

**THE ACCEPTABILITY OF A TB PATIENT MANAGEMENT INFORMATION
SYSTEM AMONG e-TB MANAGER SUPERVISORS IN OYO STATE, NIGERIA.**



By

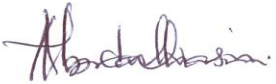
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A Research Report Submitted to the Faculty of Health Sciences, University of the
Witwatersrand in partial fulfilment of the requirements for the Degree of Masters in
Epidemiology in the field of Implementation Science

August 2020

DECLARATION

I, Abdulwasiu Ibrahim declare that this research report is my own work. It is being submitted for the degree of Master of Science in Epidemiology in the field of Implementation Science in the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

Signature: 

This 14th day of August 2020

DEDICATION

To my parents for supporting me in the pursuit of my dreams.

ACKNOWLEDGEMENT

I would like to thank my advisors, Prof. Latifat Ibisomi, Dr. Akin Adebiyi and Dr. Ejemai Eboreime, for supporting me without reservation. I learned from them how to conduct high quality research. Your guidance and support enabled me to understand and develop the research report. I appreciate all the time and efforts from members of staff, Epidemiology and Biostatistics Division, Wits School of Public Health, you have been responsive, patient and helpful all the time. I offer my kindest regards to all who supported me in any way during the completion of this research report.

I had a great time on the MSc in Epidemiology (in the field of Implementation Science) program, thanks to the great colleagues in the school. I cherish your problem-solving skills, and personal friendship with me.

Special thanks to Abiodun Medinat for completing the other half of my soul. The process of writing the research report was fun simply because of her company.

I cannot find words to express my appreciation to my parents, and siblings. My parents gave me love and most importantly their constant trust in my success in everything. I owe my success to your sacrifices.

Special thanks go to Professor Bayo Lawal and lecturers in the Department of Statistics and Mathematical Sciences, Kwara State University, Nigeria for their cooperation.

Thanks to Oyewole Oyedele, my friend, who assisted me with the submission of my research protocol to the Oyo State Ethical review committee, Nigeria. A special appreciation goes to the Oyo state Tuberculosis and Leprosy (TBL) unit coordinators and TBL supervisors. And thanks to friends, who repeatedly offered to help in any way needed to help me complete this milestone, without all of you, I would not be crossing this significant milestone.

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ABSTRACT

Background: The introduction of an electronic TB patient management information system (e-TB manager) in TB control is new in Nigeria. This innovation is important at a time Nigeria is ranked third among the TB high-burden countries in the world. Electronic patient information systems provide numerous advantages over the use of paper-based systems and the benefits of using these systems are well documented. This system assists in promoting informed decision by stakeholders on areas of improvement. However, it is crucial that this innovation is acceptable to the users of e-TB manager. This study aims to measure the acceptability of a TB patient management information system (e-TB manager) and determine the relationship between acceptability and its theoretical determinants (demographic, organisational-, structural-, provider-, innovation-, and patient- level determinants) among e-TB users in Oyo state, Nigeria.

Methods: A cross-sectional mixed-methods study involving all thirty-three users of the e-TB manager in Oyo state, Nigeria, followed by semi-structured interviews in a purposive sample (n=10). The study was conducted between May 2018 and October 2019. Quantitatively, data was collected using questionnaires and analysed with STATA 14. Composite scores for acceptability and determinants of acceptability were constructed and translated to 1 – 100 scale. Percentages, frequencies, means, and standard deviation were used to summarise data. Our outcome variable, acceptability, has three ordered categories and a robust ordered logistic regression was used to identify predictors of acceptability. All statistical tests with p-value < 0.05 were considered as statistically significant. Qualitative data were analysed using thematic analysis to explore potential factors for acceptability. The integration of qualitative and quantitative data occurred at the level of interpretation using triangulation.

Results: In the quantitative study, the mean acceptability score was 83% (SD = 10.94). The tertile distributions of mean acceptability scores were 71.60%, 82.75% and 96.46% respectively. In the unadjusted model, practice location (Rural/Urban), organisational-, structural-, provider-, innovation-, and patient- determinants positively influenced acceptability of e-TB manager. In the adjusted model, provider determinant was associated with high acceptability of e-TB manager. In the qualitative study, based on the experiences of the E-TB users, factors identified to be associated with acceptability of e-TB manager were categorized into five key themes (structural-, organisational-, provider-, innovation-, and

patient-factors) based on the conceptual framework of this study and practice location. Structural factors included challenges with the mobile network connectivity, mobile Internet subscription and access to offline module feature. Organisational factors encompassed management support, supportive supervision, workload strain, technical support and Incentive/Stipend. Provider factors included self-efficacy and training. Innovation factors included compatibility, ease of retrieval of patient information, access to patient information, security of patient record, ease of data collation and management of Stock-outs. Finally, patient factors included patient-provider relationship.

Conclusion: This study identified a useful framework that aided deeper insights into e-TB users related factors responsible for acceptability of e-TB manager in Oyo, State, Nigeria. The e-TB manager was highly acceptable by e-TB users and its acceptance was influenced by practice location, Structural-, Organisational-, Provider-, Innovation-, and Patient- level determinants. Acceptability of e-TB manager is lower among e-TB users in rural areas compared to their counterparts in the urban areas, thus special consideration should be given to this population of e-TB users. These determinants could be the target of future implementation strategies.

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LIST OF ACRONYMS

CIS	Clinical Information Systems
DOTS	Directly Observed Treatment, Short-course
EHRs	Electronic Health Records
EMR	Electronic Medical Record
HIS	Hospital Information System
IOM	Institute of Medicine
IT	Information Technology
LGAs	Local Government Areas
MDGs	Millennium Development Goals
MoH	Ministry of Health
MSH	Management Science for Health
NTBLCP	National Tuberculosis and Leprosy Control Programme
PBPR	Paper-Based Patient Record
TAM	Technology Acceptance Model
TB	Tuberculosis
TBL	Tuberculosis and Leprosy
WHO	World Health Organisation

DEFINITION OF VARIABLES / CONSTRUCTS

Variable/ Construct	Definition
Acceptability	The perception among e-TB users that e-TB manager is satisfactory, agreeable or palatable.
Perceived Usefulness	The degree to which e-TB a user believes that using the e-TB manager would enhance job performance.
Perceived ease of use	The degree to which e-TB users believes that using the e-TB manager would be free of great effort.
Intention to use	The degree to which e-TB a user has articulate conscious plans to perform job tasks through the use of e-TB manager.
Structural level factor	This construct represents the outer setting of the Ministry of Health in which the TB unit is nested.
Organisational level factor	This construct represents aspects of the organisation in which e-TB manager is being implemented.
Provider level factor	This construct represents aspects of the provider (e-TB user) who implements the innovation with the patient.
Patient level factor	This construct covers patient-provider characteristics that can impact on acceptability of the e-TB manager.
Innovation level factor	The construct that represents aspects of e-TB manager that is being implemented.
Demographic characteristics	The life around an individual pertaining to demographic factors.
Practice location	Rural areas: settlements with less than 20,000 dwellers whose occupations are mainly farming. Urban areas: settlements with 20,000 dwellers or more whose occupations are not mainly farming.

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CHAPTER ONE

INTRODUCTION

This chapter gives an overview of the global and national burden of Tuberculosis, implemented initiative towards the effective control and management of TB patients and states the relevance of the study to policy makers in Nigeria. The concept of acceptability and its conceptual framework is also discussed. The chapter ends with an adapted conceptual framework of acceptability and its possible determinants.

1.1. Background

Tuberculosis (TB) is a serious public health problem and a global emergency in countries where bacterium thrives [1, 2].

The WHO drafted a post-2015 global strategy framework aimed at ending global TB epidemic in the world. The framework comprises of milestones for 2025 and targets for 2035. For the milestones for 2025, “75% reduction in tuberculosis deaths compared to 2015; no affected families facing catastrophic costs due to tuberculosis; and 50% reduction in tuberculosis incidence rate - less than 55 tuberculosis cases per 100 000 population” [3]. The targets for 2035 are: “95% reduction in tuberculosis deaths compared with 2015; no affected families facing catastrophic costs due to tuberculosis; and 90% reduction in tuberculosis incidence rate - less than 10 tuberculosis cases per 100 000 population” [3].

The WHO region of Africa accounted for 24% of global TB cases. Nigeria is ranked sixth among the eight countries that accounted for two third of the global TB total; the eight countries are India (27%), China (9%), Indonesia (8%), the Philippines (6%), Pakistan (6%), Nigeria (4%), Bangladesh (4%) and South Africa (3%). According to WHO’s global Tuberculosis report 2019, the estimated incidence of TB in Nigeria is 429 per 100,000 population. The healthcare system burden, loss of productive work time, out-of-pocket expenses are some of the impact of TB on the healthcare system and patients [2].

In Nigeria, the target for TB control is “to detect at least 70% of all forms of TB cases by 2020; achieve treatment success rate of at least 90% for all newly confirmed TB cases, and

to eliminate TB as a public health problem by 2050” [4]. These new targets came at the back of the Millennium Development Goal (MDG) which targeted detecting at least 70% of new sputum smear-positive TB cases and cure at least 85% of these cases by 2005, and the reduction TB prevalence and death rates by 50% relative to 1990 levels [5]. However, a 2013 TB progress assessment of the 2015 targets set within the MDG framework showed that Nigeria was not on track in achieving these targets [2]. There are five indicators for monitoring TB control programmes, they are; prevalence, incidence, mortality rate, case detection rate and treatment success rate. These indicators are measured through specialized cross-sectional surveys, longitudinal surveys, routinely collected data on cohorts of patients and vital registration records (for TB mortality indicators) [5]. There have been challenges in the developing countries including Nigeria in achieving targets and management of TB indicators, this is characterised by, poor clinic records keeping, inadequate funding of the TB program and ineffective, inefficient service delivery, as well as lack of political commitment from the government. Also, co-epidemic of TB/HIV and multi-drug resistant TB are hindering the achievement of the targets [2, 6, 7].

The management of TB patients and monitoring of TB indicators is a lengthy process in Nigeria. The data collection process is hierarchical in nature. For administrative purposes, the Nigeria federation is divided into geopolitical zones, states and local government areas (LGAs). There are 774 LGAs, 36 states and a federal capital territory in Abuja. These states are further grouped under 6 geopolitical zones (North-Central, North-East, North-West South-West, South-East and South-South,) [8]. The TB patient and indicator data flow starts from the healthcare facilities and ends at National Tuberculosis and Leprosy Control Programme (NTBLCP) central unit. In order to ease collation of TB reports, facilities offering TB services compile TB patient and indicators data from the facility TB registers into a report to the local government area (LGA) Tuberculosis and Leprosy (TBL) supervisors. The reports from the LGAs TBL supervisors are compiled at the state TBL control office. Each state in the geopolitical zone sends the report to their coordinating Zonal TB supervisors. The Zonal TB coordinating office validates the data, and forwards the reports to the NTBLCP. The NTBLCP unit is the national unit that reports country’s TB data to WHO [4, 9]. This TB patient data collation process is presented in Figure 1.1.

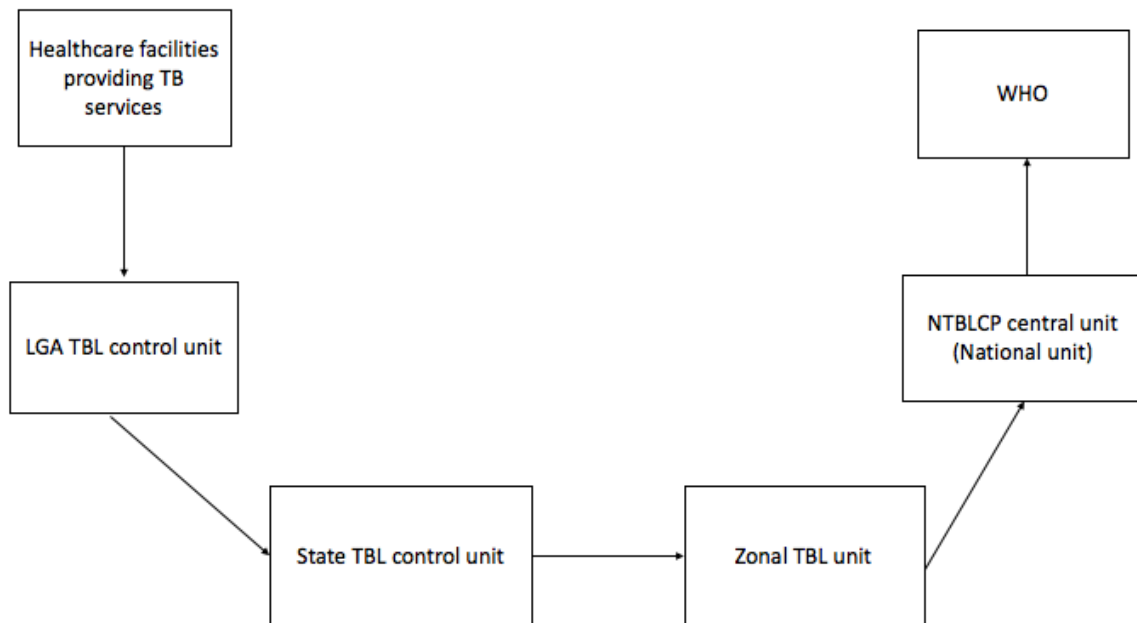


Figure 1.1: TB Patient Data Collation flow diagram

eHealth systems help advance patient care [10]. One of such eHealth systems is the TB patient management information system known as e-TB Manager. The e-TB manager was developed by Management Science for Health (MSH) to manage the information needed by national TB control programs [11]. In 2004, e-TB manager was first implemented in Brazil and was found to be effective in the management of TB patient information and control of TB. A WHO review of TB programme in Ukraine recognized e-TB Manager's advantageous role in supporting management decisions on improving TB programme performance [12]. The e-TB manager has steadily been implemented in resource-constrained countries including Nigeria [13].

The e-TB manager was introduced in Nigeria in 2011, as part of the TB control program [13]. The users of e-TB manager are Tuberculosis and Leprosy (TBL) supervisors in Nigeria. The e-TB manager is still at the roll-out stage in 19 of the 36 states of the Nigeria federation [14].

1.2. Problem Statement

Management of patient information in many healthcare facilities in Nigeria has been paper-based, where the clinician and nurses use a template to record the patients' information. Limitations of these paper-based systems include but not limited to illegibility, incomplete data, ambiguity, data fragmentation and poor availability of data,. In addition, the paper-based system has limited functionality. An electronic patient information system or eHealth systems seeks to address these limitations. The eHealth systems can prompt for completeness; provide better retrieval of patient information. Having eHealth systems can support healthcare professionals will improve operating efficiency, thus improving quality of care.

One of such eHealth systems is the e-TB manager initiative that helps to improve the effectiveness of the TB control program. However, despite the well-documented benefits of eHealth systems and the huge investment by the government and the donors, its adoption remains low in Nigeria [15, 16]. Lack of acceptability has been reported as a major hindrance to the successful adoption and implementation of the e-TB manager in resource-constrained countries [13]. Hence, this study measured acceptability of e-TB manager and investigated the factors affecting its acceptability amongst its users in Oyo state, Nigeria.

1.3. Justification of Study

To address the challenges of TB patient management and to improve TB patient care, the e-TB manager service was implemented in the country [13]. There has been growing attention given to the acceptability of patient management systems [17-22]. It is critical to study the implementation acceptability of e-TB manager among its users, as it would enable program implementers to objectively assess the quality of its implementation as well as factors that might affect it in the Nigeria context.

The current political will and commitment to TB control and prevention is an opportunity for Nigeria to meet WHO's END TB Strategy targets [23]. To achieve this, acceptability of the e-TB manager needs to be tracked, documented and continuously improved upon as acceptability is in the pathway between the initiative/intervention and programme outcome/success [24-26]. In addition, identifying the factors that affect acceptability of the

e-TB manager can guide in improving e-TB manager implementation and policies relating to TB control.

1.4. Research Question

What is the level of acceptability of the e-TB manager among e-TB users in Oyo state Nigeria, and what are its determinants?

1.5. Aim

To assess the level of acceptability of the e-TB manager and identify the determinants of e-TB user's acceptability in Oyo state, Nigeria.

1.6. Specific Objectives

The objectives of this study are as follows:

1. To measure the acceptability of e-TB manager among e-TB users in Oyo state, Nigeria.
2. To identify the determinants of acceptability of e-TB manager among e-TB users in Oyo state, Nigeria.
3. To explore the association between acceptability and e-TB users' acceptability determinants in Oyo state, Nigeria.

1.7. Literature Review

1.7.1. The Electronic Health Records (EHRs)

Over the years studies have shown that electronic patient information systems have the potential to improve health by providing improved information about their patients to healthcare professionals.

The Electronic Health Records (EHRs) is a patients' management information systems that have been around for more than fifty decades [27, 28]. The EHRs system is a program developed to store, process, and exchange of medical information by providers [29]. EHRs

have provided the platform for management of information systems for physicians [30]. The Health Information Management Systems Society (HIMSS) defines EHRs as:

“The Electronic Health Record (EHR) is a longitudinal electronic record of patient health information generated by one or more encounters in any care delivery setting. Included in this information are patient demographics, progress notes, problems, medications, vital signs, past medical history, immunizations, laboratory data and radiology reports. The EHR automates and streamlines the clinician's workflow. The EHR has the ability to generate a complete record of a clinical patient encounter - as well as supporting other care-related activities directly or indirectly via interface - including evidence-based decision support, quality management, and outcomes reporting”[27].

1.7.2. Adoption of EHRs systems in Nigeria

In Nigeria, a greater amount used in the financing health care services is provided by the State and Federal Ministry of Health (MoH) while external donors provide the remainder. Most Health Record systems in the Nigeria are still paper-based. Healthcare institutions that have started to use EHRs have variations in terms of implementation and capabilities [16, 31-34].

The first computerised Medical record system in Nigeria was implemented in 1988 [32]. The Open source system used in computerised Medical record was adapted from the U.S Department of Veteran Affairs’ (VA) public domain applications package and tools. These applications package was based on the M or MUMPS programming language. The system is entirely menu driven with basic function as inquiry to patient data, registration of patient, admission of patient, transfer and discharge of patient [31].

The setting up of an EHR system requires huge resources and sometimes beyond the reach of healthcare service providers in Nigeria and sub-Saharan Africa. Few African countries have the resources to develop the required infrastructure for a commercial EHR package [35]. The emergence of Open Source Software packages such as the Open Medical Record Systems (OpenMRS) has enhanced the opportunity of various African countries to gain access to electronic clinical information systems [36-39]. The acquisition of Open Sources is less costly and provides opportunities for local use and adaptation [36, 40].

Thompson and colleagues implemented the OpenMRS in 2009, to help address the problem of maternal and child health and management of crisis posse by the management of patients' information in Northern Nigeria. The choice of OpenMRS as a platform from which to develop the electronic health information system was as a result of its existing deployments in similar low resource settings [38, 41].

Recently, e-TB manager, a web-based electronic TB patient information system was introduced in 2011 to help promote better TB patient care. The e-TB manages all information needed by the national TB control program under the Federal and State Ministries of Health. It integrates data across all aspects of TB control including but not limited to information on patients, treatment, and outcome [11, 13, 42].

Like most African nations, Nigeria is still lagging behind developed nations in the availability, adoption and use of EHRs [43]. From the literature search, few studies have been published on the electronic health information system in Nigeria. These studies have highlighted the benefits and barriers in the adoption electronic health information systems in Nigeria. These benefits and barriers are discussed in the subsequent sections.

1.7.3. Benefits of EHRs

The ultimate goal of any healthcare provider is to offer quality patient care. EHRs have been found to be one of the mediums to realise this goal. In Boas et al. study conducted in United States, physicians reported that EHR improved the quality of the care they delivered to their patients, especially because it aided them to track their patients [44]. Likewise, in the Thompson and others study conducted in Nigeria, the benefits of OpenMRS identified by clinic staff were; reduction in time used during monthly collation of patient information; provision of accurate report; more detailed analysis of patient data; and increase in patient patronage as use of computer systems were associate with advanced clinics [33]. In addition Khalifa in his study conducted in Saudi Arabia identified ten benefits perceived by healthcare professionals when implementing a Hospital Information Systems (HIS) and EMR. These perceived benefits are - "Improved information access; Increased healthcare professionals productivity; Improved efficiency and accuracy of coding and billing; Improved quality of healthcare; Improved clinical management (diagnosis and treatment); Reduced expenses associated with paper medical records; Reduced medical errors;

Improved patient safety; Improved patient outcomes; and Improved patient satisfaction” [45].

1.7.4. Barriers to EHRs Adoption

Although EHRs offers a number of benefits, there are challenges associated with it. It has been reported that about 50% of EHRs initiatives have failed [46]. A number of barriers have impeded the adoption rate of EHRs. These barriers include lack legal framework, lack of standardization among providers, financial and technological restrictions [47]. However, barriers relating to human factors, for instance resistance from users, continue to persist [48, 49]. Studies have shown that user resistance has contributed to the failure of a number of clinical information systems [48, 50, 51]. Resistance and lack of support for EHRs from Physicians and other healthcare professionals is detrimental to its acceptance, adoption and sustainability [52, 53].

Despite the benefits of the EHRs technology, its adoption and implementation in healthcare practices is still low and there has been the issue of resistance from healthcare professionals. Khalifa in his study conducted in Saudi Arabia identified Human Barriers – this relates to the beliefs and attitudes; Professional Barriers – this relates to the nature of jobs of healthcare professionals; Technical Barriers – this relates to use of computers and information technology; Organisational Barriers – relates to the healthcare institution leadership and management; Financial Barriers – relates to funding and resources, and Regulatory Barriers – relates to regulations and legislations [54].

In 2017, Konduri and colleagues conducted a user experience analysis of e-TB manager in nine (9) resource-constrained countries. They identified barriers and functionality issues dissuading users from fully embracing e-TB manager. These barriers include; inadequate technical support, inadequate training, longer time to enter/find information, crashing of the e-TB manager system, longer time to load e-TB manager modules, and loss of data [13].

Also, Mostert-Phipps, Pottas & Korpela conducted a study in South Africa to identified factors hindering the adoption of health information technologies (HITs) in the healthcare institutions. Interestingly, their study uncovered a total of 58 factors. However, they categorised factors that have a significant impact on the adoption of HITs into the following

categories: Inadequate guidelines, policies, and procedures; Absence or little user support; Inadequate Management support; Quality control not in place; Staff capacity shortage; Insufficient training and awareness; Infrastructure deficit; Unrealistic expectations; Lack of Meaningful use of the system; High cost of installation and implementation; Change management not in place; No onsite technical support; Absence of government backed drive to implement HIS; Lack of system availability and reliability; Lack of Stakeholders involvement; and Lack of accessibility [55].

1.7.5. Factors Influencing EHRs Acceptance

Factors that have emerged in medical informatics literature as influencing EHRs acceptance are discussed in this section.

1.7.5.1. *Organisational Leadership and Commitment*

Lack of effective leadership and commitment from the top management can be detrimental to the successful implementation of an electronic patient information system. Changing from a paper-based system to an EHR system is considered a strategic change [48, 50, 56]. Healthcare institutions that have successfully implemented EHR have had strong leadership. A belligerent organisational culture toward top management or RHRs can dampen change. In Hamid and Cline study [57], where they looked at providers' (physicians and advanced practice providers) acceptance factors of the EHR adoption, they found that perceived management support, providers involvement and adequate training as facilitators to the acceptance and adoption of the EHR while provider autonomy and perceived lack of usefulness were the barriers.

1.7.5.2. *Attitude Towards Technology*

Users attitude plays a key role in the motivation and use of patient information system, with users tending to have a beforehand idea about capabilities, potential benefits of the technology, and its influences on their work. If a new technology is delivered as it should be, but the expectations do not align with that of the users, this can result in negative attitude and resistance using the new technology [58, 59]. Negative attitudes often aggravated by previous negative experiences with technology are instances where healthcare technology implementations were reported to have failed [60, 61]. A study by Alipour et al. [62] in Iran

found attitude about EHR, management support, physician involvement, adequate training, physician autonomy, doctor-patient relationship, perceived usefulness to influence users acceptance of EHR.

1.7.5.3. *Training of Users*

It is not uncommon for some physicians and users of EHR systems to have insufficient computer skills or lack the basic computing knowledge. If users do not have adequate training, this can decrease their confidence in the system and suppress user acceptance [63]. Once a decision to implement an innovation has been made, training and ongoing support for users is important as this can facilitate adoption and acceptance [64, 65].

A number of training approaches can be used; these include online sessions, classroom sessions, reading training materials and one-to-one training of users. Studies have indicated that trainings were tried and one-to-one training sessions are most effective. It is important that training needs to start before a new system is implemented and continue when it has been established to allow issue(s) that may arise to be dealt with effectively and help users to gain increasing proficiency [66-68].

1.7.5.4. *Motivation and peer pressure*

Lack of motivation in an EHR system could lead to resistance among users. Users need to be aware of the benefits provided by the system. When users recognise those benefits of the system; they will convince their colleagues to use it. The study conducted by Doolan and others found that physicians were excited about the benefits of EHR system and convinced their colleagues to use it. Also, certain amount of peer pressure (this was done through building momentum and support among physicians) to use the system caused other physicians to start using the EHR [69].

1.7.5.5. *Users Involvement and Participation*

Healthcare professionals' acceptance of EHR can make or mar implementation [49, 70]. The fundamental reason why systems fail is as a result of the inability to develop user ownership

[48, 71]. When a system is designed it needs to be tailored to the needs of professionals and organisation. This can be achieved through collaboration among system designers, implementers and end-users [64, 68]. The involvement of healthcare professionals' leaders with interest in clinical informatics allows them to serve as contacts with other healthcare professionals. In spite of an increasing recognition that senior physicians' input in EHR system design and implementation strategy in the literatures, other users' needs have somewhat been neglected, including those of nurses and administrative staff [72, 73]. It is, however, important that the EHR system fulfils a variety of requirements.

1.7.6. Acceptability and Determinants of Acceptability

The assessment of acceptability is one of the methods in evaluating clinical information systems [74]. Implementation outcomes play important role in the implementation science and research. Proctor's implementation outcomes are acceptability, appropriateness, feasibility, fidelity, adoption, cost, sustainability and penetration [75]. These implementation outcomes can serve as indicators in their own right, that is, they are able to monitor and evaluate the success of an implementation process. Also, they can be intermediated outcomes, that is, as a prerequisite for achieving the desired clinical outcome and service delivery [75, 76]. Acceptability being one and popular implementation outcome has been employed in some number health interventions, such as electronic reporting and reporting systems, rapid diagnostic test in malaria research, HIV care, health behaviour research, and maternal and neonatal care [17, 20, 77-81]. Chaudoir and colleagues [82], identified a multi-level determinant framework that captures factors that predict implementation outcomes. Theses determinants identified are structural-, organisational-, provider-, patient-, and innovation- level factors [83, 84]. Determinant factors in the Chaudoir et al.'s multi-level framework were used in this study.

1.8. Theoretical Framework

The Technology Acceptance Model (TAM) is a behavioural model of end-user acceptance of new technologies; it is one of the several theories of technology acceptance that have been developed to explain intention to use new technologies [20, 85, 86]. TAM is one of the widely used models to predict use, acceptance of information systems and technology, and assessment of how individuals' make decisions regarding the adoption of new technology.

TAM has two primary factors (perceived ease of use and perceived usefulness) influencing an individual's intention to use new technology [20, 87, 88]. Although the TAM is useful for determining acceptance of a new technology it cannot inform the factors influencing the acceptance of the new technology. As such a framework such as the Chaudoir et al. multi-level framework for predicting implementation outcomes is a framework for exploring the factors that influence an outcome [82]. This framework consists of five characteristics that are relevant for understanding and explaining implementation processes and outcomes [89-91]. The five characteristics are organisational-, structural-, provider-, patient-, and innovation characteristics. Using the TAM constructs and mapping these with the five characteristics of the Chaudoir et al. multi-level framework, we developed a conceptual framework (as shown in Figure 1.2) to understand the factors that influencing acceptability of e-TB manager among users in Oyo State, Nigeria.

1.9. Conceptual framework

This study focused on the acceptability of the e-TB manager among e-TB users. Acceptability is one of the implementation outcomes, it is defined as the perception among stakeholders that an intervention is satisfactory, agreeable or palatable [92]. In this study, the conceptual framework in Figure 1.2 was adapted from the Technology Acceptance Model (TAM) and Chaudoir et al. multi-level framework for predicting implementation outcomes [20, 93-96]. The framework shows that implementation outcome (in the case of this study, acceptability) is predicted by five constructs. The constructs are; structural-, organisational-, provider-, patient-, and innovation characteristics. In addition, the demographic characteristics of the e-TB users were included in the conceptual framework, the reason being that we are interested in how it relates to acceptability. Each of these constructs in the conceptual framework was measured by series of questions/items.

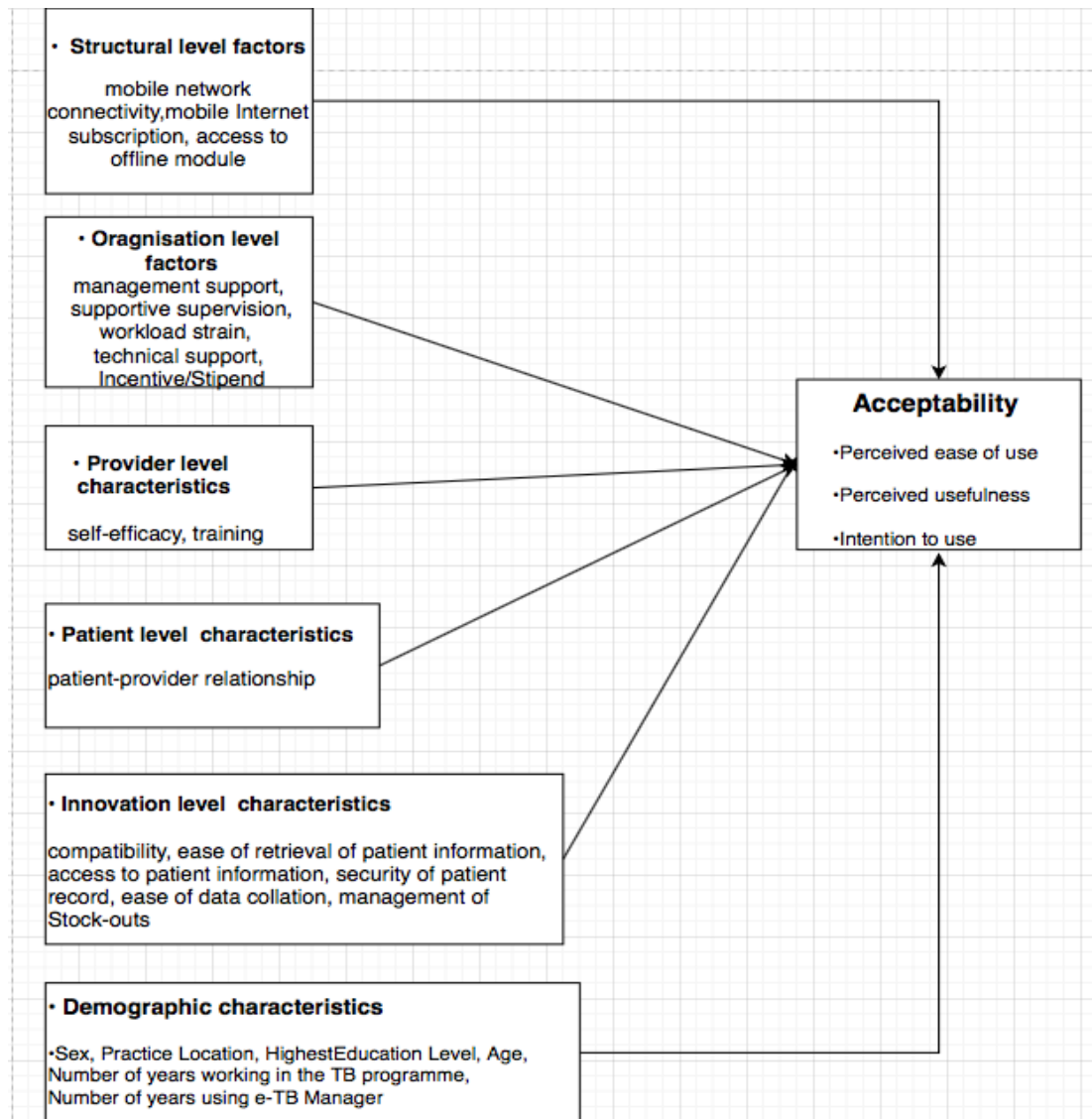


Figure 1.2: Conceptual framework of Acceptability

1.10. Overview

The remainder of the research report is organised as follows: In Chapter 2, study settings, design, the study population, sampling techniques will be described. This chapter will shed light on the research instruments adopted, the procedure used in the collection of data, management and analyses of the datasets. Also, ethical consideration will be discussed in Chapter 2. In Chapter 3, results of the findings from both the qualitative and quantitative studies will be discussed. Discussion, recommendation and conclusion will be given in Chapter 4.

CHAPTER TWO

METHODOLOGY

This chapter describes the study settings, design, the study population and the sampling techniques of this research. It shed light on the research instruments adopted in this study, the procedure used in collecting the data and the data analyses. Also, the instrument's (questionnaire) validity and reliability was checked, and the ethical considerations involved in the study highlighted.

2.1. Study Design

This study employed a cross-sectional study design that provided a snapshot of the acceptability of e-TB manager and its determinants among e-TB users in Oyo state, Nigeria [95, 97]. In this study, we employed mixed methods approach; a hybrid approach known as methodological triangulation, where both quantitative and qualitative research methodologies are used depending on the stages of the research and research objectives. Triangulation yields a richer and stronger result than either the quantitative or qualitative method could yield alone [98, 99]. The concurrent triangulation strategy was adopted – where quantitative and qualitative data were collected simultaneously [100].

2.2. Study Site

The study was conducted in Oyo state, Nigeria. Oyo state is a Nigerian state located in the South-West geopolitical zone with an estimated population of about 5.5 million people [101]. It has 33 LGAs. All Directly Observed Treatment, Short-course (DOTS) facilities in the state are managed by the Tuberculosis and Leprosy (TBL) control unit, under the State Ministry of Health. Each LGA has a TBL supervisor who is responsible for coordinating TBL control activities in the LGA. The TBL supervisors provide a monthly TB report to the Oyo state TBL control unit, whose responsibilities include collation and analysis of data on TBL activities in the state and dissemination of reports to the Zonal TB coordinating office. Oyo state being one of the four states (other are Lagos, Ogun and Kano states) that the prototype of the e-TB manager was deployed, it is essential that we look into the acceptability of the e-TB manager amongst users in Oyo state [102].

2.3. Study Population

The study population in this study was users of the e-TB manager in Oyo state between May 2018 and October 2019. The users of the e-TB manager are the TBL supervisors. At the time

of carrying out this study, the users of the e-TB manager were 33 – one each from the 33 LGAs in the state.

2.4. Sampling Procedure

Sampling was not considered for quantitative part of the study, the population size of the e-TB users in Oyo state in May 2018 was 33; this size was considered relatively small. All the 33 e-TB managers were invited, and all participated in the study.

As part of the study, the e-TB users that participated in the quantitative study were invited to indicate whether or not they would be interested in a follow-up interview to talk about their experience and acceptability of the e-TB manager. From the list of those interested in the interview, we purposefully selected and invited e-TB users using maximum variation sampling, considering practice location, number of years working in the TB programme and number of years of using the e-TB manager. Saturation of the data occurred after eight interviews and we continued two more interviews to ensure that no additional insights emerged in the interviews. In all, ten (10) interviews were conducted.

2.5. Data Collection

2.5.1. Quantitative Data Collection

The quantitative data was collected in May 2018. The data collection tool (questionnaire) was developed in line with the conceptual framework of this study to collect information on implementation acceptability of e-TB manager and factors affecting acceptability of e-TB manager among e-TB users. Responses to questions were based on 5-point Likert scale with response ranging from strongly agree to strongly disagree. The questionnaire was designed in REDCap (a web application for building and managing online surveys and databases) [103]. The method of data collection was interviewee-administered. The researcher provided paper-based questionnaire to all the e-TB users to complete and was available to take questions on items in the questionnaire. The questionnaire is attached as Appendix D.

2.5.2. Qualitative Data Collection

For the qualitative part of the study, data collection was done through semi-Structured interviews were conducted in English using an interview guide. The interview guide was followed by probes and/ or follow up questions as needed. The guiding questions focused on acceptability, views/perceptions about e-TB manager, experiences with e-TB manager, the

challenges of using e-TB manager, perceptions on acceptability of e-TB manager and the factors that might influence the acceptability of e-TB manager and what improvements should be made to improve acceptability of e-TB manager.

The interviews were conducted in the participants' offices, where confidentiality and privacy were maintained. All interviews were audio taped after obtaining the participants' permission. Each interview lasted between 45-60 minutes depending on the level of information offered by the participant. All interviews were conducted in English and backed by field notes. The qualitative data were collected in May 2018 and additional data collected in October 2019. The interview guide is provided in Appendix E.

2.6. Questionnaire Construction

The questionnaire has three sections: characteristics of respondents, determinants of acceptability and acceptability sections. The response for both determinants of acceptability and the acceptability sections were on 5-point Likert scale for respondents to mark their perceptions as related to the specific item / question. To ensure questionnaire items represent the relevant constructs, Davis and Chaudoir et al based content validity of the items on previous use and validation of the items in their studies [19, 95, 97].

2.7. Piloting of the Instruments

For the quantitative part of the study, a pre-test of the questionnaire was carried out to a group of 10 users of e-TB managers in Osun state, Nigeria (a neighbouring state) [104]. The users of e-TB manager in Osun state were not part of the study population. The pilot tested whether the items of the questionnaire were appropriate, and well defined. Issues that were observed among e-TB users in the pilot of the questionnaire included: (1) Understanding of questionnaire items and the terms used in the questionnaire, (2) The sequence of questions in the questionnaire, (3) The time taken to complete the questionnaire (that is, the length of the questionnaire), and (4) The font and lay out of the questionnaire. All comments from these e-TB users were taken into consideration. The questionnaire was re-piloted until no further changes were considered necessary.

For the qualitative part of the study, the interview guide was piloted with one e-TB user in Oyo state. This e-TB user was not among the ten (10) participants interviewed in the actual study. This pre-test was done to ensure the validity and appropriateness of questions in the

interview guide before the start of the actual interviews. The e-TB user is an experienced qualitative researcher; she had a look at the interview guide, she advised on refinement of some aspects of the interview guide and explanation of some vague terms. All her suggestions were taken into consideration.

2.8. Reliability of the Questionnaire

Reliability measures the degree to which an instrument yields consistent results when administered a number of times. Cronbach's alpha is one of the popular reliability statistics used to measure of internal consistency. Cronbach's alpha value ranges from 0 to 1. The closer this value is to 1 the more reliable the item or construct is. Alpha values of 0.7 and above is considered acceptable but lower values are sometimes used [105]. Alpha values were calculated for the items and constructs.

2.8.1. Reliability Test

In this study, internal consistency of the constructs was measured using Cronbach's alpha coefficient. The reliability test table can be found in Appendix J. The table shows that the eight (8) constructs in this study produced Cronbach's alpha values ranging from 0.61 to 0.89.

Prior to the selection of the final items for each of the eight constructs, the Cronbach's alpha values for each of the eight constructs was calculated. The Cronbach's alpha values range between 0.43 and 0.89 (see Appendix I). Structural level (SL) and Perceived usefulness (PU) had lowest and highest Cronbach's alpha values respectively. When an item was removed from the constructs, Cronbach's alpha value was recalculated, and the contribution of the Cronbach's alpha coefficients to the scale was revealed. The reliability of the structural level (SL) and innovation level (IL) constructs was however improved by deleting three items (SL1, SL5 and IL2) with low item-rest correlations. No items were excluded from Organisation level (OL), Patient level (PaL), Perceived usefulness (PU) and Perceived ease of use (PEU) constructs. However, 5 items (PrL4, PrL7, PrL12, IU3 and IU4) were removed from Provider (PrL) and Intention to use (IU) constructs because their exclusion had little effect on the Cronbach's alpha value (see Appendix I).

All the constructs scored high Cronbach Alpha values except for two constructs that had values that were less than 0.7; these constructs are organisation (alpha = 0.69) and structure

level ($\alpha = 0.61$) constructs. Clark, L. & Watson, suggest that construct with an alpha value less than 0.7 can be used [106].

2.9. Composite Variables

After the reliability test, the relevant constructs (organisational-, structural-, provider-, innovation-, and patient) were aggregated into composite variables by taking the average across each group of constructs. The acceptability composite variable was constructed by aggregating and averaging across each group of the three constructs of acceptability; these constructs are; Perceived usefulness (PU), Perceived ease of use (PEU) and Intention to use (IU). Further analysis was done on the composite variables rather than the individual items.

2.10. Data Management

2.10.1.Quantitative Data Management

All data were entered and coded in Microsoft Excel spreadsheet and analysed in STATA 14 [107]. Data cleaning consist of checking for missing and extreme values using appropriate STATA commands.

2.10.1.1. Data Management - Objective I

The measurement of acceptability was operationalized according to the constructs (PU, PEU, and IU) as specified in the conceptual framework. All three constructs were covered in a 19-item questionnaire. Rating of the items was based on 5-point Likert scale ranging from (1) strongly disagrees to (5) strongly agree with higher scores signifying increasing acceptability.

In addition, acceptability score was ordered and divided into three parts to produce tertiles. First tertile represents low score; second tertile represents moderate score, while the third tertile represents high score. Acceptability was operationalised as both continuous and ordinal (tertiles) variable.

2.10.1.2. Data Management - Objective II

The determinants of interest are structural-, organisational-, provider-, patient-, and innovation characteristics. All the five determinants (structural-, organisational-, provider-, patient-, and innovation characteristics) are constructs that have series of questions to measure them. The response to each of the question is on a five-point Likert scale.

Structural-, organisational-, provider-, patient-, and innovation characteristics have five (5), four (4), thirteen (13), three (3), and four (4) items respectively. Each of the determinants was operationalised as both continuous and ordinal (tertiles) variables. First tertile represents low score; second tertile represents moderate score, while the third tertile represents high score.

Also, demographic characteristics of the e-TB users were collected. Age was collected in years, age group (categorical variable;) was created from age; age groups (38 – 48; 49 – 59). Sex was classified as either male or female. Highest level of education was also categorized into three groups (primary education, secondary education and tertiary education). Number of years working in the TB programme was converted into a categorical variable; the categories are 1 to 10 years inclusive and greater than 10 years. Lastly, the number of years of e-TB use was converted into a categorical variable, the categories are 0 to 1 year and greater than 1 year.

2.10.1.3. Reverse Coding of Item

The single reverse coded item (SL5: *“I think that the TB and leprosy control unit does not have the necessary infrastructure to support my use of the e-TB manager”*) was reversed to align its scale with the scale of other items. This was done by changing the responses of this item in a structured manner, that is, responses coded as 1 were changed to 5; responses coded as 2 were changed to 4; responses coded as 3 remained as 3; responses coded as 4 were changed to 2; and responses coded as 5 were changed to 1.

2.10.2. Qualitative Data Management

The qualitative data were transcribed verbatim. All the transcriptions were reviewed and checked against the recorded audio by the researcher and one experienced qualitative researcher; this was done to ensure accuracy, completeness of the data and to identify and resolve variations that could occur during transcriptions. The researcher and the experienced qualitative researcher coded the data; any conflicting views were discussed until a consensus was reached. The audio recording files and interview transcripts were stored in a password-protected computer. The qualitative data analysis software program MAXQDA was used to support detailed coding and exploration of themes within the data [108].

2.11. Data Analysis

2.11.1. Quantitative Data Analysis

Descriptive statistics and frequency distribution were used to summarise and tabulate demographic characteristics and determinants of acceptability.

Nineteen (19) items were used to measure acceptability of e-TB manager. The study used the Cronbach alpha to measure the internal consistency of results across the 19 items. The Cronbach alpha was 0.93 indicating strong reliability, this implies that the items could be summed up for use in analysis. The mean overall score of acceptability of e-TB manager was then calculated with and standard. The overall score of acceptability of e-TB manager was then categorized into Tertiles (group of three).

Both demographic characteristics and determinant variables considered to be potentially associated with acceptability were examined using correlation analysis and fitting univariable and multivariable robust ordered logistic regression. The `gologit2` command in Stata was used to fit the partial proportional odds model (PPOM) was used to assess factors that are associated with acceptability. The PPOM is a special cases of the generalized ordered logit model [109]. The order logistic model (also known as proportional odds model - POM) assumes that predictor variables have the same effect across the categories of the ordered dependent variable. This assumption is known as the parallel regression assumption. In most cases the parallel regression assumption is often violated, as it is not uncommon for one or more of predictor variable coefficients to vary across values of the ordered dependent category. In PPOM where some of the coefficients of the predictor variables can be the same for all values of the response category, while others can differ across values of the response category. The Wald test of parallel lines assumption was checked to ascertain that the proportional odds/ parallel lines assumption was not violated from the final model. P-values below 0.05 were considered statistically significant. For sensitivity analysis, a multivariable linear regression model was fitted using acceptability (as continuous variable) and acceptability determinants. We ran the model diagnostics to ensure that the model assumptions were not violated. The model diagnostics tools used were VIF (variance inflation factor), Normal probability (P-P) plot and the Breusch-Pagan Breusch-Pagan to check for multicollinearity, normality of the residual and constant variance assumptions respectively.

2.11.2. Qualitative Data Analysis

The transcripts were analysed using inductive thematic analysis [110]. The analysis consisted of six phases. The phases are; familiarisation with the data, generating initial codes, searching for themes, reviewing of themes, defining and naming themes and producing the final results. The texts within each interview were coded in a codebook. Codes dealing with similar issues were grouped across all interviews and refined into themes. The review of transcripts continued until no new themes emerged. The final themes were reviewed to confirm the interpretation of data.

2.12. Integration of findings

Integration of qualitative and quantitative data occurred at the level of interpretation of findings using triangulation [111]. Here, we present the findings of both studies in a meta-matrix to facilitate comparison of the findings [112]. Meta-matrix involved presenting the result from quantitative study alongside summarised qualitative themes in a tabular format, which enabled a clear approach to determining convergence, discrepancy or silence across the findings of both data sets.

2.13. Limitations

This study relied on self-reported data from e-TB users. It is crucial to take note of the defects of self-reported data which include: social desirability bias; where e-TB users may respond to the questions in a way that is favourable to the researcher, difficulty in ascertaining data accuracy and exaggeration. Despite this limitation, the findings from this study would contribute to efforts that seek to improve the implementation of e-TB manager in resource-limited settings.

2.14. Ethical Considerations

Ethical approval for the study was obtained from the Human Research Ethics Committee (Medical) at the University of the Witwatersrand, South Africa (Protocol Number: M180111). In addition, the researcher got ethical approval from the Oyo State Ethical Review Board, Oyo state, Nigeria (Reference Number: AD 13/479/679). The ethical approvals are attached as Appendices B and C. The researcher ensured that all the e-TB users in this study were provided with sufficient description of the study and its objectives in the

participant information sheet (Appendix E). Individual informed consent was obtained from all e-TB users (Appendix F). Permission to access and collect data from e-TB users was obtained from the TBL control unit in Oyo state, Nigeria.

The researcher clearly informed all e-TB users in the study that they could choose to leave the study at any point or choose not to answer any question if they so wish. Participants were also reassured that if they choose to leave the study or decide not to answer any of the questions, their responsibility as e-TB user would not be affected.

2.15. Dissemination of the Research Findings

The research report will be submitted to the University of the Witwatersrand library for public use. A synopsis of the report will be sent to TBL control unit and Oyo state ministry of health in Nigeria in order to assist with reviewing, planning and improving e-TB manager implementation. Similarly, findings of this study will be presented at conferences and seminars (at national and international levels) and will be written up for peer-reviewed publication.

CHAPTER THREE

RESULTS

This chapter presents the results from both the qualitative and quantitative studies. For the quantitative part, statistical analysis was conducted using data obtained from all 33 e-TB users. The analyses comprised of descriptive statistics, correlation and regression analyses. For the qualitative part, thematic analysis was conducted on data from e-TB users whom were a subpopulation of the participants that participated quantitative study. Quotations are presented to illustrate the emergent themes from the qualitative study.

3.1. Demographic Profile of e-TB users

The demographic characteristics are shown in Table 3.1. Of the 33 e-TB users, 12 (36.36 %) and 21 (63.64 %) were males and females, respectively. On the practice location, 18 (62.0%) and 11(37.93%) reported that they practice in rural and urban area of Oyo state respectively. The mean age of e-TB users was 48 (SD = 6.22) years. The mean number of years working in the TB programme and the number of years of using e-TB manager was 11.16.90 (SD = 5.29) and 1.91 (SD = 0.39) years, respectively. All e-TB users reported they had tertiary education qualification. Highest Education Level will no longer be used in the formal analysis.

Table 3.1: Frequency distribution of demographic characteristics

Characteristics	Frequency	Percentage
Sex		
Male	12	36.36
Female	21	63.64
Practice Location		
Rural	18	62.07
Urban	11	37.93
Highest Education Level		
Primary / Secondary	0	0.00
Tertiary	33	100.00
Characteristics	Mean	SD
Age	48.00	6.22
Number of years working in the TB programme	11.16	5.29
Number of years using e-TB Manager	1.91	0.39

3.2. Measuring Acceptability of e-TB manager among e-TB users

The minimum acceptability score was 61.40% while the maximum score 100%. The mean overall implementation acceptability score for all e-TB users was 83.19% with standard deviation of 10.94, which indicates that the acceptability of the e-TB manager among e-TB users was very high. e-TB users in the first tertile had a lower mean implementation acceptability score compared to those in the second and third tertiles. Other descriptive features are presented in Table 3.2. Figures 3.1 and 3.2 are Box plots of the acceptability score and acceptability score tertiles of e-TB users respectively. The box plots display the minimum, maximum, median, first quartile and third quartile of the acceptability score. The median, first quartile and third quartile of the acceptability score are 80.2, 77.8, and 92.2 respectively. The median acceptability score for tertiles 1, 2 and 3 are 71.6, 80.7 and 96.6 respectively.

Table 3.2: Descriptive statistics of acceptability scores (expressed as a percentage) and its tertiles

Variable	Frequency	Mean	SD	Minimum	Maximum
Overall Acceptability score	33	83.19	10.94	61.40	100.00
Tertile 1	11	71.60	5.76	61.40	79.60
Tertile 2	12	82.75	3.94	80.00	89.80
Tertile 3	10	96.46	3.19	92.20	100.00

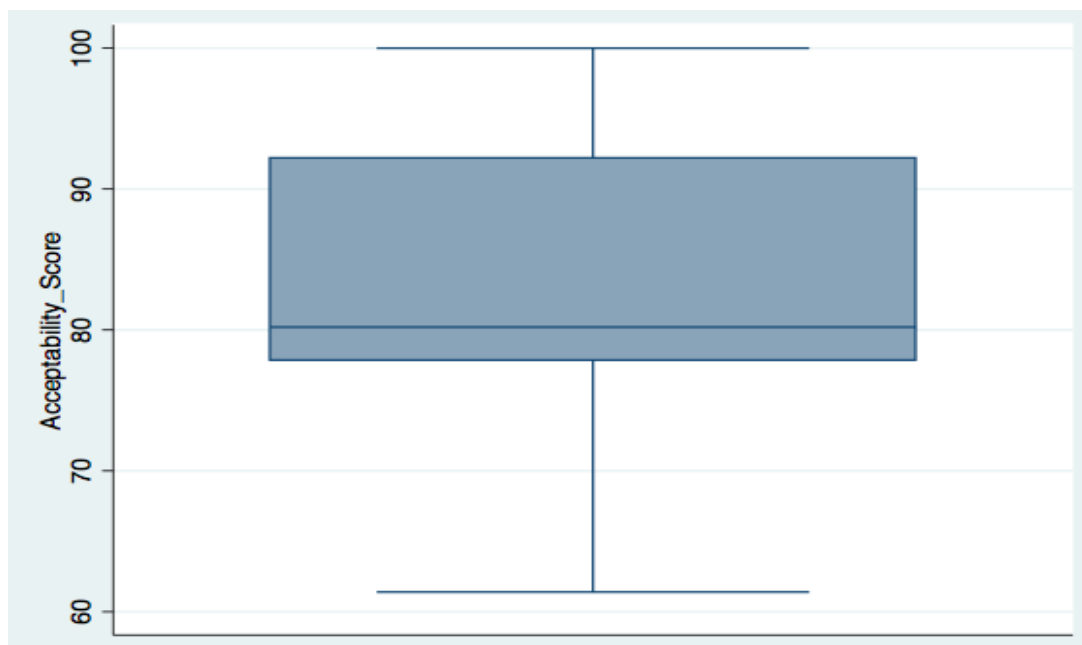


Figure 3.1: Box Plot of Acceptability score.

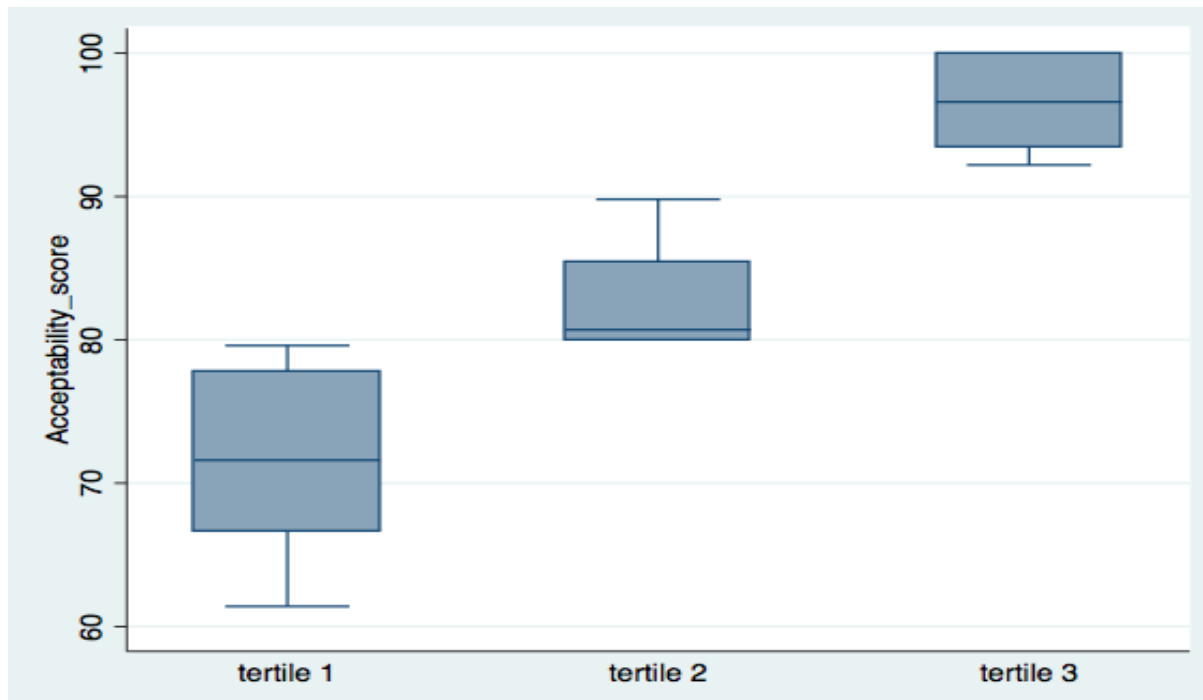


Figure 3.2: Box Plot of Acceptability score tertiles.

Table 3.3: Descriptive statistics of the acceptability scores (percentage) by demographic characteristics

Variable	Mean Acceptability	SD	Minimum	Maximum
Sex				
Male	82.15	8.51	66.60	96.60
Female	83.78	12.28	61.40	100.00
Practice location				
Rural	78.45	10.06	61.40	100.00
Urban	90.90	8.02	77.80	100.00
Number of years working in the TB programme				
1 - 10	82.48	10.98	61.40	100.00
10+	84.63	11.53	66.60	100.00
Number of years using e- TB Manager				
0 - 1	96.30	4.55	89.80	100.00
1+	81.42	10.52	61.40	100.00
Age group				
38 - 48	81.67	12.05	66.40	100.00
49 - 59	85.76	12.01	61.40	100.00

Table 3.3 shows the acceptability score by the demographic characteristics of e-TB users. Acceptability does not seem to differ by sex, age and the number of years an e-TB user has

been working in the TB programme. However, acceptability differs by practice location with acceptability among e-TB users in the urban areas being higher than their counterparts in the rural areas. Also, the acceptability for e-TB users with 0 – 1-year experience of using e-TB manager was higher (96%) compared to e-TB users with more than 1-year experience of using e-TB manager (81%).

3.3. Determinants Associated with Acceptability Score

The correlation analysis and ordered logistic regression models (adjusted and unadjusted models) were fitted to the data. Table 3.4 presents the correlation matrix of the scores, while Table 3.5 presents the results of the ordered regression analyses with demographic profile, organisational-, structural-, provider-, innovation-, and patient- scores as independent variables.

3.3.1. Correlation matrix of the scores

Table 3.4: Correlation Matrix

	AS	OS	SS	PrS	IS	PaS
Acceptability score (AS)	1.00					
Organisational score (OS)	0.6808*	1.00				
Structural score (SS)	0.5854*	0.3427	1.00			
Provider score (PrS)	0.7759*	0.5662*	0.7128*	1.00		
Innovation score (IS)	0.8357*	0.6004*	0.4609*	0.6054*	1.00	
Patient score (PaS)	0.7378*	0.5271*	0.4245*	0.5589*	0.7904*	1.00

*: Significantly associated variable; AS: Acceptability score; OS: Organisational score; SS: Structural score; PrS: Provider score; IS: Innovation score; PaS: Patient score.

The Spearman's rank correlation was used to generate the Correlation matrix in Table 3.4, all pairwise correlations were positively correlated and statistically significant, except for a not significant weak positive correlation between Organisational score and Structural score. A look at the correlation between acceptability and acceptability determinants show that the strength of association is between moderate and high. The correlation between acceptability and innovation score was the highest ($r = 0.84$) while the correlation between acceptability and structural score was the lowest ($r = 0.59$).

3.3.2. Partial Proportional Odds Models (PPOM)

3.3.2.1 Unadjusted Partial Proportional Odds Model (Model 1)

The result of the unadjusted model (Model 1) is presented in Table 3.5, practice location, organisational-, structural-, provider-, innovation-, and patient- factors were significantly associated with acceptability of e-TB manager.

Practice Location (OR = 12.49, p-value = 0.004, 95% CI: 2.28, 68.56), organisational factor, (OR = 1.17, p-value = 0.002, 95% CI: 1.06, 1.29), structural factor (OR = 1.08, p-value = 0.005, 95% CI: 1.02, 1.14), provider factor (OR = 1.27, p-value = 0.0001, 95% CI: 1.13, 1.43), and patient factor (OR = 1.14, p-value = 0.001, 95% CI: 1.06, 1.24) were positively and significantly associated with a better level of the acceptability of e-TB manager and did not differ across the acceptability category.

The innovation factor was positively and significantly associated with a better level of the acceptability of e-TB manager but it differs across the acceptability category (High vs Moderate and Low, innovation score, AOR= 1.38, p-value = 0.002, 95% CI: 1.12, 1.69; High and Moderate vs Low, innovation score, AOR = 1.12, p-value = 0.010, 95%CI: 1.03, 1.22).

3.3.2.2 Adjusted Partial Proportional Odds Models (Models 2 & 3)

The results of the adjusted models (Models 2 and 3) are presented in Table 3.5. In Model 2, only the five key determinants were modelled, of which, only the provider determinant was significantly associated with acceptability of e-TB manager. Provider factor (OR = 1.23, p-value = 0.016, 95% CI: 1.04, 1.47) was positively and significantly associated with a better level of the acceptability of e-TB manager and did not differ across the acceptability category.

The Global Wald test for the model 2 indicates that the model does not violate the proportional odds assumption with high p-value: 1.000. The likelihood ratio value for the PPOM was Chi-square = 38.07 with 5 degrees of freedom. The value of the Pseudo-R-Squared for model 2 was 0.5263.

Table 3.5: Factors identified in the partial proportional odds model (PPOM) to have an association with acceptability

Determinant	Model 1: Low versus (Moderate and High)		(Low and Moderate) versus High	
	COR (95% CI)	p-value	COR (95% CI)	p-value
Sex				
Male (Ref)	1		1	
Female	0.85 (0.24, 3.02)	0.799	0.85 (0.24, 3.02)	0.799
Practice location				
Rural (Ref)	1		1	
Urban	12.49* (2.28, 68.56)	0.004	12.49* (2.28, 68.56)	0.004
Number of years working in the TB programme				
1 – 10 (Ref)	1		1	
10+	1.35 (0.37, 4.89)	0.652	1.35 (0.37, 4.89)	0.652
Number of years using e-TB Manager				
0 – 1 (Ref)	1		1	
1+	0.10 (0.01, 1.06)	0.056	0.10 (0.01, 1.06)	0.056
Age group				
38 – 48 (Ref)	1		1	
49 - 59	1.63 (0.37, 7.23)	0.510	1.63 (0.37, 7.23)	0.510
Organisational score	1.17* (1.06, 1.29)	0.002	1.17* (1.06, 1.29)	0.002
Structural score	1.08* (1.02, 1.14)	0.005	1.08* (1.02, 1.14)	0.005
Provider score	1.27* (1.13, 1.43)	0.0001	1.27* (1.13, 1.43)	0.0001
Innovation score	1.12* (1.03, 1.22)	0.010	1.38* (1.12, 1.70)	0.002
Patient score	1.14* (1.06, 1.24)	0.001	1.14* (1.06, 1.24)	0.001

Model 2: Low versus (Moderate and High)			(Low and Moderate) versus High	
Determinant	AOR1 (95% CI)	p-value	AOR1 (95% CI)	p-value
Organisational score	1.07 (0.96, 1.20)	0.207	1.07 (0.96, 1.20)	0.207
Structural score	0.98 (0.90, 1.07)	0.644	0.98 (0.90, 1.07)	0.644
Provider score	1.23* (1.04, 1.47)	0.016	1.23* (1.04, 1.47)	0.016
Innovation score	1.08 (0.96, 1.23)	0.194	1.08 (0.96, 1.23)	0.194
Patient score	1.04 (0.93, 0.15)	0.496	1.04 (0.93, 0.15)	0.496

Model 3: Low versus (Moderate and High)			(Low and Moderate) versus High	
Determinant	AOR2 (95% CI)	p-value	AOR2 (95% CI)	p-value
Practice location				
Rural (Ref)	1			
Urban	5.03 (0.41, 60.99)	0.205	5.03 (0.41, 60.99)	0.205
Number of years working in the TB programme				
1 – 10 (Ref)	1			
10+	3.19 (0.26, 38.98)	0.363	3.19 (0.26, 38.98)	0.363
Organisational score	1.01 (0.88, 1.15)	0.920	1.01 (0.88, 1.15)	0.920
Structural score	0.97 (0.86, 1.09)	0.587	0.97 (0.86, 1.09)	0.587
Provider score	1.25 (0.99, 1.56)	0.059	1.25 (0.99, 1.56)	0.059
Innovation score	1.11 (0.95, 1.30)	0.195	1.11 (0.95, 1.30)	0.195
Patient score	1.04 (0.94, 1.15)	0.456	1.04 (0.94, 1.15)	0.456

COR: Crude odds ratio; CI: Confidence interval; AOR: Adjusted odds ratio; *: Significantly associated variable.

In Model 3, the five key determinants and demographic characteristics were modelled; none of the variables were significantly associated with acceptability except for provider related factor, which was marginally significant. Provider factor (OR = 1.25, p-value = 0.059, 95% CI: 0.99, 1.56) was positively and marginally significant associated with a better level of the acceptability of e-TB manager and did not differ across the acceptability category.

The Global Wald test for the model 3 indicates that the model does not violate the proportional odds assumption with high p-value: 1.000. In addition, the likelihood ratio value for the PPOM was Chi-square = 34.93 with 7 degrees of freedom. The value of the Pseudo-R-Squared for model 3 was 0.5584

3.4. Sensitivity Analysis

Sensitivity analysis was conducted using the multivariable linear regression. The multivariable model with demographics, organisational-, structural-, provider-, innovation-, and patient-related factors predicting acceptability of e-TB manager was significant (F = 39.88, p-value < 0.0001). Significant predictors of acceptability were provider related factor (Coef. = 0.2397, p-value = 0.024, 95% CI: 0.0053, 0.4739) organisation related factor (Coef. = 0.2701, p-value = 0.045, 95% CI: 0.0383, 0.5018), and innovation related factor Coef. = 0.5241, p-value = < 0.0001, 95% CI: 0.2885, 0.7597). All three determinants were associated with better acceptability of e-TB manager. This result therefore held partially as provider related factor was the only determinant that was marginally significant in the multivariable PPOM.

On the model diagnostics, we used the VIF (variance inflation factor) command in Stata to check for multicollinearity, all the VIF values for the determinants were less than 10 (mean VIF was 1.83), indicating that the data does not have multicollinearity issues. The Normal P-P plot for normality of the residual shows no indication of non-normality (see Appendix M). On the test for heteroskedasticity, we used the Breusch-Pagan test for heteroskedasticity and the graphical inspection by plotting the residual versus fitted value (see Appendix N), the graph shows no indication of non-constant variance. The Breusch-Pagan test for heteroskedasticity indicates that constant variance assumption holds (Chi-value = 0.30, p-value = 0.5841).

3.5. Qualitative Results

A total of ten (10) semi-structured interviews with e-TB users were conducted. The demographic characteristics of the e-TB users are provided in Table 3.6.

Table 3.6: Demographic characteristics of the e-TB users who participated in the semi-structured interviews

Variable	Frequency	Percentage
Sex		
Male	5	50
Female	5	50
Practice location		
Rural	4	40
Urban	6	60
Number of years working in the TB programme		
1 - 10	3	30
10+	7	70
Number of years using e-TB Manager		
0 - 1	5	50
1+	5	50

After the thematic analysis eighteen (18) themes were identified to influence the acceptability of e-TB manager, seventeen (17) of which can be classified under five broad themes (that is, the five key acceptability determinants). The themes are: (1) Challenges with the mobile network connectivity; (2) Mobile Internet Subscription; (3) Access to offline module feature on e-TB manager; (4) Management support; (5) supportive supervision (6) Workload Strain on e-TB users; (7) Technical support; (8) Incentive/Stipend for e-TB users; (9) Self-Efficacy on the use of e-TB manager; (10) Training of e-TB users; (11) Compatibility of e-TB manager; (12) Ease of retrieval of patient information on e-TB manager; (13) Access to patient information; (14) Security of patient record; (15) Ease of Data Collation; (16) Management of Stock-out; (17) Patient-provider relationship; and (18) practice location.

The acceptability determinants are structural-related factors (Themes 1 - 3), organisational-related factor (Themes 4 - 8), provider-related factors (Themes 9 & 10), intervention-related factors (Themes 11 - 16), and patient-related factor (Theme 17). The eighteenth theme was practice location, which was found to influence the acceptability of the e-TB manager too.

3.5.1. Structural-Related Factors

Challenges with the mobile network connectivity

E-TB users noted the main challenge they face is poor mobile network connectivity. Majority the e-TB users interviewed reported that the mobile network service provided on their tablet which houses the e-TB manager network signal is weak in some part of the state. For instance, e-TB users who work in areas with weak or no reception would not be able to work or use the e-TB manager effectively.

“...we were given network SIM ... the network is not really functioning well when it comes to my area, but we were given the SIM, what can we do? That’s one of the challenges we are facing. Had it been that we were given the network that is functioning well in our area, people would have been motivated to do the work.” (E-TB user 4)

In addition, the e-TB users believed that the objective behind the implementation of the e-TB manager was a good one. The e-TB users made an effort to reach out to the implementation team on the issue of the network given to them, as the mobile network signal was not strong in all the local government areas of Oyo state. Implementation team promised to do something about it but the problem still lingers. The e-TB users described the poor mobile network signal as outside of their control.

“ ...we called the officer in charge, then they promised [to do some about the problem] but after some time we are unable to link them again, now after sometime there was no network so we couldn’t do anything or any other thing. As far as e-TB manager is concerned, the objective behind it is okay, but the implementation is not really going well.” (E-TB user 1)

To solve the problem of mobile network service, the e-TB users acknowledged that the state implementation team told them they could use their personal mobile network service or another mobile network service that works well in their practice location. Few e-TB users in areas where the mobile network service is poor used an alternative network service provider, but not all the e-TB users agreed with the state implementation team. They felt it was not a good idea since the use of their personal mobile network service would cause distractions.

“Like what we are just told today, that if the e-TB manager is not working well with the SIM [card of subscribed service] given to us, we can use our own SIM ... to me, I see it as if its not a good thing to welcome, because I may have my own personal things I use my SIM for. For example, I might be working [on the e-TB manager] and a call just comes in, it will disturb what I am doing because I would like to receive the call. The same thing [is] applicable to the messages, so there would be distractions in using it.” (E-TB user 3)

“They gave me the subscribed network line, in my area there is no network for this network. So, I bought another line [another mobile network service provider]. I will remove the mobile network given to me and put my own line. In addition, I bought my own data (internet service) to do the work.” (E-TB user 4)

In addition to the efforts made to resolve the problem of poor mobile network service, which had lingered since the implementation of the e-TB manager, the implementation team gave out an alternative mobile network package to the subsequent batches of e-TB supervisors that were trained. In addition, they provided the alternative network service to the previously trained e-TB users who felt the subscribed mobile network service had issues in their practice areas.

“... The first group they trained were given Glo SIM ... so it was the second batch they gave MTN SIM maybe they noticed that the network was not good ... but they eventually called us that anybody who prefer to use MTN should let them know, I think they changed SIM for some of us but I didn't change my own” (E-TB user 6)

Inadequate Mobile Internet Subscription

The e-TB users described inadequate mobile Internet subscription (mobile data subscription) as a factor hindering the acceptability of e-TB manager. The problem has to do with mobile data planning, there is need to provide enough mobile data for the e-TB users. Also, responsiveness to the purchase of mobile data for the e-TB users is an issue. Most times the e-TB users do run out of mobile data; this implies that they would not have anything to work with pending the time Global Fund subscribes mobile data for them.

“... For some period we didn't have data [internet subscription]. We were told that Global Fund pays to the telecommunication company to provide the data; when they [Global Fund] pay them [the internet providers], they will restore it back.” (E-TB user 2)

Also, e-TB users mentioned that it takes about a week for the mobile data to be restored, while they wait for the Global Fund to subscribe for the mobile data, some of them have resorted to buying their own mobile data in order to do their work. Others have resorted into using an alternative mobile network with mobile data on it to do their work.

“It's mostly about data and if we don't have data, we call them immediately; within a week the data will be restored.” (E-TB user 1)

“Apart from the fact that, they gave a particular SIM from the network, there has being situations whereby I have to resort to buying my own data or using another SIM in order to do my work” (E-TB user 7)

Access to offline module feature on e-TB manager

In an effort to increase the acceptability of the e-TB manager, the offline module was introduced. This feature allows e-TB users to store patient information on the memory of the e-TB manager temporarily. When mobile network or mobile data becomes available patient information is automatically synchronised onto the central e-TB database. All the e-TB managers interviewed did not only acknowledge the importance of the offline module they also advocated for its implementation as part of the upgrade feature in the e-TB manager.

“...that was why we were advocating for the possibility of an offline module, so that we will be able to push everything [patient data] in offline [module], anytime we have network signal we just open it and everything will be uploaded” (E-TB user 8)

As noted by e-TB users working in areas distant from the state capital, the offline module feature has been configured for some of the e-TB users working in the state capital and its environs. Though they were yet to be called for the configuration of the offline module, they were optimistic that their e-TB managers will be configured with the offline module soon.

“Recently, I learnt that there is offline module, this module was given to some people. The module has not been given to us maybe because of our distance.... Personally, I

see it [offline module] as a system that is good, instead of waiting for [the mobile] data. Once there is no data, you enter and save patient information, so when the data comes [you] just enter [the e-TB manager] with your password then it will automatic upload [patient information on the central database].”(E-TB user 6)

3.5.2. Organisational-Related Factor

Management support for the implementation of e-TB manager

E-TB users indicated that management support was an important facilitator to the acceptability of the e-TB manager. The national and state management support for the implementation of e-TB manager was strong. The management formed the implementation team comprising of dedicated individuals at the national and state level and across interdisciplinary fields. All the TBL supervisors whom are now e-TB users were notified of e-TB manager training and tablets comprising of the e-TB manager application were provided to all the TBL supervisors in an effort to promote e-TB manager.

“...both sides [federal and state implementation team] were the ones that gave us the training on use of e-TB manager, especially the Federal people. The training was done in collaboration with the state [implementation team] around December of 2015 ... at the state level, they use to encourage us to use the e-TB manager.” (E-TB user 1)

Supportive supervision

Supportive supervision of e-TB users was a perceived facilitator to the acceptability of the e-TB managers. E-TB users working in the rural areas and faraway areas from the state capital recognised the importance of supervisory visits and support in the acceptance of the e-TB manager but affirmed that they did not receive such visits and support. Participants expressed frustrations that there was no supervisory plan that was put in place to monitor the implementation of the e-TB manager.

“That is where the problem is, ... no supervisory team has been put in place to monitor how well it is going [e-TB manager implementation]. If that had been put in

place, my supervisor could brush me up or retrain me in areas that he thinks I am not doing well, but there is none.” (E-TB user 5)

Workload Strain on e-TB users

Majority of the e-TB users discussed feeling exhausted by their workload. They mentioned that the workload strain affects their acceptance of the e-TB manager. The e-TB users mainly attributed the burden to the number of facilities providing TB care they supervise in the context of insufficient staff.

“...visitation and supervision of the high burden DOT facilities and private hospitals offering TB care services is part of the job of the of TBL supervisors, ... entering of data [in e-TB manager] is part of TBL supervisor’s job ... if they can provide me with an assistant that will be entering the data it would have been better, it will ease the job for the TBL supervisor. Also, counselling of TB patients is part of TBL supervisor job.” (E-TB user 3)

“I can say this, generally, we are short of staff in all the facilities. In the facility where I work, we ought to have two or three people that work with me. I am the only person that is working in my facility because of low staff at the LGA [local government area].” (E-TB user 2)

As a result of staff shortages, some e-TB users have resulted to entering patient data into e-TB manager on Fridays, while other tasks were done from Mondays through Thursday. Also, others recruited and trained ad-hoc assistants to operate in some of their roles.

“If not because we are short-staffed, we shouldn’t have to put everything [entering patient data into e-TB manager] on Friday but we need to complete all the entry of patient information [on e-TB manager] by the end of the week.” (E-TB user 1)

“I’m the only one working in the clinic I only have one ad-hoc worker when things are beyond my capacity, without the ad-hoc staff, how do you think I can cope up with all these things [tasks]?” (E-TB user 10)

Technical support

Many e-TB supervisors discussed they had access to technical support from both state and national e-TB implementation team. A communication link was established between the e-TB users and implementation team, where e-TB users have the opportunity to report issues and challenges they might be facing with the use of the e-TB manager. As reported by the e-TB users, they have the privilege of contacting the implementation team. Sometimes, the national implementers answers do not answer their calls, they attributed the non-response to their busy schedule. Also, they are able to reach out to the link persons the state level that provide support for them but if they are unable to resolve the issues, the request help from the national link persons.

“At the state level, we have link persons who always call us to know how we are finding [the usage of] e-TB manager and if we have challenges we let them know, ones that the state link persons cannot handle they request help from the national [link persons]... For example, there was a time they [the national implementers] sent like 4-5 people down from Abuja [the Nigerian capital].” (E-TB user 10)

“Those people that came to train us gave us the privilege of calling them any time; but they are very busy they don’t always pick calls immediately ... we have this link person [in the state] that we report to, so when they see his call, they respond.” (E-TB user 1)

Incentive/Stipend for e-TB users

Several e-TB users reported that the management needs to consider the provision of financial incentives for them as this would impact on their motivation to do more on their job, for instance, they reported that such incentive could be used to purchase mobile data without needing to stop work to wait for Global Fund to subscribe the mobile data for them.

“For the effective use of the e-TB manager, there is need to boost the morale of the TBL supervisors; even if it’s not directly... You invite us for training, in fact it will boost our morale and we will love it and peradventure we are given stipend to buy data, I think it is still something to work with, and if at the end of the day we are given a token its still part of it” (E-TB user 2)

Other e-TB users felt otherwise, they reported that they do not need to be given incentives for them to do their work, that the provision of the e-TB manager and free subscription of mobile data has made their work easier.

“... this e-TB manager is even better for our work, than saying we need to be given stipend before we can do the job, because the job we are doing we are serving our people, so to me I don't see the need of getting external thing [incentive] before we can do it [our job]. Once we are provided with free data then what else do we need? Just to input in it [e-TB manager].” (E-TB user 10)

“I collect my salary ... and this thing [e-TB manager] only came to help me to perform my duties well, ... I don't think incentive should be given to me, I don't know of other people” (E-TB user 8)

3.5.3. Provider-Related Factors

Self-Efficacy on the use of e-TB manager

Several e-TB users mentioned that the acceptability of e-TB manager was impacted by self-efficacy on the use of e-TB manager. They believed that their exposure to the e-TB manager have removed the fears they might have about the use of electronic devices. Also, they felt they have more control while working on the e-TB manager.

“I used to think laptops, tablets are very difficult use... but with this [tablet], I can manoeuvre my way, I can do things that I need to do, it exposes me more to using electronic devices” (E-TB user 3)

“...with the level of my training of it [e-TB manager], there is no area [of the e-TB manager] that is difficult” (E-TB user 2)

Training of e-TB users

As part of the e-TB manager implementation, trainings were conducted on the use of e-TB manager so that the e-TB users can provide the TB care services efficiently and effectively. The e-TB users expressed that the trainings they received made conducting their duties easier.

“Actually, both sides [the national and state implementation team] gave us the training on the use of e-TB manager, they prepared our minds on e-TB manager... they trained us for 5 days; the first three days was for lectures while the last two days they allowed us to do our work by ourselves.” (E-TB user 1)

“...we were trained and it wasn't for anything difficult, if you get what you are taught very well, step by step of the way you will know what to do.” (E-TB user 2)

3.5.4. Innovation-Related Factor

Compatibility of e-TB manager

The majority of e-TB users perceived e-TB manager as being beneficial to their work. Prior to the implementation of e-TB manager, TBL supervisors (e-TB users) worked with the paper-based TB registers that are heavy to carry around and involve a lot of paper work, which is time consuming. This perceived benefit delays influenced their acceptability of the e-TB manager.

“...it has a lot of advantages ... if you are having a review meeting, for instance, instead of carrying a lot of registers, just take your tablet [with the e-TB manager application in it].” (E-TB user 2)

Ease of retrieval of patient information

E-TB users were unanimous in characterizing e-TB manager as a tool for quick and easy retrieval of patient information. Information on events that occurred in past are not easily retrieved from paper-based TB registers. Also, information can be sent from the facility up to the national level seamlessly.

“ ... it is very easy to retrieve information on the e-TB manager. For instance, if a question comes on the stock of my drug and opening balance, it is very easy for me to just go to e-TB manager and retrieve the information and give it out ... e-TB manager is very useful, record can be retrieved, information can be sent, from facility level to LGA to state and to the national [stakeholders]” (E-TB user 4)

Access to patient information

In terms of access to patient information, those interviewed mentioned that there was restriction on access to patient information. The e-TB manager has password, and e-TB users were the only ones with the passwords, unlike the paper-based TB registers that any staff could easily access.

“I have a password; so if you don’t know my password you won’t be able to access it [e-TB manager] ... Anybody can just come in now and open your register... but with this one [e-TB manager], you need my password” (E-TB user 2)

Security of Patient Record

On the safe keeping of patient record, e-TB manager seem to have an advantage over the paper-based TB registers. As mentioned by the majority of e-TB users, fire, termites and other natural disasters could destroy the paper-based TB registers whereas this is not the case when patient records are on the e-TB manager central database.

“I quite agree that it [e-TB manager] is helpful in this [TB] program in the sense that hard copy registers cannot stay long, it can easily be destroyed, you can lose them, but once you have them in an electronic device for as long as you wish to keep it, it will be there.” (E-TB user 1)

Ease of Data Collation

Most of the e-TB user recognises the importance of e-TB in the collation of data. The e-TB users do have quarterly review meetings at the state level where information on collated data are discussed. In the past, manual collation from the TB register is tedious, time consuming and there is a greater possibility of mistake been made during the collation process. Also, it is easier to collate all data and prepare a report on the activities of the quarter or year without stress.

“...at the end of the year, is very easy to collate [data on the e-TB manager] and send the report without stress.” (E-TB user 1)

Management of Stock-out

In addition, the e-TB users mentioned that the e-TB manager assists in managing of stock and early detection of stock out. Stock-out on TB medication could affect delivery of quality of care to the patients and lower the morale of e-TB users.

“... you can manage your stock with the e-TB manager, once you have received your stock, you load the stock on it [e-TB manager]; step by step as you are removing for each patient it balances itself, no mistake, you won't miss out on any of your stock. It has really been helpful ... at the end of six months regimen, you will be able to say that this is the number of tablets a patient used from the beginning to the end [of the of six months regimen].” (E-TB user 4)

“...the medicine module [on the e-TB manager] was so simplified that stock out can quickly be detected through without going to the drug store, then you can a call to the supervisor regarding the stock out” (E-TB user 2)

3.5.5. Patient-Related Factor

The only theme that emerged under patient related factor was the patient-provider relationship. Some e-TB users mentioned that the relationship they had with their patient really helped the patients in adhering to TB medication. When patients come into the facilities e-TB users do have counselling sessions with them. Also, when the e-TB user observed defaulting patients they try to call them up to know why they have not been coming for their medications. With this effort made from the side of the e-TB user, some of the patients return to the facility to continue their TB treatment.

“It is very quick to know that a patient is defaulting while using e-TB manager ... it makes it easy to trace our patients ... we call them immediately, to inquire why they have not been coming... most of them do change [from being defaulters]” (E-TB user 10)

3.5.6. Practice location

Majority of the e-TB users practicing in the rural areas felt that their colleagues working in the state capital and its environs have greater access to the management and up-to-date

information about e-TB manager. They reported that logistic issues and inadequate planning fro e-TB users working in rural areas has hindered their acceptability of the e-TB manager.

“There was a training which was done in the state, those in Ibadan and Oyo [Oyo town] were invited. We were not given the opportunity to be trained but because we were in a far distance. I learnt that there was no logistic to that effect. Any training that is being given in the state for the set of TBLS should cut across but because of our distance we were calve out, so the e-TB manager is no longer working for us” (E-TB user 5)

3.6. Integrated Findings

As shown on Table 3.7, the factor score for provider shows a positive and significantly better level of the acceptability of e-TB manager among e-TB users and did not differ across the acceptability category. The illustrative quote from one of the e-TB users suggests that with the level of the training they have received on e-TB manager, navigating the features and performing tasks on the e-TB manager was quite easy.

Further details of the triangulation are provided in Table 3.7, where a meta-matrix was used to compare between findings from both data sets. For the most part, convergence was found between the qualitative and quantitative data, though discrepancy was found in qualitative themes under the organisational factor compare to the quantitative findings.

Table 3.7: Triangulation of quantitative and qualitative results: convergence and discrepancy of findings

Outcome of Interest	Quantitative acceptability findings		Qualitative interview findings		Convergence/ Discrepancy/ Silence
Factors influencing acceptability findings:	Result from the Partial Proportional odds model (PPOM)		Thematic Analysis		
	Structural score	1.0787 (p-value = 0.005)	Themes 1 - 3	<i>“...we were given Glo SIM ... Glo network is not really functioning well when it comes to my area, but we were given it [Glo SIM], what can we do? That’s one of the challenges we are facing. Had it been that we were given the network that is functioning well in our area, people would have been motivated to do the work.”</i>	Convergence
	Organisational score	1.1702 (p-value = 0.002)	Themes 4 - 8	<i>“That is where the problem is, ... no supervisory team has been put in place to monitor how well it is going [e-TB manager implementation]. If that had been put in place, my supervisor could brush me up or retrain me in areas that he thinks I am not doing well, but there is none.”</i>	Discrepancy
	Provider score	1.2717 (p-value = 0.0001)	Themes 9 & 10	<i>“I used to think laptops, tablets are very difficult use...”</i>	Convergence

				<i>but with this [tablet], I can manoeuvre my way, I can do things that I need to do, it exposes me more to using electronic devices”</i>	
Innovation score	1.1181 (p-value = 0.010)	Themes 11 - 16		<i>“I quite agree that it [e-TB manager] is helpful in this [TB] program in the sense that hard copy registers cannot stay long, it can easily be destroyed, you can lose them, but once you have them in an electronic device for as long as you wish to keep it, it will be there.”</i>	Convergence
Patient score	1.1434 (p-value = 0.001)	Theme 17		<i>“It is very quick to know that a patient is defaulting while using e-TB manager ... it makes it easy to trace our patients ... we call them immediately, to inquire why they have not been coming... most of them do change [from being defaulters]”</i>	Convergence
Practice location (Rural as reference category)	12.4903 (p-value = 0.001)	Theme 18		<i>“There was a training which was done in the state, those in Ibadan and Oyo [Oyo town] were invited. We were not given the opportunity to be trained but because we were in a far distance. I learnt that there was no logistic to that effect. Any training that is being given in the state for the set of TBLS should cut across but because of our distance we were calve out, so the e-TB manager is no longer working for us”</i>	Convergence

CHAPTER FOUR

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This study measured the level of acceptability of e-TB manager in Oyo state, Nigeria. In addition, the factors affecting the acceptability of e-TB manager was assessed. The two objectives were based on the Technology Acceptance Model (TAM) and Chaudoir et al. framework for predicting implementation outcomes - in this case, acceptability [95, 97]. The determinants of implementation acceptability used in this study are structural-related, organisational-related, provider-related, innovation-related, patient-related and demographic characteristics of e-TB users.

4.1. Measuring Acceptability of e-TB Manager

In this cross-sectional study of e-TB users, we found that the overall acceptability of the e-TB manager was 83%, indicating high acceptability of the e-TB manager among its users. This result is similar to what was found in previous research that electronic technologies could be acceptable and useful for healthcare providers [113-115]. For instance, Jensen and colleagues in a study conducted in South Africa on the acceptability and uptake of an electronic decision-making tool to support the implementation of Integrated Management of Childhood Illness (IMCI) in primary healthcare facilities, they found that acceptance of electronic IMCI was high among caregivers and operational managers [116].

4.2. Determinants Influencing the Acceptability of e-TB Manager

4.2.1. Structural level factor influencing the acceptability of e-TB manager

Structural factors such as challenges with the mobile network connectivity, inadequate mobile Internet subscription; lack of access to offline module features were found to significantly affect acceptability of the e-TB manager.

For locations with unreliable network connectivity and Internet services, most especially the rural areas of Oyo state, working with the e-TB manager could be frustrating, as work would not be done in a timely manner, thereby reducing motivation and productivity. In study the study by Odekunle and colleagues they found poor electricity supply, inadequate or lack of Internet connectivity, and lower computer literacy level as barriers to EHR adoption in sub-Saharan African countries [117]. It is important to have alternative ways of working for the e-TB users.

One of such alternative is the provision of offline data entry module, which allows for patient information to be stores the system locally until it can be uploaded to the central database. The offline feature has been implemented in the e-TB manager but the configuration is yet to be done for all e-TB users. The implementation and team needs to ensure speedy configuration of offline module for all e-TB users. This is in the line with the Allen and colleagues study which found that offline module has been successfully employed in Rwanda using OpenMRS [41].

4.2.2. Organisational level factor influencing the acceptability of e-TB manager

Organisational level factor was a significant determinant affecting acceptability of e-TB manager among e-TB users. The commitment of the federal and state ministries of health top management is a paramount factor in the success of e-TB manager implementation as revealed in this study. Previous studies have revealed the prominent impact of top management on the acceptability and success of interventions [49, 71, 118-121]. For example, Jahanbakhsh and others in their study noted a high Managers' commitment as a requirement for the successful implementation of EMR in Iran, this include allocation of sufficient manpower, financing, motivation, personnel training and empowerment. They found a relationship between managers attitude toward EMR implementation and their commitment [121]. In addition, the results of the current study showed that the e-TB users had relatively favourable views about the management support and their involvement in the e-TB implementation. Management support is related to the ability to provide resources for implementing and training of e-TB users. The results of study by Morton confirm the current findings [122].

The current study shows that the provision of financial incentive to e-TB users would go a long way in motivating e-TB users. At the moment, none of the e-TB users were provided with incentives to boost meaningful user of the e-TB manager. The study by Odekunle and colleagues found lack of financial incentives as one of the factors hindering the widespread adoption of an EHR in sub-Saharan Africa [117]. The US for instance, through the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 provided direct payments to incentivize the adoption and meaningful use of EHRs by US eligible healthcare professionals [123, 124]. The Act sets a minimum standard for the incentives to be earned by the healthcare professionals. They were expected to demonstrate meaningful use of EHR technology based on the

metrics established by the Centers for Medicare & Medicaid Services [123, 125, 126]. Nigeria could borrow a leaf from the US experience through adaptation of the core elements of the HITECH incentive program. This in line with Marmor and others study that found financial incentives as facilitator to rapid adoption of EHR applications [127].

Physician burnout has become increasingly prevalent in the healthcare sector and has become the focus of national initiatives. EHRs and the ever-increasing clerical duties associated with it have often been cited as a factor of physician stress and burnout [128, 129]. Since the introduction of e-TB manager, the users have been reported to work longer hours, with many completing their patient data entry at home, during evenings or weekends. The e-TB users revealed that there is shortage of staff in their facilities leading to them taking up additional tasks. Low control of workload, high pressure to complete data entry on the e-TB manager, has worsened workloads and contributing to burnouts. Increasing support staff, on-going technical support and shifting organisational culture to place more value on e-TB users wellness would help reduce the consequences of worsened workloads.

4.2.3. Provider level factor influencing the acceptability of e-TB manager

Implementers of a public health intervention do not want the interventions to fail or to be underutilized. Adequate training and continuous training of users is critical raising implementation level the e-TB manager. Insufficient training, lack IT skills of users may lead to demotivation in the use of EMR [130, 131]. In this study, all users received the required training to use e-TB manager, which reduces technical issues resulting from misuse and thus made it easy for e-TB users to operate and navigate the feature in the e-TB manager platform. This study reinforces earlier inferences by Ball, who reported that training of end users is critical to the successful use of an initiatives [132]. Training and support needs be revisited for newly employed e-TB users. Training should be provided regardless of previous exposure to e-TB manager.

This study found e-TB manager self-efficacy as an influencing factor in the acceptability of e-TB manager. E-TB users felt that they are able to conduct tasks on every aspect of the e-TB manager without difficulty. This study found that e-TB users with high self-efficacy expected the e-TB manager to be easy to use and also useful in their practice. Because e-TB manager are anticipated to be critical to high quality of care, the management should pay particular attention to factors like

e-TB manager self-efficacy that could predict low acceptance. In line with Bandura's self-efficacy theory [133], individuals with higher self-efficacy are more likely to experience a positive effect than those with lower self-efficacy. In addition, the Harle's study found that computer self-efficacy predicted both higher perceived ease of use and higher perceived usefulness of EHRs [134]. These results suggest the importance of e-TB manager training and implementation managers to ensure that e-TB users are well trained to boost self-efficacy.

4.2.4. Innovation level factors influencing the acceptability of e-TB manager

The way a user perceives the attributes of an innovation has an impact on the rate of adoption [135-137]. Our finding indicates that innovation level score was also a significant determinant affecting acceptability of e-TB manager among e-TB users in study. e-TB users perceive e-TB manager as a superior alternative over the Paper-Based Patient Record (PBPR), they think that the process of implementation and their interaction with the e-TB platform wasn't complex. The e-TB manager promises considerable advantages over the PBPR. For instance, such potential advantage might include: better communication between care providers, reduced medication errors, reduced cost, improved documentation, better organisation of patient information, and easier entry and retrieval of patient information [138, 139].

E-TB users perceive the system as user-friendly and easy to use. The level of user-friendliness of a system can impact on users' attitude towards using it [97]. Perceptions of the benefits of EMR over the manual record system are a key driver in implementing an EMR. Perceptions of benefits, ease of use and usefulness of EMR, lead to positive attitude towards EMR systems [140-142]. This is similar to a study conducted in Nigeria, where the healthcare professionals (physicians and nurses) had a positive attitude towards computerized health information systems [143].

4.2.5. Patient level factors influencing the acceptability of e-TB manager

Patient level factor was a significant determinant affecting acceptability of e-TB manager among e-TB users. Baron and colleagues [144] suggest that EHRs may improve the Patient-Provider relationship. Other studies have shown that a good Patient-Provider relationship will not only

increase the depth of patients' satisfaction but that will also lead to the delivery of high-quality care [144-146].

4.2.6. Demographic Characteristics

In this study, the demographic characteristics that appeared to have influenced users' acceptability of the e-TB manager initiative is practice location. Urban users of e-TB manager have an increased acceptability compare to users in the rural areas. Possible explanation might be that users in the urban areas tend to have more access to technical and support teams; hence, they report less problems or barriers. This finding is consistent with previous evidence from a study in Florida, US, which showed that urban physicians rated barriers less frequently than their rural counterparts. Commonly barriers cited in the US study were temporary disruptions to productivity and disruptions in access to patients record when computer systems fail [147].

4.3. Implications for Policy & Practice

This study provides useful data for Oyo state TBL unit, state and federal ministries of health and e-TB manager implementation team. Understanding the needs of e-TB users will help facilitate a smooth improvement and implementation of e-TB manager.

There are few instances in Nigeria where ministries of health use electronic patient information management system data to examine population health. It is important to gather evidence on how e-TB manager and other patient information management systems in health care organisations can improve the practice of epidemiology and public health.

This study adds knowledge regarding those factors that are associated with e-TB manager's acceptance among e-TB users. The results can be used to improve the implementation of e-TB manager in Nigeria. Also, we believe that identifying the key individuals within the TB control units who can promote the change effort is most important. This includes identifying potential e-TB champions and the identification the key person(s) driving change in the TB control units is important.

4.4. Limitations and strengths

Although all e-TB users were included in the quantitative study, we were limited by sample size. As such, our findings are not generalizable. The collection tool was self-reported, social desirability bias is a potential limitation. Despite these limitations, the study has a number of strengths. The mixed methods design used in this study enabled the integration of quantitative and qualitative data, which improved the validity of our findings. This mixed methods design allowed us to gain additional insights to a better understanding of the acceptability of e-TB manager among e-TB users than would have been possible with either qualitative or quantitative methods alone. Also, existing theoretical frameworks guided the design and data collection for the study; this helped to increase the validity of the study.

4.5. Conclusion

In conclusion, the electronic TB patient management information system (e-TB manager) was an acceptable initiative for managing TB patients towards better outcomes in the context of Oyo state, Nigeria. Factors that influenced the acceptability of e-TB manager include organisational-, structural-, innovation-, patient-, provider-related factors, and practice location. E-TB users whose practice location is rural areas, had lower acceptability for e-TB manager technology, special consideration should be given to this population.

4.6. Recommendations

Based on findings from this study, the following recommendations are made:

- I.** Technical support should be improved for e-TB users in the rural areas, as inadequate support may have accounted for the reduction in implementation acceptability score observed in the area in this study.
- II.** The e-TB users should participate in the stakeholder forum to ensure their contribution to TB policy.
- III.** There should be a well-established medium of providing adequate and regular feedback from the e-TB users to the top management. This will ensure their optimal participation in the TB control program.

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APPENDICES

APPENDIX A: PLAGIARISM DECLARATION REPORT



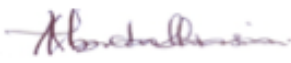
PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I ABDULWASIU O. IBRAHIM (Student number: 1708336) am a student registered for the degree of MSc in Epidemiology (Implementation Science) in the academic year 2020.

I hereby declare the following:

- ❖ I am aware that plagiarism (the use of someone else's work without their permission and/or without acknowledging the original source) is wrong.
- ❖ I confirm that the work submitted for assessment for the above degree is my own unaided work except where I have explicitly indicated otherwise.
- ❖ I have followed the required conventions in referencing the thoughts and ideas of others.
- ❖ I understand that the University of the Witwatersrand may take disciplinary action against me if there is a belief that this is not my own unaided work or that I have failed to acknowledge the source of the ideas or words in my writing.

Signature: 

Date: 24 / 03 / 2020

APPENDIX B: WITS ETHICS CLEARANCE CERTIFICATE



R14/49 Mr Abdulwasilu Ibrahim

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M180111

NAME: Mr Abdulwasilu Ibrahim
(Principal Investigator)
DEPARTMENT: School of Public Health
Division of Epidemiology and Biostatistics
National Tuberculosis and Leprosy Control Programme Office
Oyo State, Nigeria

PROJECT TITLE: The Acceptability of a TB Patient Management
Information System among e-TB Manager Supervisors
in Oyo State, Nigeria

DATE CONSIDERED: 26/01/2018

DECISION: Approved unconditionally

CONDITIONS:

SUPERVISOR: Dr Latifat Ibisomi

APPROVED BY: 
Prof C Penny, Chairperson, HREC (Medical)

DATE OF APPROVAL: 30/04/2018

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report.** The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in January and will therefore be due in the month of January each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature _____

Date _____

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

APPENDIX C: ETHICAL APPROVAL LETTER (NIGERIA)

TELEGRAMS.....

TELEPHONE.....



MINISTRY OF HEALTH
DEPARTMENT OF PLANNING, RESEARCH & STATISTICS DIVISION
PRIVATE MAIL BAG NO. 5027, OYO STATE OF NIGERIA

Your Ref. No.

All communications should be addressed to

the Honorable Commissioner quoting

Our Ref. No. AD 13/479/ 679

28th February, 2018

The Principal Investigator,
School of Public Health,
University of the Witwatersrand,
Parktown, 2193, Johannesburg,
South Africa.

Attention: Abdulwasii Ibrahim

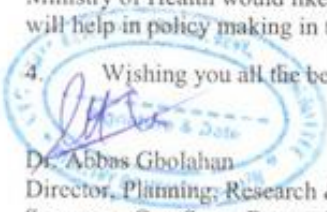
**ETHICAL APPROVAL FOR THE IMPLEMENTATION
OF YOUR RESEARCH PROPOSAL IN OYO STATE**

This is to acknowledge that your Research Proposal titled: "The Acceptability of a TB Patient Management Information System Among e-TB Manager Supervisors in Oyo State, Nigeria." has been reviewed by the Oyo State Ethical Review Committee.

2. The committee has noted your compliance. In the light of this, I am pleased to convey to you the full approval by the committee for the implementation of the Research Proposal in Oyo State, Nigeria.

3. Please note that the National Code for Health Research Ethics requires you to comply with all institutional guidelines, rules and regulations, in line with this, the Committee will monitor closely and follow up the implementation of the research study. However, the Ministry of Health would like to have a copy of the results and conclusions of findings as this will help in policy making in the health sector.

4. Wishing you all the best.


Dr. Abbas Gbolahan
Director, Planning, Research & Statistics
Secretary, Oyo State, Research Ethical Review Committee

APPENDIX D - QUANTITATIVE DATA COLLECTION TOOL

Confidential

Acceptability
Page 1 of 6

Acceptability Questionnaire

Participant ID _____

Demographic characteristics

Sex ☐ Male
☐ Female

Practice location ☐ Rural
☐ Urban

Age _____

Highest education level ☐ Primary
☐ Secondary
☐ Tertiary

Number of years working in the TB programme _____

Number of years using e-TB Manager _____

Organizational level

Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree

	1	2	3	4	5
I feel e-TB manager is important to both federal and state ministries of health	☐	☐	☐	☐	☐
I feel e-TB manager was introduced to me effectively by the TB and Leprosy control unit	☐	☐	☐	☐	☐
I feel the TB and Leprosy control unit is doing a helpful job in the implementation of the e-TB manager	☐	☐	☐	☐	☐
I feel the TB and Leprosy control unit expects routinely use the e-TB manager	☐	☐	☐	☐	☐

Structural level					
Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree					
	1	2	3	4	5
I feel I have close working relationship with other users of e-TB manager	☐	☐	☐	☐	☐
I feel that the level of involvement of my superiors in e-TB manager implementation is enough	☐	☐	☐	☐	☐
I feel performance measure of the e-TB manager is collected or monitored	☐	☐	☐	☐	☐
I feel the information provided has influenced my opinion on the e-TB manager	☐	☐	☐	☐	☐
I think that the TB and leprosy control unit does not have the necessary infrastructure to support my use of the e-TB manager	☐	☐	☐	☐	☐

Provider level - e-TB user training					
Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree					
	1	2	3	4	5
I feel I received the training required to use the e-TB manager	☐	☐	☐	☐	☐
I feel e-TB manager training has made it more useful to me	☐	☐	☐	☐	☐
I feel e-TB manager training has made it easier for me to use this technology	☐	☐	☐	☐	☐

Provider level - e-TB user involvement

Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree

	1	2	3	4	5
I feel my involvement in the e-TB manager implementation is effective	☐	☐	☐	☐	☐
I feel my involvement in the e-TB manager implementation has made the e-TB manager more useful to me	☐	☐	☐	☐	☐
I feel my involvement in the e-TB manager implementation is a must	☐	☐	☐	☐	☐
I feel my involvement in the e-TB manager implementation will positively affect my attitude about e-TB manager	☐	☐	☐	☐	☐

Provider level - e-TB user attitude

Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree

	1	2	3	4	5
Using e-TB manager is advisable in TB management	☐	☐	☐	☐	☐
Using e-TB manager is a pleasant idea	☐	☐	☐	☐	☐
I enjoy using e-TB manager	☐	☐	☐	☐	☐
I am satisfied in using e-TB manager	☐	☐	☐	☐	☐

Provider level - e-TB user perceived behavioural control

Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree

	1	2	3	4	5
I am confident that I could perform tasks on the e-TB manager	☐	☐	☐	☐	☐
The decision to perform tasks on the e-TB manager is not beyond my control	☐	☐	☐	☐	☐

Innovation level

Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree

	1	2	3	4	5
I perceive the e-TB manager as being a superior alternative to a paper based TB patient management	☐	☐	☐	☐	☐
I think the process of implementing e-TB manager is complex	☐	☐	☐	☐	☐
I think information provided to me shows that e-TB manager is appropriate	☐	☐	☐	☐	☐
I think information provided to me shows that e-TB manager will work	☐	☐	☐	☐	☐

Patient level

Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree

	1	2	3	4	5
Most of my patients welcome the fact that I use the e-TB manager	☐	☐	☐	☐	☐
The use of the e-TB manager could help me to monitor my patients and patient information more rapidly	☐	☐	☐	☐	☐
The use of the e-TB manager could improve the monitoring of my patients and patient information	☐	☐	☐	☐	☐

Acceptability - Perceived usefulness

Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree

	1	2	3	4	5
Using e-TB manger in my job has enabled me to accomplish tasks more quickly	☐	☐	☐	☐	☐
Using e-TB manager has improved my job performance	☐	☐	☐	☐	☐
Using e-TB manager has enhanced my effectiveness on the job	☐	☐	☐	☐	☐
Using e-TB manager has made my job easier	☐	☐	☐	☐	☐
I found e-TB manager useful in my job	☐	☐	☐	☐	☐

Acceptability - Perceived ease of use

Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree

	1	2	3	4	5
Learning to operate e-TB manager has been easy for me	☐	☐	☐	☐	☐
I found it easy to get e-TB manager to do what I want it to do	☐	☐	☐	☐	☐
My interaction with e-TB manager has been clear and understandable	☐	☐	☐	☐	☐
I found e-TB manager to be flexible to interact with	☐	☐	☐	☐	☐
I found it easy to become skillful at using e-TB manager	☐	☐	☐	☐	☐
I found e-TB manager easy to use	☐	☐	☐	☐	☐

Acceptability - Intention to use					
Please indicate your degree of agreement with each of the following statements by checking your answer using the proposed scale. 1= Strongly disagree, 2= Disagree, 3 = Neither agree nor disagree, 4 = Agree, 5 = Strongly agree					
	1	2	3	4	5
In future, I intend to continue using the e-TB manager in my job	☐	☐	☐	☐	☐
I will increase the use of e-TB manager for my job tasks	☐	☐	☐	☐	☐
I intend to recommend the use of the e-TB manager to other intervention programmes because it is useful	☐	☐	☐	☐	☐
I will not stop using the e-TB manager in my job	☐	☐	☐	☐	☐
I intend to perform task on the e-TB manager in a timely manner	☐	☐	☐	☐	☐
I intend to perform task on the e-TB manager more frequently	☐	☐	☐	☐	☐
I intend to ensure completeness of patient data on the e-TB manager	☐	☐	☐	☐	☐
I intend to ensure that patient data on the e-TB manager are provided in real time	☐	☐	☐	☐	☐

APPENDIX E - QUALITATIVE DATA COLLECTION TOOL

At the beginning of all interviews:

- Self-introduction
- Introduce study
- Interviewer talk about audio recording, anonymity and confidentiality
- Explanation of the how data will be used
- Obtain Informed Consent

Interview Date:

Interview start:

Hello [Dr/Mr/Mrs/Ms],

My name is Abdulwasiiu Ibrahim. Thank you for your interest and involvement in the study. The aim of the study is to assess the level of acceptability of the e-TB manager and the association between acceptability and determinants of e-TB user's acceptability in Oyo state, Nigeria.

These findings from this study will be summarized in a report to, the office of the National Tuberculosis and Leprosy Control Programme, the State and Federal Ministries of Health. You will not be identified you as a participant, nor will your healthcare facility be identified in any part of the report.

The interview will take about 60 minutes. Your participation in this interview is voluntary. You can stop the interview at any time, and let me know if you would rather not answer a particular question.

In order to make sure I capture all of the information you provide, your responses will be audiotaped; this recording would later be transcribed for analyses. The audio file for the recording will be uploaded to a restricted access. Is this okay with you? Do you have any questions?

We can begin once you have read and signed the consent form.

Interview Guide

Background information:

For the context of the interview, it would be helpful to know some brief information about you. Can you give me some background information about yourself? Can you tell me about a typical day working as a TBL supervisor and as a user of the e-TB manager?

Perception:

Has your job been affected by the introduction of e-TB manager? Yes / No

Probe: If yes, could you tell me what has affected your job by the introduction of e-TB manager?

Probe: how the has it affected your job by the introduction of e-TB manager?

Do you find e-TB manager useful in your job? Yes / No

Probe: If yes, what did you find useful about the e-TB manager?

Do you feel that e-TB manager has led to the desired performance expectancy on your job?

Probe: If yes, could you elaborate on this?

Do you think the e-TB manager as being a superior alternative to the paper-based system?

Yes / No

Probe: If yes, can you tell me about the advantage of using the e-TB manager over the paper-based system?

Do you feel that the e-TB manager is difficult to use? Yes / No

Probe: If yes, can you tell me about the most difficult aspect of using the e-TB manager?

Leadership:

What is the leadership style of your leader(s) with respect to e-TB manager use and implementation?

Describe the effectiveness of the leadership style.

Training:

Did you receive training in the use of the e-TB manager prior to using it? Yes / No

Probe: If yes, could you describe the type of training you were given on how to use the e-TB manager?

Probe: How long was this training?

Probe: Is there provision for continuous training?

Probe: What is your experience with this training?

Motivation:

Are you motivated to use the e-TB manager more? Yes / No

Probe: If yes, what are those things that motivate you to use the e-TB manager more?

Management and/or organisational support:

To what extent do management and/or organisational support influence the use of e-TB manger?

Problem:

Can you tell me about the problems you have encountered as a user of the e-TB manager?

Probe: How long have you had the problem?

Probe: How has it affected you in your day-to-day job tasks?

Problem reporting:

If you had a problem with the e-TB manager, how would you communicate it to the organisation?

Probe: Whom would you talk with?

Probe: Can you tell me about a scenario where you had a problem with the e-TB manger?

Probe: How was the problem resolved?

Probe: How long did it take to resolve the problem?

Facilitators:

What are some of the enablers or facilitators to the use of the e-TB manager?

Barriers:

What are some of the challenges or barriers to the use of the e-TB manager?

Success/failure of e-TB manager implementation:

In your own opinion, what determines the success of the e-TB manager?

In your own opinion, what determines the failure of the e-TB manager?

Overall experience:

What has been your experience so far in using the e-TB manager?

Based on your experience, do you think that e-TB manager is meeting the goals of the organisation?

View of the e-TB manager:

I would like to know what you thought of the e-TB manager and what you liked and disliked about it. What impact has the e-TB manager had on you, if any?

Closing:

Do you have any further questions? Thank you for participating in this interview.

Interview end time:

APPENDIX F - INFORMATION SHEET

Study Title:

THE ACCEPTABILITY OF A TB PATIENT MANAGEMENT INFORMATION SYSTEM AMONG e-TB MANAGER SUPERVISORS IN OYO STATE, NIGERIA

Greeting:

Hello Sir/Ma

Introduction:

My name is Abdulwasiiu Ibrahim. I am a post-graduate student at the School of Public Health, University of the Witwatersrand, Johannesburg, South Africa. I am conducting a study on the acceptability of a TB Patient Management Information System among e-TB Manager Supervisors in Oyo, State, Nigeria. In this study, we want to measure the acceptability of the e-TB manager among e-TB users and to explore the association between acceptability and e-TB users' acceptability determinants in Oyo state, Nigeria.

Invitation to participate:

You are being invited to take part in a research study measuring the acceptability of the e-TB manager among e-TB users and to explore the association between acceptability and e-TB users' acceptability determinants in Oyo state, Nigeria. Before you decide, it is important for you to understand why the study is being done and what it will involve. Please take time to read the following information carefully. You are free to ask me if there is anything that is not clear or if you would like more information. Please take time to decide whether or not you wish to take part in the study.

What is involved in the study?

This is a cross-sectional study design. Your participation will involve completing a self-administered questionnaire. The self-administered questionnaire will take about 15 minutes to complete. It is hoped that all the 33 e-TB users will be involved in the quantitative component of the research.

Your participation in this study is entirely voluntary. Before agreeing to participate, it is important that you read and understood the explanation of the purpose of the study.

The purpose of the information sheet is to help you decide if you would like to participate. If you have any questions, do not hesitate to ask. If you do agree to participate in completing the self-administered questionnaire, you are still free to withdraw from the study at any stage and this will not be held against you. If you decide to take part in this study, you will be asked to sign the informed consent form to confirm that you understood the study and agree to take part. You will be given a copy of the participant information sheet to keep.

Risks and Benefits:

There are no risks involved in participating in this study. The benefit of the study is that we intend to determine the factors influencing acceptance of e-TB manager and then make

recommendations to the state and federal ministries of health for action. Also, participants will be provided with the information after the results of the study are available.

The participant will be given pertinent information on the study while involved in the study and after the results are available.

Participation is voluntary, that refusal to participate will involve no penalty, and that the participant may discontinue participation at any time without penalty loss of benefits to which the participant is otherwise entitled.

Confidentiality:

All information obtained during the course of the study will be kept strictly confidential. Data that may be reported in the research report and scientific journals will not include any information that identifies you as a participant in this study. Only the researcher and supervisor will have access to the data from the questionnaire. Organisations that may inspect and/or copy the research records for quality assurance and data analysis include groups such as the Research Ethics Committee.

Contact details of the researcher:

For any further clarification and/or inquiries, please do not hesitate to contact Abdulwasiiu Ibrahim, School of Public Health, University of the Witwatersrand, South Africa.

Telephone number: +27738555071

Contact emails: 1708336@students.wits.ac.za / yemiabdulwasiiu@gmail.com

Contact details of Research Ethics Committee (REC) administrator and chair: for reporting of complaints/problems. Please contact Professor Clement Penny.

Telephone number: +27(0) 11 717 2301

Contact email: Clement.Penny@wits.ac.za

Research Office Secretariat: Faculty of Health Sciences, Phillip Tobias Building, 3rd Floor, Office 304^[11] Parktown, ^[11]Johannesburg, South Africa.

Thank you for your time.

APPENDIX G - INFORMED CONSENT FORM

Informed Consent

I hereby confirm that, I have been informed by study researcher Mr AbdulwasIU Ibrahim about the nature, conduct, benefits and risks of the study. I have also received, read and understood the participant information sheet regarding the study. I am aware that results of the study will be anonymously processed into a study report and may, at any stage without prejudice withdraw my consent and participation in the study.

I am aware that the researcher will give me a copy of the informed consent form to keep. I have had sufficient opportunity to ask questions. I declare myself prepared to participate in the study.

Participant's signature _____ Date _____

I, AbdulwasIU Ibrahim, herewith confirm that the above participant has been fully informed about the nature and conduct of the above study.

Researcher's signature _____ Date _____

APPENDIX H - AUDIO RECORDING AND TRANSCRIPTION CONSENT FORM

Audio recording and transcription consent

I hereby confirm that, I have been informed by study researcher Mr AbdulwasIU Ibrahim about the nature, conduct, benefits and risks of the study. By signing this form, I am allowing the researcher to audiotape me and transcribe the audio recording as part of this research.

Participant's signature _____ Date _____

I, AbdulwasIU Ibrahim, herewith confirm that the above participant has been fully informed about the nature and conduct of the above study.

Researcher's signature _____ Date _____

APPENDIX I: RELIABILITY SCORES OF QUESTIONS/ITEMS USED IN ALL CONSTRUCTS

Determinants of Acceptability Constructs	Abbreviation	Questionnaire item	item-test	item-rest	Alpha (Item)	Alpha (Construct)
Organisational Level (OL)	OL1	I feel e-TB manager is important to both federal and state ministries of health	0.7892	0.6173	0.5393	0.6870
	OL2	I feel e-TB manager was introduced to me effectively by the TB and Leprosy control unit	0.5721	0.3784	0.6810	
	OL3	I feel the TB and Leprosy control unit is doing a helpful job in the implementation of the e-TB manager	0.6713	0.5064	0.6290	
	OL4	I feel the TB and Leprosy control unit expects routinely use the e-TB manager	0.8783	0.5914	0.6197	
Structural Level (SL)	SL1	I feel I have close working relationship with other users of e-TB manager	0.3279	-0.0211	0.5397	0.4338
	SL2	I feel that the level of involvement of my superiors in e-TB manager implementation is enough	0.6830	0.4041	0.2215	
	SL3	I feel performance measure of the e-TB manager is collected or monitored	0.6159	0.3641	0.2945	
	SL4	I feel the information	0.6615	0.4044	0.2552	

		provided has influenced my opinion on the e- TB manager				
	SL5	I think that the TB and leprosy control unit does not have the necessary infrastructure to support my use of the e-TB manager	0.5211	0.0765	0.5203	
	PrL1	I feel I received the training required to use the e-TB manager	0.5738	0.5011	0.8461	
	PrL2	I feel e-TB manager training has made it more useful to me	0.5548	0.5030	0.8485	
	PrL3	I feel e-TB manager training has made it easier for me to use this technology	0.7211	0.6637	0.8387	
	PrL4	I feel my involvement in the e-TB manager implementation is effective	0.6512	0.5508	0.8423	
Provider Level (PrL)	PrL5	I feel my involvement in the e-TB manager implementation has made the e- TB manager more useful to me	0.7629	0.7105	0.8346	0.8550
	PrL6	I feel my involvement in the e-TB manager implementation is a must	0.4340	0.3318	0.8543	
	PrL7	I feel my involvement in the e-TB manager implementation will positively affect my attitude about e-TB manager	0.3995	0.2528	0.8652	
	PrL8	Using e-TB	0.6617	0.6092	0.8427	

Innovation Level (IL)		manager is advisable in TB management				
	PrL9	Using e-TB manager is a pleasant idea	0.6343	0.5596	0.8423	
	PrL10	I enjoy using e- TB manager	0.7155	0.6190	0.8372	
	PrL11	I am satisfied in using e-TB manager	0.7601	0.6766	0.8328	
	PrL12	I am confident that I could perform tasks on the e-TB manager	0.6905	0.6199	0.8383	
	PrL13	The decision to perform tasks on the e-TB manager is not beyond my control	0.5568	0.4156	0.8553	
	IL1	I perceive the e- TB manager as being a superior alternative to a paper-based TB patient management	0.7790	0.5369	0.4555	
	IL2	I think the process of implementing e-TB manager is complex	0.7418	0.3142	0.7220	
	IL3	I think information provided to me shows that e-TB manager is appropriate	0.7016	0.5704	0.7016	0.6280
	IL4	I think information provided to me shows that e-TB manager will work	0.6474	0.4459	0.5538	
	PaL1	Most of my patients welcome the fact that I use the e-TB manager	0.8768	0.5456	0.7629	
	PaL2	The use of the e- TB manager could help me to monitor my	0.8148	0.5108	0.6700	0.7818
Patient Level (PaL)						

		patients and patient information more rapidly				
	PaL3	The use of the e-TB manager could improve the monitoring of my patients and patient information	0.8275	0.6686	0.6900	
Acceptability Constructs	Abbreviation	Questionnaire item	item-test	item-rest	Alpha (Item)	Alpha (Construct)
	PU1	Using e-TB manager in my job has enabled me to accomplish tasks more quickly	0.7538	0.6259	0.8887	
	PU2	Using e-TB manager has improved my job performance	0.8624	0.7578	0.8622	
Perceived usefulness (PU)	PU3	Using e-TB manager has enhanced my effectiveness on the job	0.8612	0.7825	0.8561	0.8900
	PU4	Using e-TB manager has made my job easier	0.8984	0.8235	0.8440	
	PU5	I found e-TB manager useful in my job	0.7958	0.6955	0.8752	
	PEU1	Learning to operate e-TB manager has been easy for me	0.7274	0.6237	0.8718	
	PEU2	I found it easy to get e-TB manager to do what I want it to do	0.7841	0.6516	0.8717	
Perceived ease of use (PEU)	PEU3	My interaction with e-TB manager has been clear and understandable	0.8801	0.7986	0.8423	0.8813
	PEU4	I found e-TB manager to be flexible to interact	0.7641	0.6543	0.8667	

Intention use (IU)	to	PEU5	with I found it easy to become skillful at using e-TB manager	0.7677	0.6997	0.8679	0.8872
		PEU6	I found e-TB manager easy to use	0.8771	0.8101	0.8403	
		IU1	In future, I intend to continue using the e-TB manager in my job	0.8696	0.8072	0.8566	
		IU2	I will increase the use of e-TB manager for my job tasks	0.8487	0.7831	0.8596	
		IU3	I intend to recommend the use of the e-TB manager to other intervention programmes because it is useful	0.7534	0.6909	0.8732	
		IU4	I will not stop using the e-TB manager in my job	0.7774	0.6913	0.8697	
		IU5	I intend to perform task on the e-TB manager in a timely manner	0.8135	0.7191	0.8687	
		IU6	I intend to perform task on the e-TB manager more frequently	0.9002	0.8611	0.8530	
		IU7	I intend to ensure completeness of patient data on the e-TB manager	0.4875	0.3705	0.8969	
		IU8	I intend to ensure that patient data on the e-TB manager are provided in real time	0.4725	0.3677	0.8960	

APPENDIX J: RELIABILITY TEST FOR THE FINAL SELECTED ITEMS OF THE CONSTRUCTS

Construct	Number of items	Alpha
OL	4	0.69
SL	3	0.61
PrL	10	0.84
IL	3	0.72
PaL	3	0.78
PU	5	0.89
PEU	6	0.88
IU	6	0.86

APPENDIX K: FREQUENCY DISTRIBUTION OF ITEMS USE FOR THE CONSTRUCTS

Item	Strongly disagree	Disagree	Neither disagree or agree	Agree	Strongly agree	Total	Missing
Organisational Level							
OL1	0	1	0	10	22	33	0
OL2	0	0	0	17	16	33	0
OL3	0	0	0	15	18	33	0
OL4	2	2	0	13	16	33	0
Structural Level							
SL1	3	0	4	17	9	33	0
SL2	2	8	5	15	3	33	0
SL3	1	3	4	18	7	33	0
SL4	1	4	2	17	9	33	0
SL5	4	6	2	12	8	32	1
Provider Level							
PrL1	0	1	0	16	16	33	0
PrL2	0	0	0	21	11	32	1
PrL3	0	1	1	20	11	33	0
PrL4	1	3	3	16	9	32	1
PrL5	0	1	2	15	15	33	0
PrL6	0	2	1	17	12	32	1
PrL7	1	4	1	16	11	33	0
PrL8	0	0	1	14	18	33	0
PrL9	0	1	2	14	16	33	0
PrL10	1	5	4	14	9	33	0
PrL11	0	7	6	12	8	33	0
PrL12	0	2	2	17	12	33	0
PrL13	2	3	2	15	11	33	0
Innovation Level							
IL1	1	2	2	15	13	33	0
IL2	5	11	1	12	4	33	0
IL3	0	0	1	20	12	33	0
IL4	0	1	1	16	15	33	0
Patient Level							
PaL1	2	3	12	12	3	32	1
PaL2	1	0	2	13	17	33	0
PaL3	0	1	1	15	15	32	1
Perceived usefulness							
PU1	0	1	5	17	10	33	0
PU2	0	3	3	14	13	33	0
PU3	0	1	3	16	13	33	0
PU4	0	2	4	13	14	33	0
PU5	0	1	2	18	12	33	0

**Perceived ease
of use**

PEU1	0	2	4	20	7	33	0
PEU2	1	4	4	15	9	33	0
PEU3	1	3	5	13	11	33	0
PEU4	0	4	4	19	6	33	0
PEU5	0	1	1	24	7	33	0
PEU6	0	3	3	15	12	33	0

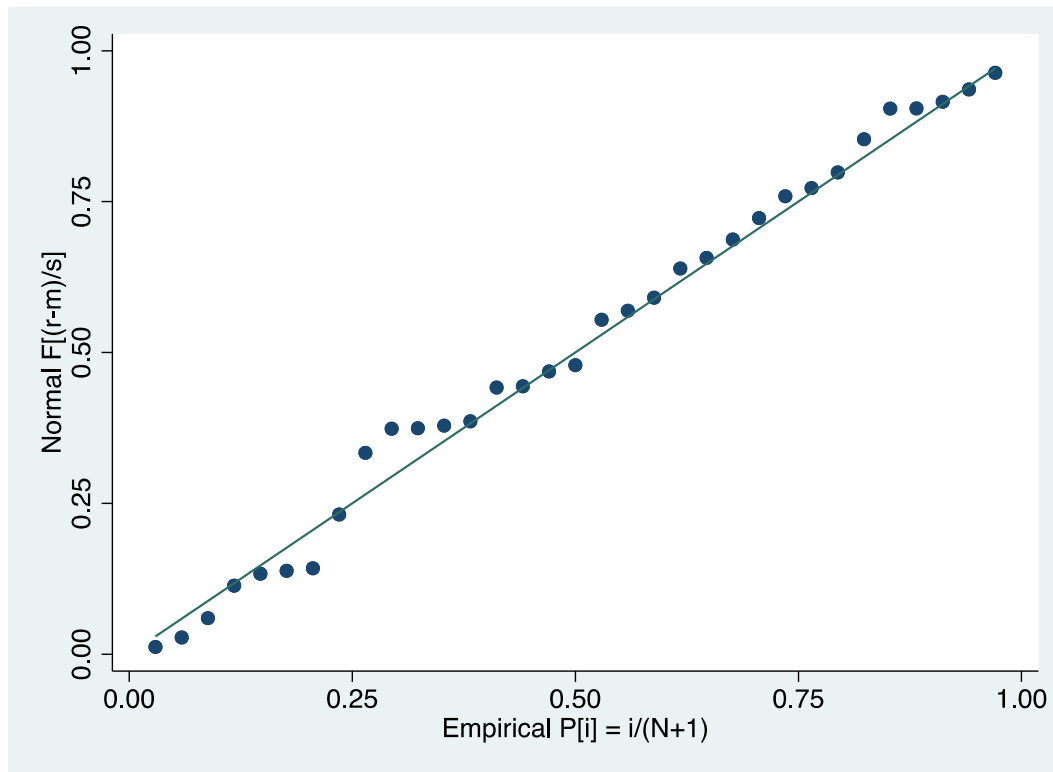
**Intention to
use**

IU1	1	0	0	16	16	33	0
IU2	1	0	0	22	10	33	0
IU3	0	0	0	15	18	33	0
IU4	0	1	1	13	18	33	0
IU5	1	1	0	19	12	33	0
IU6	0	1	0	17	15	33	0
IU7	0	0	1	16	16	33	0
IU8	0	0	0	19	14	33	0

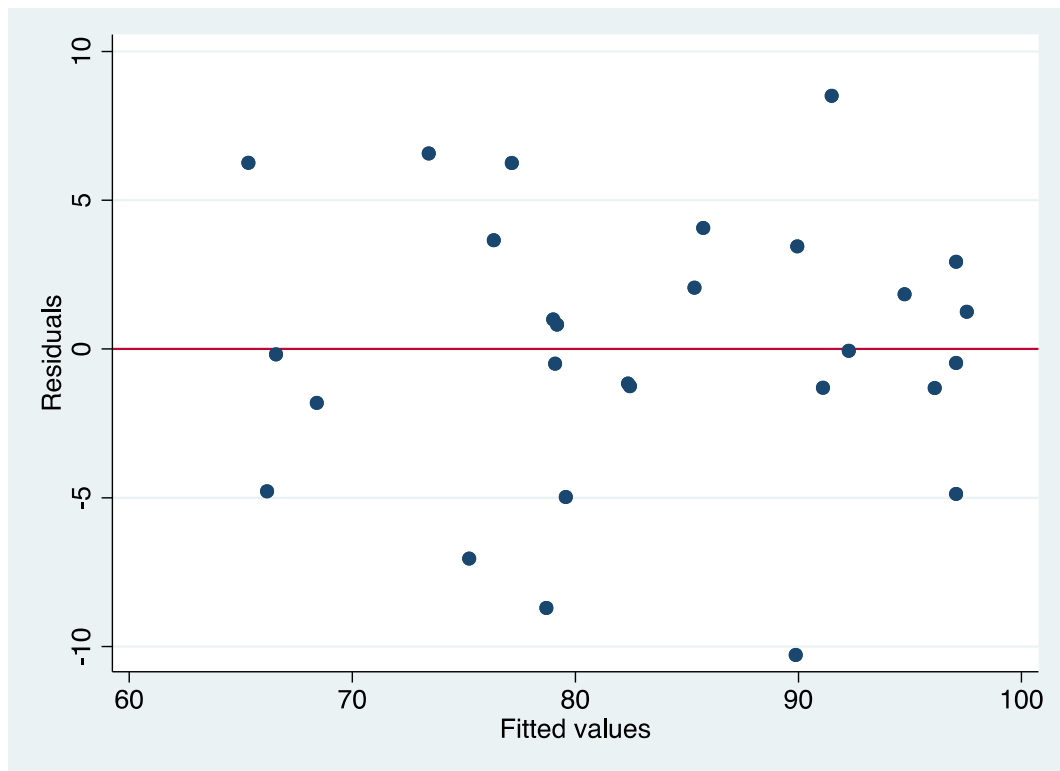
APPENDIX L: DESCRIPTIVE STATISTICS OF SCORES

	Mean	SD	Minimum	Maximum
Acceptability score	4.16	0.55	3.07	5.00
Organisational score	4.45	0.53	2.75	5.00
Structural score	3.65	0.78	2.00	5.00
Provider score	4.17	0.53	3.00	5.00
Innovation score	4.27	0.62	3.00	5.00
Patient score	4.03	0.74	1.67	5.00

APPENDIX M: NORMAL PROBABILITY (P-P) PLOT



APPENDIX N: RESIDUALS VS FITTED PLOT



APPENDIX O: TURNITIN REPORT

