>31.</td>
<td>It can be of immense benefit to all involved</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32.</td>
<td>Am positive towards its adoption in the state</td>
<td></td>
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<tr>
<td></td>
<td>A lot of research into requirements for PGHD is needed and evidence from a pilot study could sway its implementation on a LGA level, before a state level adoption</td>
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</tr>
<tr>
<td>34.</td>
<td>It is worth a pilot trial &amp; I believe with good adoption, improvement could be assessed to judge how meaningful it can be</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>35.</td>
<td>It's worth a try</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>36.</td>
<td>A blueprint for its adoption can be achieved via research &amp; it will improve patients who adopt it with good doctors support</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>37.</td>
<td>It will likely be tried out but the quality of its usefulness and management will determine its continuity</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>38.</td>
<td>I am positively disposed to PGHD and with great commitment it can improve care delivery</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>39.</td>
<td>It is a good means of involving the patient even more, and it can work in the state with good support</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>40.</td>
<td>It will be effective if properly considered during implementation</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>41.</td>
<td>Its promising, but with caution until fully piloted and lessons learned</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>42.</td>
<td>It’s a welcome approach and its worth trying out</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>43.</td>
<td>I'm positive it will work</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>44.</td>
<td>I believe it will be at least tried out by most Lagosians but will work better if it targets chronic care management</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>45.</td>
<td>Strongly positive it will impact care delivery in the State</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>46.</td>
<td>I am ok with it and will adopt it if there is adequate structure for PGHD</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td>47.</td>
<td>I am positively disposed to PGHD in Lagos State</td>
<td>●</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
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Appendix 13: Table showing Sample Correlations of Indicators for Six Exogenous Latent Constructs

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### Appendix 15: Table showing CFA Goodness of Fit Threshold (Hu and Bentler 1999)

Some materials have been removed due to 3rd party copyright. The unabridged version can be viewed in Lancaster Library - Coventry University.

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### Appendix 16: Table showing Sample Correlations of Indicators for Two Endogenous Latent Constructs

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### Appendix 17: Table showing Standardised Residual Covariance of Variables for Two Endogenous Latent Constructs

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Appendix 18: Table showing Sample Correlations
### Appendix 19: Table showing Standardised Residual Covariance

| pgdb3 | pds5 | peou1 | pgdhub3 | pgdhub2 | se3 | peou3 | fc2 | fc1 | pds4 | pgdhub1 | pgdhub2 | pds1 | pds2 | pds3 | fc4 | si1 | si2 | si3 | se1 | se2 | peou1 | peou2 | pu1 | pu2 | pu3 | pu4 |
|-------|------|-------|---------|---------|-----|-------|-----|-----|------|---------|---------|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|-----|-----|-----|-----|
| .000  | .815 | .000  | .000    | .000    | .000| .922  | .000| .000| .000 | .000    | .000    | .000| .822 | .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000|
| .000  | .000  | .000  | .000    | .000    | .000| .000  | .000| .000| .000 | .000    | .000    | .000| .000  | .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000|
| .000  | .000  | .000  | .000    | .000    | .000| .000  | .000| .000| .000 | .000    | .000    | .000| .000  | .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000|
| .000  | .000  | .000  | .000    | .000    | .000| .000  | .000| .000| .000 | .000    | .000    | .000| .000  | .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000|
| .000  | .000  | .000  | .000    | .000    | .000| .000  | .000| .000| .000 | .000    | .000    | .000| .000  | .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000|
| .000  | .000  | .000  | .000    | .000    | .000| .000  | .000| .000| .000 | .000    | .000    | .000| .000  | .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000|
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| .000  | .000  | .000  | .000    | .000    | .000| .000  | .000| .000| .000 | .000    | .000    | .000| .000  | .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000| .000|