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# **The impact of an Information Management System on healthcare service delivery in South Africa**

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## DEFINITION OF KEY CONCEPTS

<b>Abbreviation</b>	<b>Meaning</b>
CA	Clinical Associates
DRSM	Dr Ruth Segomotsi Mompoti
HER	Electronic Health Record
EMR	Electronic Medical Record
IOM	Institute of Medicine
IT	Information Technology
JMM	Joe Morolong Memorial
LIMS	Laboratory information management system
NHLS	National Health Laboratory Services
PAAB	Public and Administration Billing
PMR	Patient Medical Record

## ABSTRACT

The purpose of this study was to explore the impact of information management systems (IMS) on healthcare service delivery in the Dr RSM district of the NWP in South Africa. A quantitative positivist approach was adopted as a research paradigm. The overall research methodology used was a quantitative method and a survey method as the design genre was followed. Data were collected from stratified random sampled respondents by means of self-administered structured questionnaires. Overall, a total sample size of 150 respondents took part in the study. The data analysis in the study involved the use of reliability analysis, descriptive statistical analysis and exploratory factor analysis with the aid of a quantitative data analysis software, SPSS version 25. Among the key findings of the study was that the operational behaviours of IMS (TrackCare in this case) are characterized by unfavourable facets such as data inconsistency, and inaccuracy, among others, which negatively impact on improved healthcare service delivery. The main conclusion drawn from this study was that implementation of an information management system can negatively effect on healthcare service delivery due to some unfavourable system operational behaviours like difficulties in data interpretation, accessibility and identification coupled with personnel, administrators and management staff who are ill-equipped and have less IT skills resulting in inefficient and underuse of the IMS. A key recommendation from the study is that unless health personnel, administrators and management staff are fully equipped by properly orienting, training and properly educating themselves with the operational behaviours of the IMS, the merits associated with the use of IMS in medical health record-keeping will never be fully realized.

**Keywords:** Healthcare service delivery, inconsistent data, task technology fit theory.

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## CHAPTER 1: INTRODUCTION AND BACKGROUND TO THE STUDY

### 1.1 INTRODUCTION

Electronic health (e-health) services have permeated many countries. The adoption of ICT into the health system has been welcomed by many states with promises that it will improve the quality of health care and efficacy in the way the data is kept and disseminated. However, the promises are diminishing due to incompatible information system of health care in South Africa. In order to be at par with other countries, South Africa adopted ICT in the health delivery system which is referred to as e-health (Alberts, *et al.*, 2014). The introduction of e-health was seen as a new dawn in solving the problems that were haunting the health delivery system. Donomichiello (2015) and Tavares (2018) argue that e-health improves the quality of health delivery system by offering a safer health system which is efficient and easily accessible to patients. The introduction of the information management system on healthcare offers an opportunity for the improvement on access to diagnostic services, by the removal of the distance between service providers and patients (Tavares, 2018).

Bowman *et al.* (2013) and Siting and Singh (2013) argue that despite the benefits associated with the introduction of the electronic health record systems, there is a body of growing evidence that indicates the potential safety hazards associated with their use, which is sometimes referred to as “e-iatrogenesis”. Siting and Singh (2013) including Bowman *et al.* (2013) elucidated on the errors related to the Health Information Technology (HIT) by mentioning that data are being lost or incorrectly entered, displayed or transmitted. When HIT interacts with another system component incorrectly, the decisions that result from it as a result of the errors make the integrity of information to be lost. What is baffling is, the lack of data quantifying the extent of risks due to HIT. Due to the lack of that data, it may mean that HIT-Induced medical error, harm or death have increased significantly (Bowman *et al.*, 2013).

This study contributes to the few studies done on the impact of HIT on health outcomes in South Africa and in Taung in particular where the HIT was introduced. The National Health Laboratory Service (NHLS) implemented a Web-based portal

(TrakCare) which enables laboratory results such as HIV, CD4 counts, Viral loads, Creatinine and Tuberculosis to be sent via cell phones and SMS machines for improved Turn-around-Times (NHLS National Strategic Plan on HIV, STDs and TB 2012 – 2016, page 15). Hence, there is coordination between the hospital and other services providers like the laboratory. That implies that patients can now easily access their medical results from the laboratory. Before the introduction of HIT, in some instances, patients' results were delayed, had errors or not delivered at all. Some patients' results could not be accessed remotely until a hard copy was delivered to the facility. Therefore, the study seeks to investigate the impact such errors or delays have on the patients.

## **1.2 BACKGROUND**

Masilela *et al* (2014) posit that South Africa's adoption of e-health was a global trend which was spearheaded by the United Nations and its agencies such as WHO. As an African state, South Africa had to abide by the resolution made by the Regional Committee for Africa in 2010. The resolution urged member states to build e-health infrastructure, train manpower on e-health and provide monitoring and evaluation systems on e-health (Masilela *et al*, 2014). After the attainment of democracy in 1994, South Africa was eager to transform the health sector. On transforming the national healthcare, the government had to embrace technology in the health delivery system through the promulgation of the National Health Act 61 of 2003 and the introduction of the e-health Strategy South Africa 2012 -2017 (Katu, 2016; Republic of South Africa Department of Health, 2015; Republic of South Africa Department of Health, 2012). One of the aspects highlighted in the e-health strategy is the adoption of electronic document and records management systems (EDRMS) in the health institutions (Republic of South Africa Department of Health, 2012).

In support of the government's vision of adopting the system of management of electronic document and records, the National Health Laboratory Service (NHLS) which is the largest diagnostic pathology laboratory service in South Africa, implemented InterSystems' TrakCare Laboratory Information System (LIS) across all of its 349 laboratories in all 9 provinces in South Africa. This laid the base for other healthcare and state-owned entities (SOEs) to implement a single, integrated e-health platform to manage patient results (Hlabangane, 2016). According to Isfahani

*et al.* (2014), LIS is described as a computer application used in management and data storage within the healthcare professional fraternity as part of the daily healthcare routines. Khajouei *et al.* (2014) further explain that this system is relevant and fit for purpose for automation of applicable laboratory procedures, for handling and controlling of test samples, for reporting test results in line with the requirements from the clinicians.

CSIR (2015) argues that the NHLS provides their service to almost more than 80% of the population in South Africa. Within the area of this study, Statistics South Africa (2016) affirms that NHLS serves approximately 105 villages in the Greater Taung Local Municipality and these communities receive health-related services from 29 clinics and one district hospital covering a population of approximately 167 827 people. The study has found that most of the clinics are located far apart from the NHLS central laboratory which is located in the district hospital yard with the furthest clinic being 96km away. The laboratory has a dedicated courier facility which regularly and reliably delivers pathology reports to different clinics.

For administration and billing, NHLS makes use of TrakCare whilst the public hospitals make use of Public administration and Billing (PAAB) information management system. Both information systems operate independently from one another.

Concerning the transcription of information from the patient file onto the patient form for the laboratory tests, the district hospital is responsible for manual capturing the patient's details. In return, NHLS is responsible for data capturing into the laboratory IMS, TrakCare. If and when there are discrepancies experienced on the receipt of the hospital information when compared against the database information from the laboratory, these transcription errors have a potential to render the laboratory reports unreliable and therefore they could delay medical treatment.

### **1.3 PROBLEM STATEMENT**

Hospitals in South Africa use PAAB system whilst the NHLS makes use of TrakCare. The two systems are used for processing and disseminating the samples as well as analysing and producing the results that must be given to the patients. Due to the stand-alone operation of the PAAB and TrakCare systems, there are evident

transcription errors from manual data input entries however the extent of the impact of the transcription errors have not yet been explored.

Despite the promises emanating from the Trakcare laboratory information system, it is associated with errors due to ineffective, inefficient or mismanagement of patient information or samples between the hospital information systems (PAAB) and the Trakcare Laboratory Information System (LIM). The weaknesses of the Trakcare are highlighted by NHFL (2018) in their annual report of 2017/ 2018. This report states that between April 2016 and December 2016, the results of the proficiency testing schemes (PTS) of NHLS conducted externally for quality assessment (EQA) were rated at 91% from a total of 84% of laboratories achieving a performance score of more than 80%. The 2017/2018 annual report on the quality management system for NHLS states that the overall performance of NHLS regressed with 2% from 84% to 82% between 2015/2016 and 2016/2017 financial years. These results indicate that their system is not squarely perfect although they are using a technology-driven approach. In the report, NHLS stated they are in the process of upgrading their infrastructure which is obsolete and aged (NHLS, 2018).

A descriptive-analytical study that was conducted cross-sectionally from June to May 2011 in Iran concurs with other studies that indicate that LIMs are unreliable. The study was carried by Khajouei, Jahanbakhsh and Mirmohamadi. According to Khajouei *et al* (2014), the research population consisted of all LIMs in use in the 18 teaching and private hospitals in Isfahan (13 teachings and five private hospitals). On this study, they evaluated the hospital laboratory IMS constructed on the standards of the American National Standard Institute. According to Khajouei *et al* (2014), the results of this study suggest that conformity of the LIMs in the study is relatively low with a comparison drawn between academic and teaching hospitals. Given the low standard of LIMs, they pose danger to the patients' life causing more harm or even death.

Bowman *et al* (2013) concur with other studies on the ineffectiveness of LIMs. They argue that there are safety hazards as a result of their use. This is further supported by Sitting and Singh (2011) who assert that patient diagnostic outcomes are often jeopardised by Health Information Technology errors, and these often occur as a

result of latent errors that are noticeable at the “blunt end” of the health care system, potentially affecting large numbers of patients if not hastily corrected.

Alberts *et al* (2014) argue that mainly errors emanate from erroneous or incomplete design specifications, unreliable hardware or software platforms, programming errors or bugs and the way medical doctors perform their duties daily. These can introduce new potential fiascos. Bowman *et al* (2013), recommended that to minimise the errors, safer organizational cultures and practices should be developed so to include appropriate training users procedures, establishing a conducive working environment, and ensuring that the decision support systems are appropriate for the clinical tasks for which it is being used. It is, therefore, in this light that this study wishes to investigate the impact of information management systems on healthcare service delivery in South African hospitals within the North West Province (NWP) in Dr Ruth Segomotsi Mompati (Dr RSM) district.

#### **1.4 RESEARCH OBJECTIVES**

This study aims to explore the impact of information management systems (IMS) on healthcare service delivery in Dr RSM district of the NWP in South Africa. In the pursuit to this aim, the three objectives formulated are:

- To examine how IMS adoption impacts on healthcare service delivery in the Dr RSM district hospitals of the NWP.
- To investigate the extent to which improved healthcare service delivery in hospitals in Dr RSM district of NWP depends on the IMS operational behaviours.
- To examine whether the adoption of IMS promotes improved healthcare service delivery in Dr RSM district of NWP.

#### **1.5 RESEARCH QUESTIONS**

The study was guided by the following research questions:

- What is the impact of the adoption of IMS on healthcare service delivery in the hospitals in Dr RSM district?
- How do the operational behaviours of IMS contribute to improved healthcare service in hospitals in Dr RSM district of NWP?

- To what extent does the adoption of IMS in Dr RSM district of NWP promote improved healthcare service delivery.

## **1.6 THEORETICAL FRAMEWORK AND BRIEF LITERATURE REVIEW**

The foundation of any study is a comprehensive literature review, which is a thorough examination of previously conducted research work by others on healthcare (e-health) management information systems (Okeke & Van Wyk, 2016: 133). Central to this study is to investigate the impact of information management systems on healthcare service delivery in South African hospitals within the North West Province (NWP) in the Dr Ruth Segomotsi Mompati district. The study starts by reviewing research work done globally and nationally.

### **1.6.1 Theoretical Framework**

This study is guided by the Task -Technology Fit (TTF) theory, which posits that information technology (IT) is more likely to increase individual performance and can be used if the capabilities of the IT match the tasks that the user must perform (Goodhue & Thompson, 1995, in Kilmon, 2008). A measure of task-technology fit theory was developed by Goodhue and Thompson (1995) and consisted of eight (8) factors of quality, capability, authorization, compatibility, ease of use/training, production timeliness, systems reliability, and relationship with users (Cane et al, 2010).



### **1.6.2 Task -Technology Fit (TTF) theory**

Goodhue (1995) in Kilmon et al (2008:198) define Task technology fit (TTF) as the degree to which technology assists an individual in performing his or her portfolio of tasks. Similarly, Tariq and Akter (2011) define TTF theory as the extent to which the introduction of information technology impacts users in performing some tasks and how technology fits well with these tasks. The task-technology-fit model (TTF), in addition to taking into account the technology and user, considers the complexity of the clinical tasks which have to be supported by an IT system.

## **1.7 RESEARCH DESIGN AND METHODOLOGY**

A research methodology is a defined structure within which the study is undertaken to realize results (Grove *et al*, 2013:195). Schwardt (2007:195) defines research

methodology as a theory of how an inquiry should proceed. On the other hand, a research design is a strategic framework that has been created to answer research questions and the implementation of the research strategy (Durrheim, 2004:29). A paradigm is a basic belief system (worldview) that guides the investigator in choosing a method for carrying out a study in ontological and epistemological fundamental ways (Guba & Lincoln, 2010). In this study, a quantitative positivist approach was followed as inspired by insights from Aliyu *et al* (2014)'s assertion that a positivist research paradigm allows the researcher to scientifically and empirically study and observe genuine, real and factual happenings. An explanatory research design in which a survey design genre was used followed Creswell (2013) who asserts that a survey permits the researcher to critic behaviour and presents the outcome accurately. Details of the research design and methodology used in the study are given in chapter 3 of this dissertation.

### **1.7.1 Population and Sampling**

A population is a set of common elements that have common predetermined characteristics concerning some research problems (Creswell, 2013). In this study, the target population consisted of all categories of medical doctors, qualified nurses and specialist doctors who have been working as medical doctors for more than 1 calendar month in all hospitals in South Africa. On the other hand, Grove *et al* (2013:37) define sampling as a process involving the selection of a group of people or participants, events, behaviour or other elements involved in a study. In this case, it is a process of choosing participants or respondents to represent the whole population so that inferences or conclusions about the whole population can be made (Polit & Beck, 2012:275). There are two main different types of sampling designs which are non-probability and probability sampling designs. Probability sampling design uses probability theory to randomly select population elements and, on the other hand, in non-probability sampling design, population elements are not selected randomly (Creswell *et al*, 2016). One district (Dr RSM district) was conveniently sampled (non-probability sampling) from the target population. The stratified random sampling design was implemented to choose a true representative of the population (Plooy-Cilliers *et al* 2014:135) and capture key population characteristics in the sample. Doctors and clinical associates were taken as the first (Stratum 1) participants and nurses as the second homogeneous group of

participants (stratum 2). The two strata consist of hospital personnel who have worked for more than one (1) calendar month in the hospitals in Dr RSM district. Details of the sampling procedure are in chapter 3 of this mini– dissertation.

### **1.7.2 Data Collection Methods**

According to Polit and Beck (2012:175), the gathering of information to address a research problem is called data collection. For this study, a structured self-administered questionnaire (Appendix II), with three sections A, B and C with closed-ended questions was administered to medical doctors, professional nurses, medical specialists and Clinical Associates (CA) in Dr RSM district. Participants in this study were given 25 minutes to independently complete the questionnaire.

### **1.7.3 Data Analysis**

After data collection using self-administered questionnaires, the researcher scored (coded) the data from closed-ended questions which implies assigning scores to responses (Creswell, 2005). The assigned scores generated quantitative data and were then captured in SPSS 25.0 statistical software. Before data analysis was done, the researcher cleaned the data and accounted for missing data in the data collection instruments. Missing data can be a result of non-response by respondents to some sections of the questions in the instrument. Data cleaning is a process of checking whether all scores in the spreadsheet are within the accepted range in the codebook (Creswell, 2014). This was done by constructing frequency distributions using the Microsoft Excel or SPSS 25.0 software. Trial runs of data validation were done by checking whether entries correspond with items and sub-items in the questionnaire. The identified discrepancies were dealt with by consulting the original questionnaires and corrections made before actual analysis (Creswell, 2005:180-181). Inferential statistical data analysis procedures, Reliability analysis, exploratory factor analysis (EFA) and descriptive statistical analysis were used in this study. Details of data the analysis procedure are outlined in chapter 3 and analysis results are presented in chapter 4 in this mini – dissertation.

## **1.8 SIGNIFICANCE OF THE STUDY**

Like other countries, the adoption of ICT (e-health) into the South African health system is welcomed and seen as a new dawn in solving the problems that were haunting the health delivery system. However, the expectations from this introduction are diminishing due to the unfavourable behaviours of the management information system during the processing of information (Alberts, *et al*, 2014). There is a need to investigate how does the adoption of this e-health systems contribute to service delivery endeavours. Donomichiello (2015) and Tavares (2018) argue that e-health improves the quality of health delivery system by offering a safer health system which is efficient and easily accessible to patients. Besides, Tavares, 2018, argues that the implementation of IMS on healthcare may significantly improve access to diagnostic services by the removal of the distance between service providers and patients. It is, however, noticed that there is very little reported literature on the impact of an information management system on healthcare service delivery in South Africa, North West Province in particular. This study will highlight the dangers of the manual input of patients' information from one system (PAAB) to TrakCare information system. It will also inform the need to implement a complete electronic system in order to avoid these dangers. This study will influence the policy that guides healthcare management information systems in South Africa and contribute to the growing body of literature on the impact of adopting IMS (e-health) in health care services delivery.

## **1.9 ETHICAL CONSIDERATIONS**

The need by the researcher to ensure that no harm (physical or psychological) occurs to participants, community or society involved in the research study (APA, 2009) is called ethical considerations. Ethical principles were adhered to by applying and getting ethics approval certificate from the NWU Ethics clearance committee. Also, a letter was written to the department of health to request for permission to survey the sampled hospitals in NWP and the permission was granted. Informed consent copies were attached to questionnaires informing the participants of the confidentiality and privacy of the information that they give to the researcher. Pseudonyms were used in the analysis and results reporting to ensure the privacy of participants in the study. According to Burns and Grove (2009:195), individuals are entitled to determine under what circumstances should personal

information be shared or withheld from others. Finally, people involved in this study are entitled to be protected from harm and discomfort (non-maleficence) at all cost (Botma *et al*, 2010:20). The researcher ensured that there was no harm to the participants in the research and they voluntarily participate fully aware of the risks involved in the study. Whatever information they gave was treated as confidential information. Comments and opinions from this enquiry were identified with pseudonyms.

### **1.10 MEASURES TO ENSURE RELIABILITY AND VALIDITY**

To check the feasibility of the study, study cost and reliability of the data collection instruments, a pilot study was used as a preliminary study and statistical variability and reliability were tested before implementing a full-scale research project (Okeke & Van Wyk, 2016). Detailed theoretical definitions, background and procedures for implementing measures to ensure reliability and validity are presented and discussed in chapter 3.

### **1.11 CHAPTER ORGANISATION**

The mini-dissertation is organised into five chapters with the following headings;

- Introduction and background to the study;
- Literature review and theoretical background;
- Research design and methodology;
- Data analysis results, interpretation and discussions; and
- Summary of major findings, conclusions and recommendations.

Brief descriptions of what constitutes each of the chapters are given below;

#### **Chapter 1: Introduction and Background to the Study**

- The general outline of what was done in the study was given. The chapter gave a brief description of the research design, data collection, data processing and analysis methods that were used. A brief explanation of the target population and sampling procedures, sample and research instruments used in the study was also outlined in brief.

#### **Chapter 2: Literature review and theoretical background**

- A comprehensive literature review (studies did globally and nationally) is given in this chapter and a thorough account of the theory that guides the study are given in this chapter.

### **Chapter 3: Research design and methodology**

- Descriptions of research paradigms, research design and methodology, data collection methods and data collection instruments are undertaken in this chapter. Details of the target population and how it was chosen are outlined in this chapter. Sampling designs, sample size, data collection, validation and statistical data analysis procedures used in the research are also discussed in this chapter.

### **Chapter 4: Data analysis results, interpretation and discussions**

- This chapter presents quantitative data coding, cleaning, validation and statistical analyses and results. Also, a summary of the quantitative analysis of results is given.

### **Chapter 5: Major findings, discussions, conclusions and recommendations**

- A summary of the major findings is presented. Also, conclusions and recommendations are presented in this chapter.

## **1.12 SUMMARY**

This chapter dealt with the following aspects; background to the study, problem statement, aims and objectives, research questions, research hypothesis, theoretical framework, brief literature review, research design and methodology, population and sampling, data collection, management and analysis methods, the significance of the study, ethical considerations, measures to ensure reliability and validity of the study and lastly chapter organization. The next chapter deals with the literature review and the theoretical framework of the study.

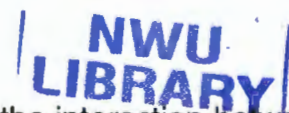
The chapter highlighted the information management system errors giving rise to the problem statement from once the patient is registered in the PAAB system until the laboratory reports (TrakCare) are issued. The errors were also identified by previous

academic researchers but the impact never assessed and reported. The chapter underlined problems caused by bridging the PAAB system and Trakcare with a manual input capturing of the same into the TrakCare LIMS.



other theories developed which only focused on the impact of the individual and technology, in this model Goodhue (1995) as cited in Ammenwerth et al (2006) considered the complexity that the clinical task possesses which thus needs attention from an IT system. In detail, individual abilities, characteristics of technology and task have a great impact on the performance of an IT system. TTF also stretches other models and theories as it concentrates on the fit and elements of a clinical task, for example, complexity, orientation of task and overlapping of tasks which need to be addressed by Information Technology (Goodhue, 1998).

In recent developments, TTF has been used to evaluate the adoption of IT system based on mobiles in different sectors which include mobile banking systems and mobile location system (Lee et al., 2007; Zhou et al., 2010; Junglas et al, 2008). This research has commenced by allocating factors influencing TTF theory in mobile health (mHealth) to come up with concepts of a TTF. Sertic et al (2019:8) state that the World Health Organization (WHO), in collaboration with the Global Observatory for eHealth, has defined mHealth as "*medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices*". Sertic et al (2019:8), further state that mHealth is considered to be a component of eHealth that refers to health services and information delivered or enhanced through the use of the Internet and other forms of technologies.



Ammenwerth et al (2006), argue that TTF tends to leave out the interaction between users and tasks which is of great importance for the introduction of IT projects, for example, failure of projects due to lack of motivation from the nurses as there is a lot of documentation at the beginning. Also lack motivation from the physicians to make an entry of order instead of assigning a nurse to do so because of more additional time to them (Ammenwerth et al, 2006)

Fit and interaction can change as user task attributes and technology frequently change in clinical environments (Ammenwerth et al, 2006). However, this idea of fit has been also highlighted in studies such as the one by Folz-Murphy (1998) who detailed the fit problems between IT functionality and individual requirements. Zigurs (2000) studied the group system support of the fit between technology and task. Dishaw, et al, (2002) constructed a computer self-efficacy which extended the TTF

combined with TAM. This model by Dishaw et al (2002) indicated the relation between user attributes and task. Ammenwerth et al (2006) proved that adoption of the electronic record management depends on the individual aspects such as attitude, motivation and fear to use the IT system. Also included are technological attributes such as perceive of use, performance, and hospital tasks such as how complex the task is. Through using the FITT framework ("Fit between Individuals, Task and Technology"), the functionality of a system was analysed.

Rai et al. (2002) suggested that TTF is the best model for researches related to mHealth in predicting the behavioural model of information systems in the remote and rural areas. To deal with issues on health care in remote rural areas, a need to contextualize TTF constructs is required. Contextualization should give a complete picture of the health care (Chiasson & Davidson, 2004) system. Wills et al (2012) assert that TTF can be adapted and extended to the health care and clinical reasoning. TTF showed the impact of Electronic Health Records on Clinical reasoning where a pleasing fit between model and data was shown from the analysis. TTF can be adapted to the new modern technology (Wills et al, 2012). The vital aspect of TTF is its capacity to determine the performance of a system in comparison to the Technology Acceptance Model (TAM), (Davis, 1989).

## **2.2 RECORD KEEPING FRAMEWORKS AND MEDICAL HEALTH SERVICE DELIVERY**

Health record administration aims at improving quality, genuineness and data security both in paper and electronically (Akinboade *et al*, 2012). Chodzaza and Gombachika (2013) assert that numerous hospitals are incorporating ICT into health record administration as a result of the high level of deficiencies of manual health records such as misfiling of patients' health records, huge amounts of space, neatness of clinicians' penmanship, exchange of therapeutic records or records from one division to the other which need the association of more faculty. Research by Acquash-Swanzy (2015) found out that the use of an electronic health information system significantly decreases errors and lost records, work, consumption on paper co-ordinations and recovery of stole away bills. On the other hand, Fernandez-Aleman *et al*. (2013) highlighted some benefits of Electronic Health Records (EHRs)

as reduction in costs, improved quality care, promotion of evidence-based medicine and good record-keeping method and mobility.

Despite the benefits of ICT in health contexts, The Institute of Safe Medication (2000) detailed a calculated 39% in pharmaceutical error due to eligibility of 13 written by hand prescriptions. In another study done by DesRoches et al. (2015), it was found out that as much as 97% of the users had the opinion that electronic health records take much longer time to be executed while 82% said that electronic health records emphatically impacts on the quality of clinical decisions.

Cline and Luiz (2013) argue that the worth of automated IMS in the South African healthcare base is not understood as less investment in information technology is reflected. However, the sluggish development of consideration in IT investment was imminent to have improved capacity and resource utilisation. Nevertheless, healthcare workers continued with the old paper-based record despite the evidence shown in the improved efficiency revealed by EHRs system. When information technology (IT) was introduced in these hospitals within the study area conducted by Line and Luiz (2013), it was discovered that clinicians experienced increased workload as a result of their slowed adaptation to the new IT processes. Cline and Luiz (2013:6) further found that almost 75% of the administrative and nursing staff supported the introduction of the IT process into the healthcare system. It was believed it is secure and confidential whereas 58% of medical doctors have a different view. The Inkosi Albert Luthuli hospital showed that 86% of respondents who held awareness that patients' waiting times for doctors improved, and 66% of respondents in Sebokeng hospital concurred with them.

### **2.3 CHALLENGES ON USAGE OF ELECTRONIC MEDICAL RECORD (EMR)**

EMR system is a computerised system that stores all patient details and medical records including patients' demographics, encounter summaries, medical history, laboratory test and allergies (Ludwick and Doucette, 2009:24). Conversely, Electronic Health Record (EHR) is an information management system with Electronic Medical Records (EMR) that may be used comprehensively for automated medical alerts, medical appointments and reminders (Sumbi, 2016:1). The researcher differentiated Electronic Health Record (EHR) and Electronic Medical

Record (EMR) in that EHR collects the patient's health record from birth to death whereas EMR can do all and manipulate data for use by the healthcare workers and supports the capabilities to share medical information data between medical healthcare providers (Zahabi *et al*, 2015:805).

### **2.3.1 Incompatibility of EMR systems**

The EMR system is intended to depict data that precisely reflect the patient state of health at all time. The system moderates the duplication of patient's data and files thereby consolidating information in one for use in comprehensive health care management. The system allows for retrieval of the patients' records as a dashboard by ensuring that accurate data is both appropriate and legible. The retrieval of the patient's previous records is used to assess possible trends and long-term medical changes in the patient's health (Habib, 2010).

Sumbi (2016:24) found, in a case study conducted in the coast general hospital at Strathmore University, that the majority of nurses, health records officers, doctors, laboratory technologists and administrators have no EMR system in use in their daily activities. Only the pharmacy had an EMR system used in prescribing medication. A higher percentage of the EMR system users in the pharmacy were found to be within the age group of 18-35 years with the least users to be between the age of 44-51 and 52-60 years.

This finding confirms the incomplete patient health information caused by patient health records existing in silos. The incompatibility of the systems in practice impedes sharing of patients' health information and therefore debilitates comprehensive health care provision by health care workers. The flaws created by the incomplete EMR records are detrimental to the healthcare management system as not all of the patient's health information will be incorporated in the relevant prescription of the patient health management. It has been found in several published case studies that patient overdose existed as a result of flaws in EMRs system interface design and errors (Zahabi *et al.*, 2015:806). These errors pose a safety risk in the use of EMRs for healthcare management and health information sharing.

The study conducted by Shamliyan, Duval, Du and Kane (2008:47) on the use of information systems in healthcare management infers that the computerised

physician order entry system had a substantial reduction of medical errors. It was, however, found that the effects of the use of EMRs are not consistent among patient populations and clinical settings. The bias was found to be that the study included results from the academic centres only and that there may have been a different outcome from a non-academic setting.

### **2.3.2 Management skills from administrators, policymakers and funders.**

To achieve quality, management should be very effective from the administrators, policy deciders, and the sponsors as well (Andreassen *et al*, 2015). It is noted from many studies that public hospitals suffer from good management from nurses, physicians and managers (Frimpong, *et al*, 2016). Verbeke *et al* (2013) cited that in the most public hospital there were some flawed criteria in choosing the managers and other professionals at these hospitals. However, measures and objectives have been implemented as for now, but there is no guarantee that there will be changes. In some parts of Kenya, a mobile-based health delivery service was introduced to provide services through the World Wide Web (Housego & O'Brien, 2012). According to Ahmad (2014), weak financial knowledge, fewer skills, corruption and IT inefficiency led to ineffective and inefficient health service delivery system regardless of it being accepted on its introduction stage.

### **2.3.3 Avoidance of the EMR system by physicians**

According to a study done by Roberts *et al* (2016) on avoidance of electronic medical record (EMR) system by physicians, resistance from physicians is at its lowest when there is a strong capacity of information to be used again in the future. Also, resistance is high in urgent care scenarios. In other words, resistance depends on how serious the diagnosis is and how long the patient requires medication. Sparks *et al* (2004) noted that there is no uniformity in a person's mood, intention and conduct between people who encounter ambivalence. Therefore, supervisors who target stability and regularity from their co-workers should boost the pleasing features of the system and decrease the negative features by making the required modifications. This can be achieved by making certain changes needed to reach people's demands and simplifying EMR systems. Making the required adjustments can improve the adaptation of ICT in health sectors.

One of the difficulties faced by the health care professional is the lack of ability to move with the continuously changing technology. This may lead to disruption of the

administration due to trust issues and tensions between the head and junior management (Tey & Lai, 2013). Only dedication and commitment from the senior and junior professionals to put the patient first can be a solution to this challenge

Abdekhoda *et al* (2015) conducted a study to analyse the impact of regional contextual factors on nurses and physicians' conduct and behaviour upon the adaptation of EMR in Iran. Technology Acceptance Model (TAM) and other variables were used to analyse physician's attitude upon the adaptation of EMR systems. The key findings from the study cited that usability, simplicity, management, physician support, physician-patient relationship have an important impact on the adaptation of EMR. Solutions like the training of physicians did not indicate a positive impact on usability and perceived ease of use.

#### **2.3.4 Physicians' attitudes on the application of the EMR system.**

In a survey done in Taiwan, data from experienced physicians with EMR system was collected and analysed by making use of structural equation modelling (Hsein, 2015). The study showed that there were several factors which affected. They are attitude, physician's autonomy, trust, perceived risk, subjective aspect. In this study physicians' attitude towards EMR exchange can be predicted most effectively. Physicians EMR- exchange consists of many differences as compared to the behaviour of the users. It was found that some physicians believe that the EMR system is very helpful in saving peoples' lives. EMR system is only for more developed and bigger hospitals because it is not easy to use. It is also questioned by some physicians on whether the privacy of the information which belongs to patients is guaranteed by the EMR system. Therefore, EMR technologists and suppliers should not just provide the electronic system. They have to do more than that to engage everyone by emphasizing on how they value the trust.

The introduction of EMR has also brought some small concerns indicated by the TTF model. These include how the navigation system can take longer to allocate the specific document with the right information, automatically logging off of the system and how users need to enter their data every time they want to log in into the system (Kilmon *et al*, 2015). This can only lead to a decrease of interest by the health care professionals in using the system.

## **2.4 SOLUTIONS TO CHALLENGES ON EMR SYSTEM APPLICATION**

In dealing with challenges associated with EMR system usage in improving the health welfare of patients, there is a need to improve laboratory data quality using six sigma quality improvement tools. There is a dire need to equip the health personnel with critical IT resources and relevant IT knowledge or skills. The Health delivery system needs to adopt TTF to monitor and evaluate the effectiveness of the EMR system.

### **2.4.1 Improving laboratory data quality entry using six sigma**

Health care systems do not deliver high-quality medical care due to medical errors, particularly in resource-limited sites. According to the Institute of Medicine (IOM), medical errors are attributed to defective systems, processes and settings leading people to commit errors (Elbireer *et al*, 2013:497). The design of high quality and safe health systems and processes could reduce and avoid errors and endorse quality results. The researchers used a Six Sigma quality improvement tool to improve and measure the defect-elimination progress in the Makerere University – John Hopkins University core laboratory at the infectious disease institute in Kampala, Uganda. The Six Sigma tool was approved and implemented by the laboratory. The laboratory managers believed that the Six Sigma improved pre-analytical data capturing errors.

The Six Sigma project in the John Hopkins University Core laboratory found that data entry happens during the transfer of data from the requisition forms into the LIMS. The transcription errors occur when data is manually typed into the laboratory information system as occasionally information on the request form is unclear or if the writing is illegible. Transcription errors are often aggravated by working long hours and having many samples to enter into the system per day (Elbireer *et al.*, 2013:500). The people in the laboratory experience pressure from capturing high volume data for long hours. There is a 12-24hours turnaround time which needs to be achieved and the bulk of work does not arrive in the laboratory until 5 pm. It was found that the laboratory information system could not detect errors nor identify incorrect information from data entry to block them. Multitasking is another factor exacerbating the situation as it affects the concentration of the staff.

A significant improvement was realised after the implementation of the Six Sigma project when 174 errors (4.57 Sigma) between March 2010 and February 2011 were reduced from 423 errors (4.34 Sigma) (Elbireer et al., 2013:504). The project went further to estimate the cost of correcting each error. The researchers estimated the cost to be \$16.25 per error and thus the reduction of errors by 257 errors was saving the laboratory \$50 115 each year.

Corn (2009), as cited by Elbireer *et al.* (2013:506) posits that the healthcare field is unwilling to implement the Six Sigma tool as it is traditionally linked to the manufacturing industries, although it was successfully implemented before in health care settings. This is because it is easy to work on the machine to eliminate errors as compared to working with a human being who also use their intelligence.

#### **2.4.2. Adopting the TTF framework - monitoring and evaluating EMR system.**

TTF (task technological fit) is by far the best model to highlight errors and point out weaknesses and strengths. Kilmon *et al.* (2008) used TTF as a diagnostic tool to evaluate the implementation of the first stage of an EMR at a university hospital. The research was conducted when the hospital had just finished the first stage of EMR which is diagnostic testing and result reporting. As a means to the study, a survey was conducted where questionnaires were given to many nurses and physicians using a validated questionnaire developed by Goodhue (1998) to determine the fit between EMR technology and their tasks. The questionnaire was based on a Likert scale, a seven-point measurement of the construct included in the TTF model. Findings from the questionnaire showed that users accepted the diagnostic test results on EMR and they were satisfied with it. TTF dimensions meet the needs which are the presentation of data, reliability of the system, how easy the system can be to use and finally the availability of the technology.



Kilmon *et al* (2008) noted how TTF showed areas of strength and weakness of the EMR system: The issue of accessibility of information was greatly resolved by the introduction of EMR as the paper system was time-consuming. Accessibility of information was also made possible remotely. All this led to a faster delivery service by the hospital personnel to the patients.

Information from TTF model can also help institutions of Health care to engage and encourage vendors to develop their products accordingly (Kilmon et al., 2008).

### **2.4.3 Training of Health personnel on the integration of the EMR system.**

Akinboade et al (2012) argue that to solve the challenges that are faced by EMR systems, there is a need to fully equip the administrators and management staff with all the critical resources and knowledge to enable them to effectively oversee resources. For the effectiveness of adopting and integrating the EMRS system into the health sector, the staff or the health personnel need the training to keep up with modern technological advancements. In another study done in Uganda, the members recognised that the utilisation of ICT come about with benefits such as administration of medical records and other medical reports as well as effectiveness in accessing data on patients (Yegos et al, 2017). Furthermore, they, however, pointed out that there is lack of skills on the utilisation of ICT and this hinders the ICT operations (Yegos et al, 2017).

## **2.5 SUMMARY**

The chapter has outlined a literature review and theoretical framework on the Task Technology Fit (TTF) theory and its applicability in monitoring and evaluating information management systems. It was learned that the TTF model can improve the quality of EMR data with improved speed of accessibility, retrieval and quality. It was also learned that a buy-in from system users such as administrators and physician is important in order for effect to be realised. The chapter reviewed some studies (both local and abroad) about health care information management systems. The next chapter deals with the research design and methodology.

## **CHAPTER 3: RESEARCH METHODOLOGY**

### **3.1 INTRODUCTION**

Chapter 2 is a comprehensive literature review of health care information management systems and the theoretical framework that guided this study. This chapter discusses the research methodology and design used for the study. It gives details of the target population, sample size and the sampling procedure used. The chapter also gives a description of the research paradigm used, data collection and analyses methods as well as the data collection instruments used in the study.

### **3.2 THE RESEARCH DESIGN AND METHODOLOGY**

A research paradigm is a basic belief system that guides the researcher in choosing a method for carrying out a study (Guba and Lincoln, 2010). It defines the researcher's philosophical orientation and has significant implications for decision making in a research process, inclusive of the choice of the research methodology and methods (Kivunja & Kuyini, 2017: 26). Durrheim (2004:29) defines research design as a strategic framework created to answer research questions.

A research design implies research planning and provides the blueprint for the research (Diggines & Wiid, 2011:33). There are three major types of research designs and these are qualitative, quantitative and mixed methods. The term Methodology is the broad term used to refer to the research design, methods, approaches and procedures used in the research study to provide answers to the research questions. The methodology includes assumptions made, limitations encountered and how they were dealt with (Kivunja & Kuyini, 2017: 27).

#### **3.2.1 The research paradigm and design**

A positivist research paradigm was adopted in this study. The positivist paradigm defines a worldview to research, which is grounded in the scientific method of investigation. Research in this paradigm relies on deductive logic, formulation and testing of hypotheses, statistical modelling and analysis, graphical analysis and extrapolations to derive conclusions (Kivunja & Kuyini, 2017: 83). Since a positivist research paradigm was adopted in this study, the study, therefore, followed a

quantitative research design and the strategy of inquiry (genre) was a survey design. The survey design was used in this study because it allows the researcher to judge behaviour and accurately presents the findings. A survey allows further exploration of the research problem utilising a qualitative paradigm (Creswell, 2013) if there is a need.

### **3.2.2 Data collection techniques**

According to Polit and Beck (2012:175), data collection is the gathering of information to address a research problem. A data collection instrument consisting of a series of questions and other prompts to gather information from participants is called a questionnaire (Abawi, 2013) and questionnaires can be structured (for quantitative data collection) or unstructured (for qualitative data collection). In this study, the data collection instrument used was a structured and self-administered questionnaire (Appendix II) adopted from the validated questionnaire developed by Goodhue (1998: 105-138). For this questionnaire adopted from Goodhue (1998: 105-138), a 7 point psychometric Likert scale was used where a 1, 2, 3, 4, 5, 6, and a 7 correspond to strongly disagree, partially disagree, disagree, neutral, partially agree, agree and strongly agree respectively (Willis et al, 2009:2-5).

### **3.2.3 Population and sampling methods**

All individuals or units of interest with common predetermined characteristics defined by some research problems are called a population (Creswell, 2013). A sample is a group of a relatively smaller number of people selected from a population for investigation purpose (Avi, 2016: 11). Sampling is a process which involves selecting a group of participants, events, behaviour or other elements involved in a study (Grove et al., 2013:37). Each sampling process in scientific research follows a uniquely defined process called a sampling design which can be either probability or non-probability design.

Probability sampling designs use probability theory to randomly select population elements and conversely, a non-probability sampling design involves non-random selection of population elements (Creswell et al., 2016). Examples of probability sampling include simple random sampling, systematic random sampling and stratified random sampling. A number of participants who are given consent of

participation and have been recruited in a study make a sample size (Grove et al. 2013:708). In this quantitative study, a sample has to be a true representative of the population and each element should have an equal chance of being selected. Therefore, stratified random sampling design was implemented to choose a true representative of the population (Plooy-Cilliers et al., 2014:135) and capture key population characteristics in the sample. Doctors and clinical associates were taken as the first (Stratum 1) and nurses as the second homogeneous group of participants (stratum 2).

The population comprised of all hospitals in the North West Province, of which one district, Dr Ruth Segomotsi Mompati (Dr RSM) district, was conveniently sampled because it is the district in which the researcher works, hence easier to access and therefore lowering costs (Creswell et al., 2016) of carrying out the research. Clinical associates, medical doctors and professional nurses working in the hospitals in the Dr RSM district constituted the target population of the study. The accessible population consisted of all clinical associates, medical doctors and professional nurses working in the three (3) sampled hospitals. The units of analysis were the clinical associates, medical doctors and professional nurses from each sampled hospital. Three hospitals were selected using criterion of importance (criterion-i) purposeful sampling (Palinkas et al, 2015). The three hospitals are Taung district, Joe Morolong memorial and Ganyesa community hospitals were selected on the basis that each of these hospitals has a laboratory on their sites.

**Table 3.2: Doctors, clinical associates and professional nurses' population  
(adapted from NWU Department of Health, 2019)**

	HOSPITALS					
	Taung district		Joe Moronga memorial		Ganyesa community	
STRATA	POP	SAMPLE	POP	SAMPLE	POP	SAMPLE
DOCTORS & CL ASSOC	13	7	30	20	11	6
PROF NURSES	51	28	149	84	35	20
POPULATION	64		179		46	
SAMPLE		35		104		26

NB: N = 289, and overall n = 165, N = total accessible population and n = is the overall sample size for all three hospitals.

Cochran (1963, 1975)'s sample size formula (I) with finite population correction was used to determine the overall sample size in this study (Singh & Masuku, 2014).

$$n = \frac{\frac{z^2 \times p(1-p)}{e^2}}{1 + \frac{z^2 \times p(1-p)}{e^2 N}} \dots\dots\dots (I)$$

n = Sample Size for infinite population

Z = Z value (e.g. 1.96 for 95% confidence level)

p = population proportion (expressed as decimal) (assumed to be 0.5 (50%))

e = Margin of Error at 5% (0.05)

N = Population Size

So for a population of 289 at 5% margin of error, the overall sample size (n) is given using (I) as;

$$n = \frac{\frac{1.96^2 \times 0.5(1-0.5)}{0.07^2}}{1 + \frac{1.96^2 \times 0.5(1-0.5)}{0.07^2 \times 289}} \dots\dots\dots (II)$$

= **165 participants,**

and the sample size for each stratum was calculated using the proportionate stratification sampling formula (III) (Ahmed, 2009).

$$n_h = \left(\frac{N_h}{N}\right)n \dots\dots\dots(III)$$

where,

$n_h$  is the sample size for the stratum h,  $N_h$  Population size for stratum h, N is the population size and n is the study overall sample size. Applying (I), (II) and (III), sample sizes appearing in table 3.2 were generated.

After calculations for sample sizes for each hospital in each stratum, actual participants in each stratum were selected as follows;

- Members of the population were listed and assigned numbers in each stratum;
- Random numbers were generated using the computer (from 1 ..... up to n); and
- These generated n random numbers became the selected members of each stratum.

### **3.2.4 Data analysis**

After questionnaire data coding (codebook creation) and capturing into Microsoft Excel spreadsheet, statistical data analysis was carried out with the aid of SPSS statistical software version 25.0. Data was initially validated by constructing frequency distribution tables and perform trial analysis runs checking the entries if they correspond with items and sub-items in the questionnaire. Where discrepancies were observed, the original questionnaire would be consulted and corrections made before actual and conclusive analysis. The pilot study data was subjected to validity (Pearson's product-moment correlations) and reliability (Cronbach's Alpha) analysis to assess the validity of the data collection instrument and to assess whether items in this instrument (questionnaire) would measure the same construct that they are purposed to measure.

The actual survey data were analysed using a mixture of exploratory (cross-tabulations, bar and pie charts) and descriptive statistics (exploration of measures of central tendency and measures of dispersion) which formed the basis of data analysis. Exploratory factor analysis (EFA) was used to explore contributing factors on technology fit to healthcare tasks performance and confirms the extent to which such factors contribute to technology fit to health care service delivery. Results were displayed in the form of histograms, box and whisker plots to assess the overall distribution of perceptions of participants on the impact of information management systems on healthcare service delivery in Dr RSM district hospitals.

### **3.3 ETHICAL CONSIDERATIONS**

Ethical considerations in research refer to the need by the researcher to ensure that participants, the community or society involved in the research study are/is protected from psychological, financial or social harm (APA, 2009). To ensure adherence to ethical principles, the application for ethical clearance was done to the NWU ethics clearance committee and an ethical approval certificate was offered to the researcher (Appendix III).

A consent letter for permission to do research in the district (Appendix IV) was obtained from the provincial health department (the North West department of health). The consent letter from the provincial health department was submitted to the gatekeepers of each of the three hospitals Taung district, Joe Morolong memorial and Ganyesa community hospitals for permission to research in their respective hospitals. Consent letters (Appendix V) were also written and attached to the questionnaires informing the participants of the purpose, confidentiality and privacy of the information that they would give during the study (Burns & Grove, 2009:195). In the consent letters attached to the questionnaires, it was specified that participants' comments and opinions would be in all circumstances identified with pseudonyms and not with the actual names. The researcher also explained to participants that their participation in the study was voluntary. Therefore, they participated fully aware that they had the right to be protected from harm and discomfort (non-maleficence) at all costs (Botma *et al.*, 2010:20). Participants were also given assurance by the researcher that they had the freedom to withdraw from participating at any stage upon feeling any discomfort during their participation in the research.

### **3.4 CONCLUSION**

The chapter discussed and presented research design and methodology, research paradigms, data collection methods, instruments and data analysis methods used in this study. It also stated the population, sample size and the sampling method used in the study. Besides, the ethical considerations that the researcher followed were unpacked in this chapter.

The study was carried out in 1 district (DrRSM) out of the possible 4 districts in the Northwest Province which could have yielded better population and sampling. Therefore, this may limit the confidence of generalization of the conclusions and may call for a research with larger population and inclusive on the other districts and/or provinces



## **CHAPTER 4: DATA ANALYSIS, INTERPRETATION AND DISCUSSIONS**

### **4.1 INTRODUCTION**

The purpose of this chapter is to present statistical data analysis results from the survey. The chapter presents the exploratory, descriptive and inferential statistical analysis results for the demographics and the views of the health personnel; medical doctors, clinical associates and professional nurses regarding the impact of information management systems (IMS) on healthcare service delivery in Dr RSM district of the NWP in South Africa. Results are presented in histograms and box and whisker plots that are interpreted accordingly.

### **4.2 VALIDITY AND RELIABILITY ANALYSIS**

Even though the questionnaire used was developed and validated by Goodhue (1998: 105-138), the researcher fine-tuned some of the items and re-validated the questionnaire through a pilot test to validate and confirm its reliability. This was done using validity and reliability analysis outlined below.

#### **4.2.1 Validity and Reliability analysis**

Validity and reliability analysis was carried out to assess the degree of internal consistency of scores from a set of indicators (questionnaire items). Firstly, "Corrected item-total Correlations" (Table 4.3, Appendix I) were checked to determine the level of internal consistency of one item's scores with the composite scores from all other items designed to measure the same construct. Results of the analysis (Table 4.2, Appendix I) showed that for Items Q6, Q7, Q8, Q9, Q10, Q11, Q24 and Q25, correlations between each item and the total score from the questionnaire were very weak ( $\text{corr} < .3$ ). These items were taken as not correlating with the overall score from the scale. Valid items (items that significantly correlated with the total score) are highlighted in table 4.2, Appendix I. The majority of the Items (19 items, 70% of all items) correlated well ( $\text{corr} > .3$ ) with the overall score from the scale. Subsequently, more than 50% of the items tested were valid, the researcher proceeded with reliability analysis. Items with less correlation were dropped from the questionnaire because they were not internally consistent with the other items. These items appeared not to measure the same construct that they were purported to measure. Before considering deleting them, they were checked to determine

whether deleting each of those items would increase Cronbach's Alpha (Table 4.2) and it was observed that none of the items would increase Cronbach's Alpha.

**Table 4.1: Reliability Statistics**

<b>Cronbach's Alpha (<math>\alpha</math>)</b>	<b>Cronbach's Alpha Based on Standardized Items</b>	<b>N of Items</b>
.778	.775	24

The overall Cronbach's alpha (Table 4.2) was moderately high at ( $\alpha \geq .60$  but  $\alpha < .80$ ) and internal consistency of ( $\alpha = 0.78$ ). This was an indication that there was a decent internal consistency (reliability) of scores from this set of indicators and the researcher considered adopting the questionnaire and used it in this research.

#### **4.3 FACTOR ANALYSIS**

The purpose of factor analysis was to explain correlations among multiple outcomes resulting from one or more underlying explanations or factors to reduce data dimensionality. Exploratory factor analysis (EFA) was done on the questionnaire items data by running Principal Component Analysis (PCA) in SPSS to explore the factor loadings and as a result, 7 factors were extracted. The results of Quartimax were obtained with Kaiser Normalization, a method of orthogonal rotation (Field, 2009). Solutions of factor loadings from the PCA are described in table 4.4 Appendix I and Table 4.5 below. The interpretation is that all items in each factor touched the criterion of loading at least 0.40 on their factor (Tabachnick & Fidell, 1996). Further, factor wise eigenvalues and percentage variances for each factor were summarized in Table 4.3. In PCA, the proportion of variance accounted for by the factors is represented by the eigenvalues. It was interpreted from Table 4.3, Appendix I, that the eigenvalues greater than 1 showed that 7 factors represented 64.65 % of the total variance which is considered good (Akram et al, 2016).

**Table 4.5: Extracted Factors by EFA**

<b>FACTORS</b>	<b>ITEMS</b>	<b>ITEMS INCLUDED</b>
1. Difficulty in interpreting stored data (DID)	4	Q13, Q14, Q15, Q16
2. Easy of data access (EDA)	4	Q19, Q21, Q22, Q23
3. Needed data easy of identification (NDEI)	5	Q4, Q5, Q6, Q7, Q8
4. Easy for data integration (EDI)	4	Q12, Q17, Q18, Q27
5. Availability of data that serve the purpose (ADSP)	4	Q20, Q24, Q25, Q26
6. Reliability of data in clinical care (RDCC)	2	Q9, Q10
7. Patient data accuracy (PDA)	1	Q11
<b>Overall</b>	<b>24</b>	<b>24</b>

N B : Responses were: 1. strongly disagree, 2. partially disagree, 3. disagree, 4. neutral, 5. partially agree, 6. agree and 7. strongly agree.

Extracted factors were labelled as follows (Table 4.50); Difficulty in interpreting stored data (DID), 11.54%, Easy of data access (EDA), 11.44%, Needed data easy of identification (NDEI), 10.75%, Easy of data integration (EDI), 9.79%, Availability of data that serve the purpose (ADSP), 8.39%, Reliability of data in clinical care (RDCC), 7.23%, and Patient data accuracy (PDA), 5.52%. Reliability analysis (Figure 3) showed a very good overall internal consistency of items included in the data collection instrument ( $\alpha = .78$ ) which was accepted with pleasure.

#### **4.4 DEMOGRAPHICS**

A descriptive statistical analysis (Table 4.6) showed that most of the respondents were females (52.7%) and the minority were males (47.3%). The majority of the respondents were within the 41 – 50 years' age bracket.

**Table 4.6: Demographics summary**

<b>GENDER</b>	<b>Frequency (N)</b>	<b>Percentage (%)</b>	<b>AGE (years)</b>	<b>Frequency (N)</b>	<b>Percentage (%)</b>
Male	71	47.3	Under 30	12	8
Female	79	52.7	31 - 40	36	24
<b>JOB TITLE</b>			41 - 50	69	46
ProfNurses	103	68.7	Over 50	33	22
Drs / CIAs	46	31.3			

This was an indication that most of the health personnel in Dr RSM district are middle-aged, hence the people who responded to the questionnaire were mature enough to give information that the research needed. Also, the majority (68.7%) of participants were nurses and the minorities (32.7%) were doctors and clinical associates. Most professional health workers are nurses in this reasonable distribution.

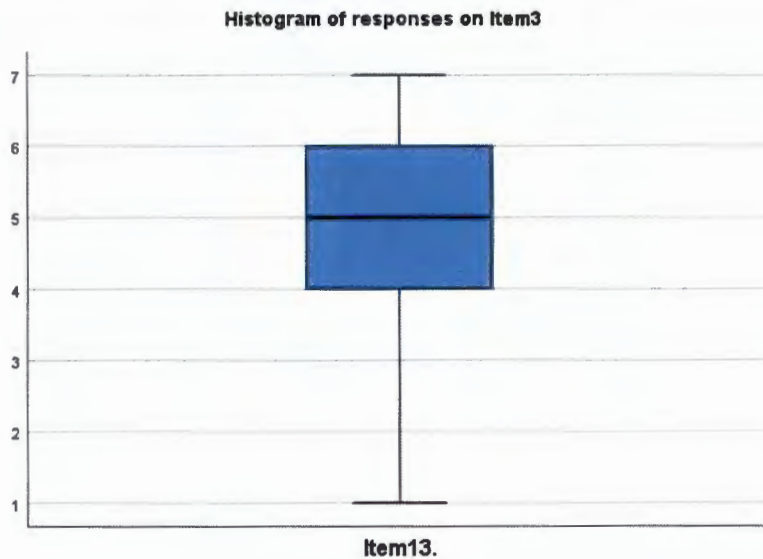
#### **4.5 DIFFICULTY IN INTERPRETING STORED TRAKCARE DATA (DID)**

The factor DID was made up of items Q13, Q14, Q15 and Q16 and a detailed analysis of each of these items was done in this section and reported overall hospitals to get the general perception from the respondents.

##### **4.5.1 Item 13 analysis results**

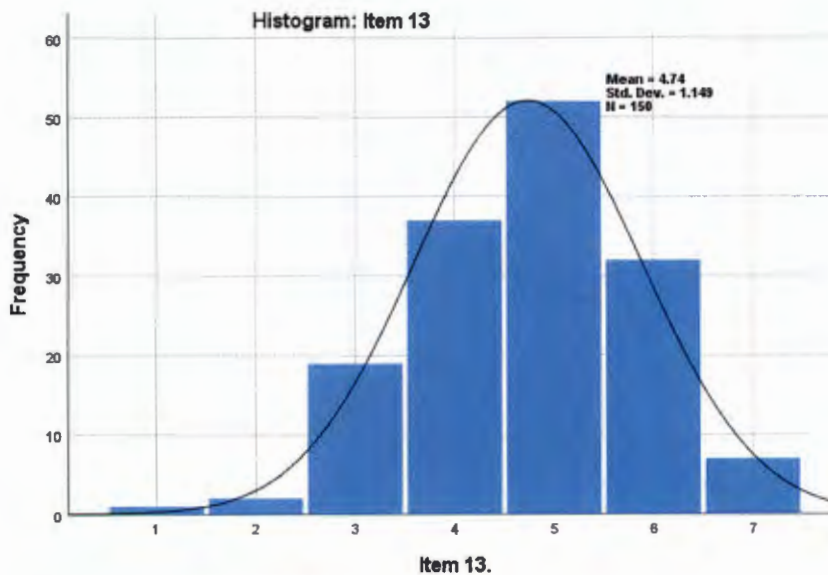
Item 13 was a lens to see whether a variety of terms used for the same idea or procedure sometimes makes it impossible to compare or aggregate data from online and paper sources. The box and whisker plot for 3 hospitals responses (Figure 4.4) showed that 50% of the responses lie between responses 4 and 6 and 25% of the responses were greater than response 6 (upper quartile was 6). Checking on the histogram (Figure 4.5) showed that the high, higher and highest frequencies were recorded for responses 6,4 and 5 respectively.

**Figure 4.4: Box Plot of all responses from the 3 hospitals**



The general perception indicated here (Figure 4.5) was that there are some issues in Trakcare like the variety of terms used for the same idea or procedure which sometimes makes it impossible to compare or aggregate data from online and paper sources.

**Figure 4.5: Histogram of responses distribution for 3 hospitals**



#### 4.5.2 Item 14 analysis results

On item 14, health personnel were asked to give their views on whether, in Trakcare, patient data is stored in so many different places and so many forms that it is hard to know how to use it effectively. The analysis was done in overall hospitals. Figure 4.6,

appendix II is a box and whisker diagram that was used as a summary to illustrate the distribution of responses. The analysis of all the data from 3 hospitals was done to find out the general distribution of responses across the 3 hospitals. The results (Figure 4.6, appendix II) from all hospitals personnel showed that the data distribution was positively skewed. Most of the observations lie between responses 3 and 6 inclusive. Figure 4.7, Appendix II is a histogram of responses to item 14. The responses distribution on the histogram concurs with the pattern displayed in figure 4.7 that more frequent responses were recorded from responses 4, 5, 6 & 7. This is an indication that the general perception that patient data is stored in so many different places and so many forms make it hard to know how to use it effectively.

#### **4.5.3 Item 15 analysis results**

The purpose of item 15 was to find out the respondent's views on whether, in a TrakCare, many different systems files exist with slightly different data, and whether they are hard to understand and to use in a given situation. Results from the analysis (Figure 4.8, appendix II) show that all the 3 hospitals display a similar symmetrical distribution where 75% of the responses are below response 5.

The overall analysis (Figure 4.8, appendix II) also shows a similar distribution where the box and whisker show asymmetric distribution. It shows that 75% of the responses lie between 5 and 1 indicating that respondents do not concur with the notion. Fig 4.9 shows a symmetrical distribution, where 75% of the responses were lower than response 5. Responses 3, 4 and 5 had the highest frequencies. This is an indication that although many respondents disagree that many different systems files exist with slightly different data, hard to understand and to use in a given situation, quite a number agree with this statement. Further, the box plots (Figure 4.9, appendix II) show a symmetrical distribution. 50% of the responses lie within 3 – 5 responses further emphasising that there is no unanimous agreement from the respondents regarding this issue.

#### **4.5.4 Item 16 analysis results**

Item 16 was formulated to find out from the respondents whether it is easy to find out what data the organization maintains on a given patient. The data distribution was presented in the form of a histogram (4.10, Appendix II) and a box – whisker plots

(figure 4.11, appendix II). A histogram (figure 4.10, appendix II) shows that responses 3 and 4 were the most frequent ones. The histogram also shows a normally distributed response. Very few respondents had a clue about this issue. In this symmetric distribution, 75% of the responses (figure 4.11, appendix II) are between 1 and 5 which is an indication that people do not agree with the idea that it is easy to find out what data the organization maintains on a given patient.

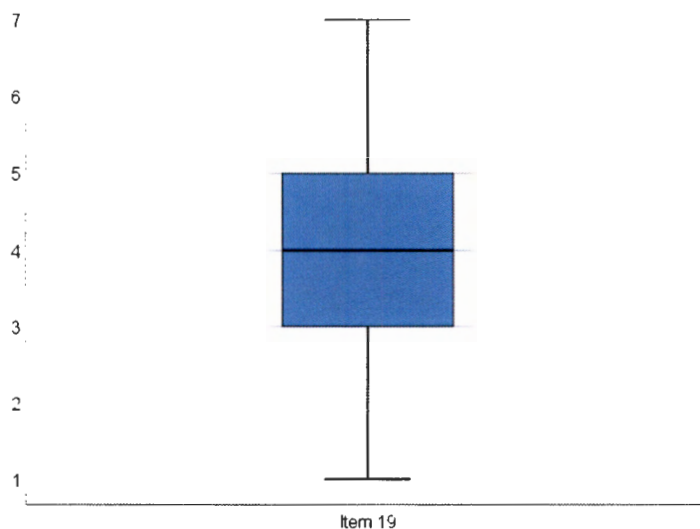
#### 4.6: EASY OF DATA ACCESS (EDA)

Questionnaire items Q19, Q21, Q22 and Q23 constitute the factor that was coded as EDA. A detailed analysis of these items was done in this section and reported overall hospitals to get the general perception from the respondents.

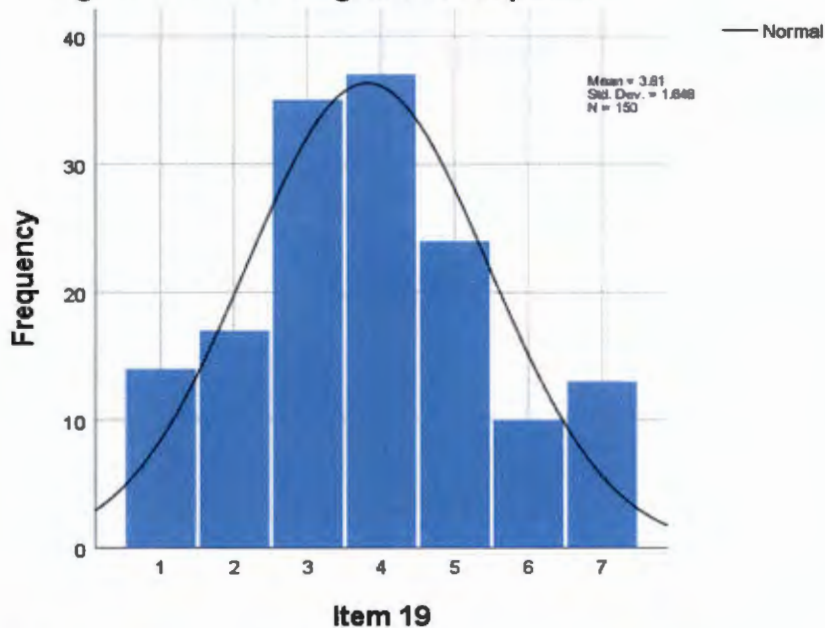
##### 4.6.1 Item 19 Analysis

Item 19 on the questionnaire asked whether the hospital personnel can get data quickly and easily when they need it. The results showed that most responses were within the range 3-5 (figure 10.12). The issue here was that there are very few clinical personnel who come out bravely and explicitly to disagree or explicitly agree with the statement. As a result, the distribution (figure 10.11) of responses become bell-shaped (normal distribution). The indication is that the hospitals' personnel can get data not that quickly and that easily from the laboratory information management system, TrakCare.

**Figure 10.11: Box and whisker plot**



**Figure 10.12: Histogram of responses**



#### **4.6.2 Item 21 Analysis**

Item 21 is about whether the hospital personnel are getting the help they need in accessing and understanding the data from the electronic health system. The results of the data analysis are shown on the histogram (figure 10.13, appendix II) and box –whicker plot (figure 10.14, appendix II). From figure 10.13, it can be deduced that most respondents were very negative and most of them strongly disagreed and partially disagreed that they are getting the help they need in accessing and understanding the data from the electronic health system. Besides, the box and whisker plot (figure 10.14, appendix II) shows a skewed distribution, with a low median.

#### **4.6.3 Item 22 Analysis**

On item 22 the researcher explored whether it is easy for hospital personnel to get assistance when having trouble finding or using the data from the electronic health system. The histogram (figure 10.15, appendix II) and the box –whicker plot show the non-skewed distribution of responses. There are mixed reactions here on whether hospital personnel get assistance when having trouble finding or using the data from TrakCare. For this item, there are as many personnel who are agreeing as those who are disagreeing, hence the research cannot make tangible conclusions based on this item.

#### 4.6.4 Item 22 Analysis

Item 23 explored whether there are times when supposedly equivalent data from online and paper sources is inconsistent. The results of the analysis (figure 10.17, appendix II) show that the majority of the respondents indicated that there are times when supposedly equivalent data from online and paper sources is inconsistent. Quite a number disagreed that there are times when supposedly equivalent data from online and paper sources is inconsistent. This might mean that sometimes it happens and sometimes it does not.

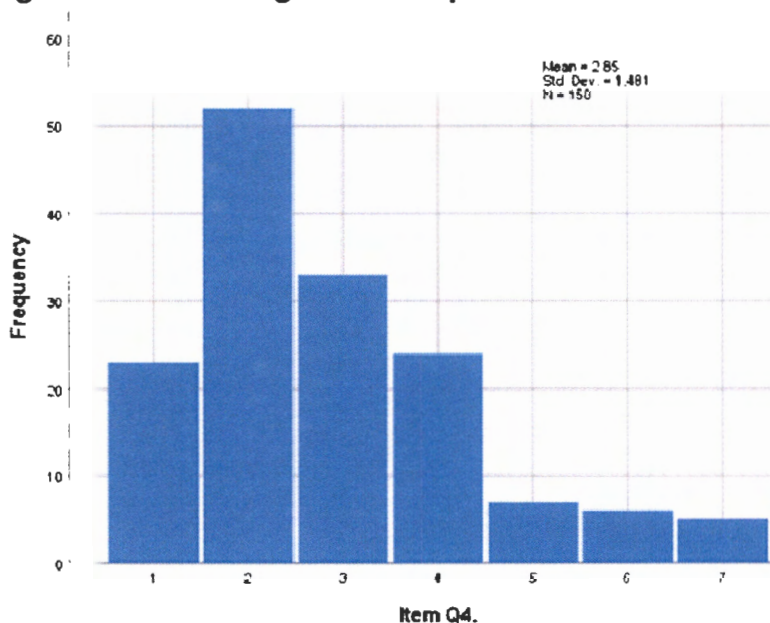
#### 4.7 NEEDED DATA EASY OF IDENTIFICATION (NDEI)

Q4, Q5, Q6, Q7 and Q8 were the questionnaire items that constituted factor 3 coded "Needed data easy of identification". Each of the items in this factor is closely analysed.

##### 4.7.1 Item Q4 analysis

Q4 explored whether online patient health care information is on the right level of detail for hospital personnel needs. The analysis of results (figure 10.18) shows that most respondents were neutral (4), partially disagree (3), disagree (2) and strongly disagree (1). Very few were positive. This is an indication that online patient health care information is not on the right level of detail for hospital personnel needs.

**Figure 10.19: Histogram of responses**



#### **4.7.2 Item Q5 analysis**

Q5 explored whether the organization sufficiently maintain detailed patient records. The analysis results (figure 10.19.1, appendix II) shows that most respondents were neutral (4), partially disagree (3), disagree (2) and strongly disagree (1). Very few were positive. This is an indication that online patient health care information in TrakCare is not sufficiently maintained as detailed patient records'

#### **4.7.3 Item Q6 analysis**

Q5 explored whether the computer systems for patient access are convenient and easy to use. Figure 10.20 (appendix II) shows that most respondents were neutral (4), partially disagree (3), disagree (2) and strongly disagree (1). Fewer were positive. This might indicate that the computer systems for patient access are not convenient and not easy to use.

#### **4.7.4 Item Q7 analysis**

Q7 asked if it is easy to learn how to use the computers systems to access the data. Figure 10.21 (appendix II) shows that most respondents were packed to the extreme left of the histogram thus showing that there are more of negatives than positives, therefore, appears it is not easy to learn how to use the computers systems to access the data.

#### **4.7.5 Item Q8 analysis**

Q8 dealt with whether the hospital personnel can count on the system to be "up" and available when I need it. The results of the analysis are displayed on figure 10.22 and it was observed that most respondents more of negative than positive giving a signal that the hospital personnel cannot count on the system to be "up" and available when they need it.

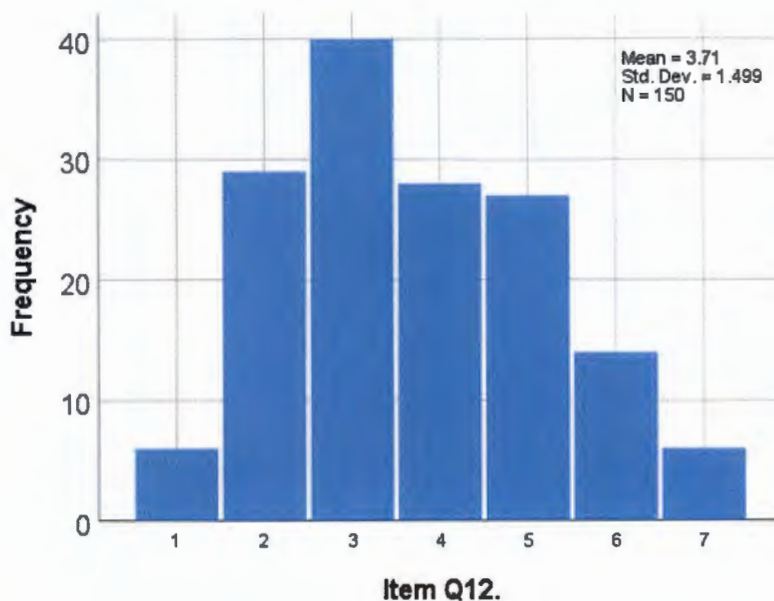
### **4.8 EASY OF DATA INTEGRATION (EDI)**

Items Q12, Q17, Q18 and Q27 make up the factor called 'easy of data integration'. Each of these items is therefore closely analysed. Both the histogram and the box-whicker plot as analysis outputs are used to assess the response data distribution.

### 4.8.1 Item Q12 Analysis

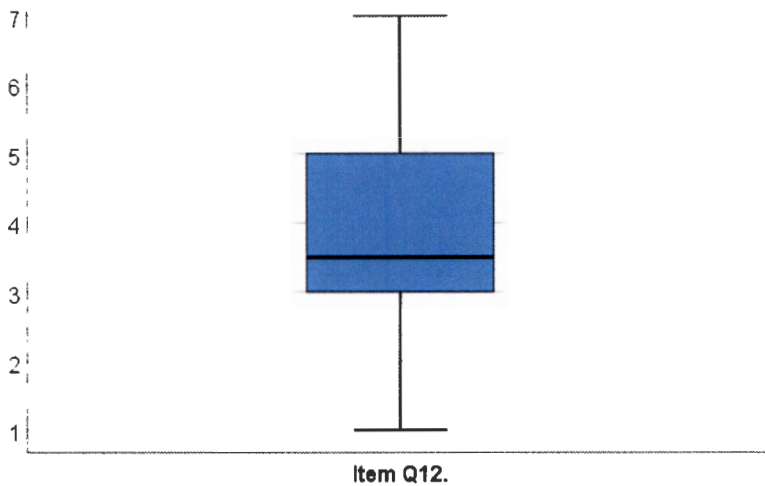
Item Q12 is phrased as “unexpected inconsistencies exist when online records are compared to paper records” in TrakCare. The histogram (figure 10.23) and the box-whisker plot (figure 10.24) summarise the distribution of responses data from the survey. It is interesting to note that most of the respondents (figure 10.23) disagreed with the statement though quite a number agreed.

**Figure 10.23: Histogram of responses**



The box-whisker plot shows a positive skew, but 50% of the responses are either a 5 (partially agree), a 4 (neutral) and a 3 (partially disagree). Besides, the box –whisker plot shows that 25% of the responses are on the agree on category (a 5,6 or a 7) and all the same 25% in the agree on category (a 3, 2 and a 1). Hence, at this point, the general perception from the respondents may be that though there are unexpected inconsistencies that exist when online records are compared to paper records, there exist some consistencies as well when online records are compared to paper records in electronic medical records.

**Figure 10.24: Box –whisker plot**



#### **4.8.2 Item Q17 Analysis**

Item Q17 is phrased as “easy to obtain data on a particular diagnostic test/ procedure, even on first time”. Both the histogram (figure 10.25, appendix II) and box – whisker plot (figure 10.26, appendix II) show symmetric responses data distribution. In as much as there are respondents on the disagreeing side, there are also those on the agreeing side. The perception, therefore, is that for some personnel, it is easy to obtain data on a particular diagnostic test/ procedure, even on the first time and to some or sometimes it is not.

#### **4.8.3 Item Q18 Analysis**

Q18 is phrased as “the exact data definition of data fields relating to my tasks is easy to find out”. The results of the analysis (figure 10.27, appendix II) show that most of the respondent could not concur with this statement even though some confirmed that “the exact data definition of data fields relating to my tasks is easy to find out”. To further analyse the perception of the respondents, the researcher took a closer look at the box – whisker plot (figure 10.27, appendix II). It was observed that the lower quartile equals the median with a value of 3 (partially disagree) and is positively skewed. This again gives the researcher a tough time to deduce the general perception from the respondents. However, it can be deduced that in general, the respondents are saying that the exact data definition of data fields relating to their tasks are not easy to find out.

#### **4.8.4 Item Q27 Analysis**

Item 27 is about whether the data needed by the hospital personnel are displayed in a readable and understandable form. As shown in figure 10.29 (appendix II), quite a number were in the disagreeing category on whether the data needed by the hospital personnel are displayed in a readable and understandable form. A large number also agreed that the data needed by the hospital personnel are displayed in a readable and understandable form. Further discussion can be made on looking at the distribution of the responses displayed in figure 10.30 (appendix II). The box – whisker plot shows that the response data is positively skewed, Responses data constitute a higher frequency of high valued scores. In this case, it can be deduced that the respondents perceive that data needed by the hospital personnel are displayed in a readable and understandable form.

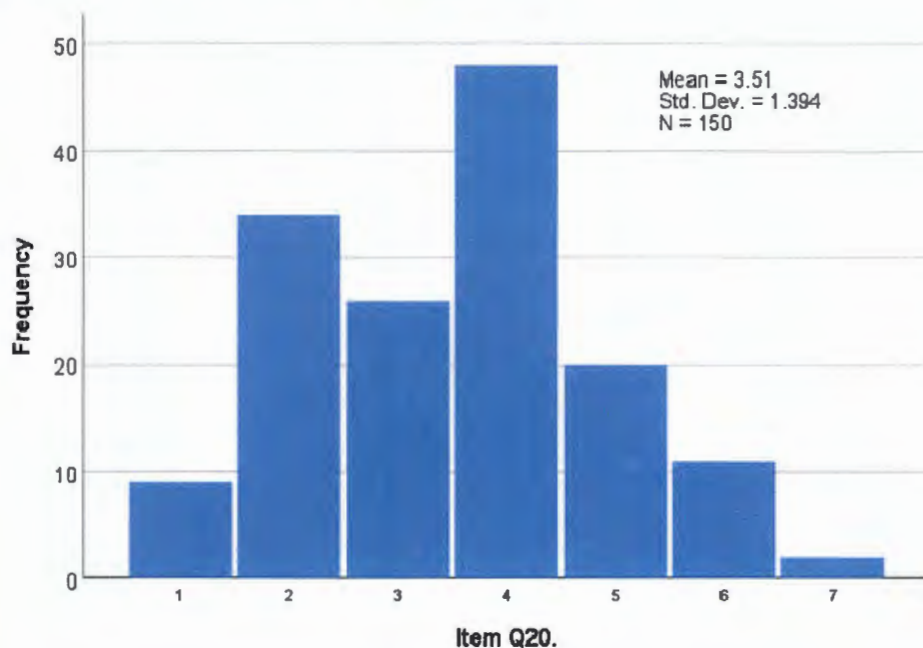
#### **4.9 AVAILABILITY OF DATA THAT SERVE THE PURPOSE (ADSP)**

Items Q20, Q24, Q25, Q26 constitute the factor called 'availability of data that serve the purpose (ADSP)'. Each of these items was, therefore, subjected to closer analysis.

##### **4.9.1 Item Q20 Analysis**

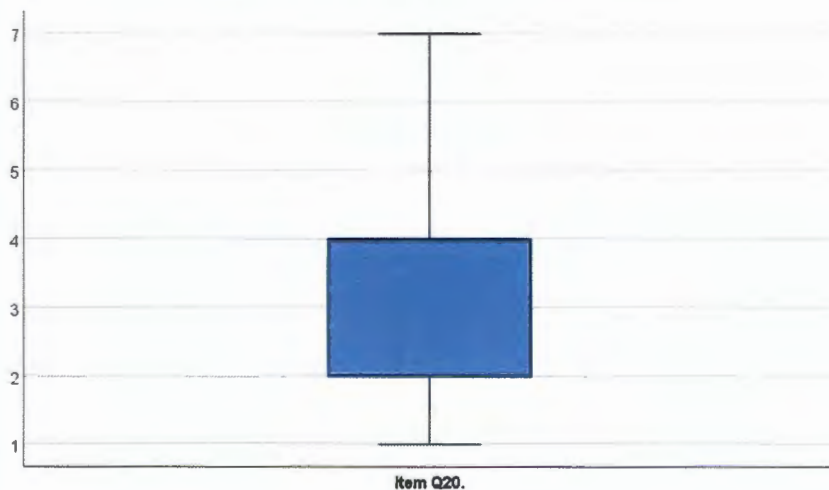
Item 20 is "it is easy to get access to the data that I need". The distribution of the responses data is displayed on the histogram (figure 10.31) and the box - whisker (figure 10.32). The highest recorded frequency (modal response) on the histogram under item 20 was is a 4 (neutral). This implies that among the hospital personnel, there are quite many people who have no idea as to whether or not it is easy to get access to the data that they need from the electronic medical records. It is, however, observed that most of the respondents indicated that they partially agree, disagree and strongly disagree, they perceive that it is not easy to get access to the data that they need. The fewer number however partially agree, agree and strongly agree that it is easy to get access to the data that they need.

**Figure 10.31: Histogram of responses**



The box – whisker plot (figure 10.32) shows that more than 50% of the responses are below responses like a 4, meaning they are 1 (strongly disagree), 2 (disagree) and a 3 (partially disagree). This further emphasises the general perception from the respondents that it is not easy to get access to the data that the health personnel need from the electronic health management system.

**Figure 10.32: Box –whisker plot**



#### **4.9.2 Item Q24 Analysis**

Analysis of item 24, “data is up-to-date enough for my purposes”, showed (appendix II, figure 10.33 and 10.34) that the median equals upper quartile and 75% of the

responses fall within the partially agree (5) and agree (6) responses. The modal response was partially agreed (5). The general perception, therefore, is that “data is up to date enough for the hospital personnel’s purposes”. The quartiles on the box – whisker plot (figure 10.34, appendix II) show that 75% of the responses fall in the agree with category (4, 5 and a 6). This further gives evidence that data is up-to-date enough for hospital personnel purposes.

#### **4.9.3 Item Q25 Analysis**

Analysis of item Q25 “I can’t get data that is current enough to meet my needs” shows that the majority of the respondents (figure 10.35, appendix II) were positive that they “I can’t get data that is current enough to meet my needs” and quite a few were on the disagree category. The box and whisker plot (figure 10.36, appendix II) also shows that more than 50% of the responses 5, 6 or 7 (all in the agree on category).

#### **4.9.4 Item Q26 Analysis**

Analysis of item Q26 “Data is presented in a readable and useful format.” shows that the majority of the respondents (figure 10.37, appendix II) were positive that in a healthcare management information system, data is presented in a readable and useful format. Besides, the box and whisker plot (figure 10.38) also shows that more than 50% of the responses 5, 6 or 7 (all in the agree on category), hence the general perception is that data is presented in a readable and useful format in an electronic health care system.

### **4.10 RELIABILITY OF DATA IN CLINICAL CARE (RDCC)**

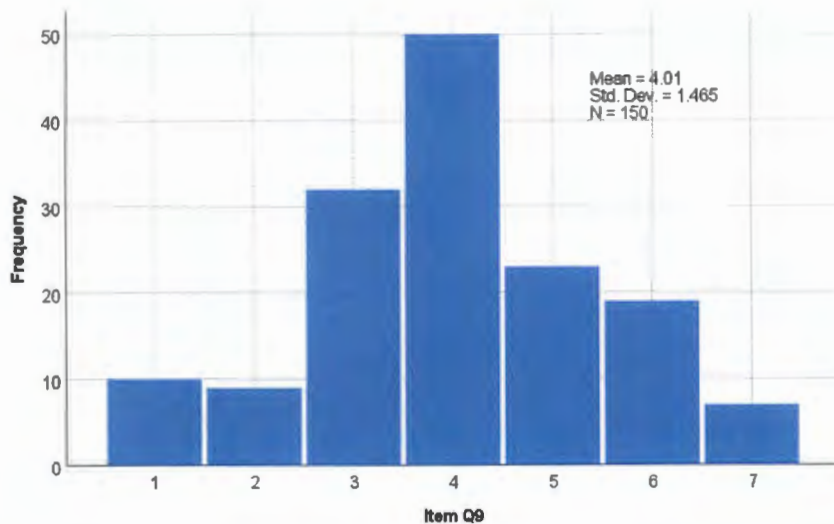
Items Q9 and Q10 are the items which constitute the factor RDCC. The questionnaire item Q9 was, “the data is subject to frequent system problems and crashes” and Q10 was “patient data is accurate enough to support clinical care.

#### **4.10.1 Item Q9 Analysis**

Focussing the attention on item Q9, it is observed that most of the respondents were on the neutral side (Figure 10.39). This may transform to the opinion that the respondents have no idea of what is happening with the electronic healthy system regarding whether data is subject to frequent system problems and crashes or not. The respondents could not take sides with quite a number of them disagreeing

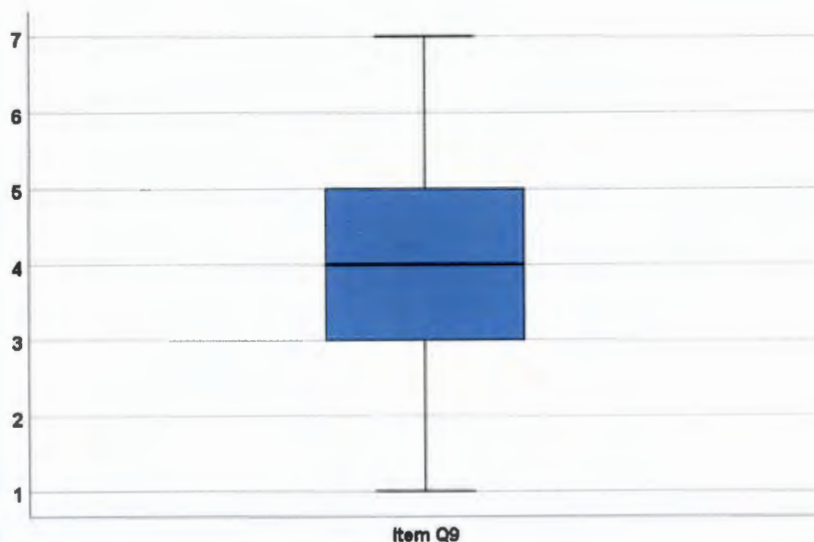
(partially or strongly) that the “data is subject to frequent system problems and crashes”. It would mean that the data is not subject to frequent problems and crashes because many respondents have partially disagreed, disagreed, strongly disagreed and those with no idea meaning everything is well with this group.

**Figure 10.39: Histogram of responses**



The box and whisker plot (figure 10.40) shows the quartiles and response data distribution. The median is neutral and the position of the box plot shows that 50% of the responses a 4 or a 3. This might mean that the personnel are not much aware of what is happening with the electronic health system regarding reliability of electronic data in clinical health care.

**Figure 10.40: Box –whisker plot**



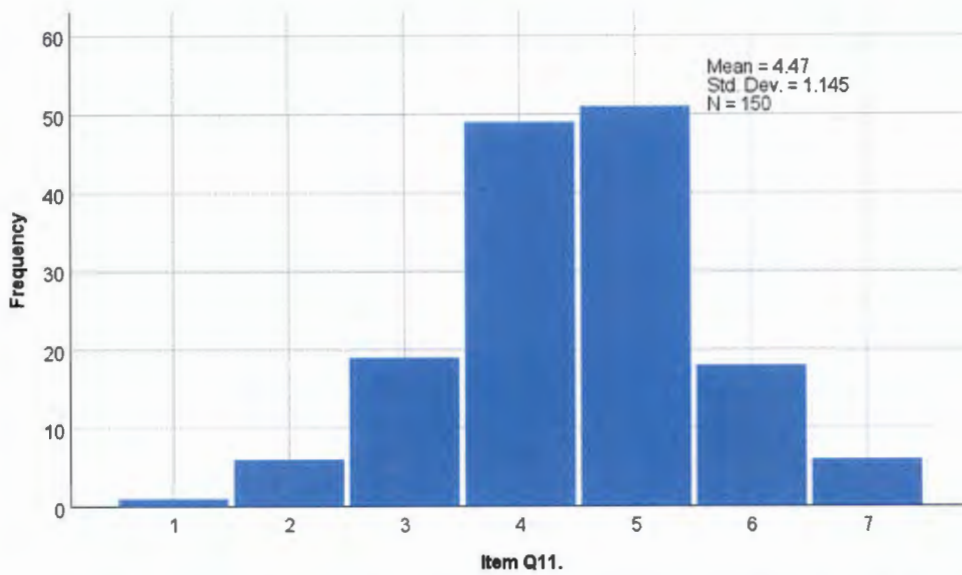
#### **4.10.2 Item Q10 Analysis**

Item Q11 explored whether “patient data is accurate enough to support clinical care’. The results of the analysis (figure 10.41, appendix II) showed a similar pattern as analysis results in 4.10.1. Most respondents could not take sides (neutral) and quite a number of them disagreeing (partially or strongly) that the “patient data is accurate enough to support clinical care”. Quite a number, however, advocate that patient data is accurate enough to support clinical care. The response data distribution (figure 10.42, appendix II) also replicates the pattern displayed in section 4.10.1. 50 % of the responses are either partially disagree (3), neutral (4) or a partially agree (5). This again cannot give us adequate information to conclude regarding how reliable electronic healthcare data is on clinical care given that the box and whisker plot (figure 10.42, appendix II) shows symmetric data distribution.

#### **4.11 PATIENT DATA ACCURACY (PDA)**

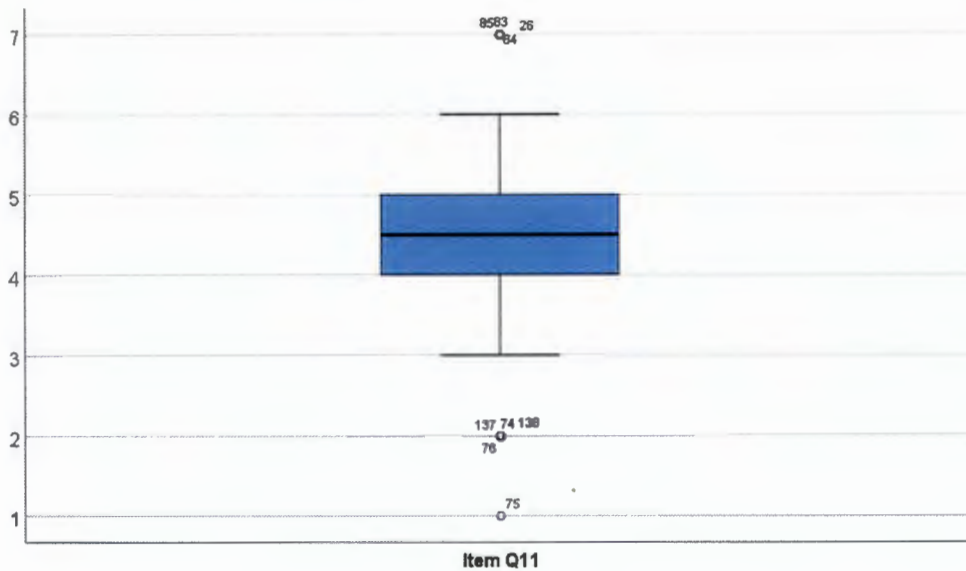
Item Q11 was the only item that makes up the factor “PDA”. Q11 was phrased as “there are accuracy problems in patient data”. Therefore, a disagree would mean that there are no data accuracy problems and vice versa. Figures 10.43 and 10.44 showed that 50% of the responses lie between a 4 and a 5, implying that the responses are mainly neutral and partially agree. Therefore, a conclusion cannot be made on what is the general perception of the respondents about patient data accuracy. Perhaps the hospital personnel have not put their mind on deciphering on how accurate is data from electronic healthy records. Further inquiry using a case study (qualitative research) research would help if the study had engaged a mixed-methods approach.

**Figure 10.43: Histogram of responses**



Further, on looking at the box –whisker plot (figure 10.44), this is a symmetrical distribution with the mean approximately equal to the median (4 i.e. neutral). We cannot generalize the perception of the respondents here regarding patient data accuracy.

**Figure 10.44: Box –whisker plot**



## **4.12 CONCLUSION**

This chapter presented the analysis of results. The statistical analysis of results used exploratory, descriptive and inferential statistical analysis methods were presented. Results were presented in the form of summary tables, histograms, box and whisker plots. Exciting patterns that are discussed in chapter 5 (that follows) were obtained during the analysis.

## CHAPTER 5: FINDINGS, DISCUSSIONS, CONCLUSIONS AND RECOMMENDATIONS

### 5.1 INTRODUCTION

This chapter presents the findings from data analysis results from chapter 4 and discussion of findings. It also discusses the findings and presents some recommendations based on the discussions, findings and conclusions.

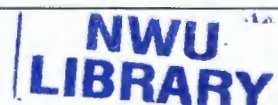
### 5.2 FINDINGS

According to Habib (2010), a healthcare information management system allows for retrieval of the patients' records as a dashboard by ensuring accurate data. It is both appropriate and legible and allows the information to be used to assess a patient's health possible trends and long-term medical changes. From the analysis, it was found that although there are positive impacts of the use of TrackCare management information system, there is however a multiple of issues regarding the accuracy, reliability, availability, interpretability, accessibility, integration and identification of patients' records data. On unpacking the analysis of results from the survey, the following issues regarding using TrakCare were discovered and are summarised in Table 5.1.

**Table 5.1: Summary of Findings**

Categories of Findings	Findings
Difficulty in interpreting stored data	<ul style="list-style-type: none"><li>• variety of terms used for the same idea/procedure in Trakcare complicates data interpretation.</li><li>• patient data is stored in so many different forms and places and makes it difficult to know how to use them effectively.</li><li>• files exist with slightly different data, hard to understand and to use</li><li>• not easy to find out which data is maintained for which patient.</li></ul>
Easy of data access	<ul style="list-style-type: none"><li>• Personnel gets the help they need in accessing and understanding the data from TrakCare</li></ul>

	<ul style="list-style-type: none"> <li>• Getting patient data from TrakCare not quick/not easy</li> <li>• online and paper sources are inconsistent</li> </ul>
Needed data easy of identification	<ul style="list-style-type: none"> <li>• online patient health care information is not on the right level of detail for hospital personnel needs</li> <li>• online patient health care information not sufficiently maintained as detailed patient records.</li> <li>• computer systems for patient access are not convenient and not easy to use by the health personnel</li> <li>• not easy to learn how to use the computer systems to access TrakCare patient data.</li> </ul>
Easy for data integration	<ul style="list-style-type: none"> <li>• definition of data fields relating to some specific are not easy to find out in TrackCare</li> <li>• some personnel easily obtain data on particular diagnostic test/ procedures</li> <li>• data is displayed in a readable and understandable form.</li> </ul>
Availability of data that serve the purpose	<ul style="list-style-type: none"> <li>• Data is presented in a readable and useful format</li> <li>• Not easy to get access to the data that health personnel need.</li> </ul>
Reliability of data in clinical care	<ul style="list-style-type: none"> <li>• Data subjected to problems and clashes</li> </ul>
Patient data accuracy	<ul style="list-style-type: none"> <li>• TrackCare patient data accuracy not that plausible</li> </ul>



### 5.2.1 Difficulty in interpreting stored data

The variety of terms used for the same idea or procedure in Trakcare sometimes makes it impossible to compare or aggregate data from online and paper sources. It was also discovered from the users of TrakCare that patient data is stored in so many different forms and places that sometimes it is difficult to know how to use it effectively. Many different systems files exist with slightly different data. This is hard to understand and to use in a given situation. Besides, according to responses from

the survey, it is not easy to determine which data the organisation maintains for a given patient.

### **5.2.2 Easy of data access**

According to comments from the hospital personnel, they are getting the help they need in accessing and understanding the data from TrakCare, but time-wise to getting the useful enough patients' data from the laboratory information management system (TrakCare) is not that quick and that easy. According to responses from the survey, supposedly equivalent data from online and paper sources are inconsistent, hence there is a need for help from the TrakeCare technical team.

### **5.2.3 Needed data easy of identification**

One of the merits that users of electronic records look forward to is how easy it is to identify the data they need for patient treatment. Conversely, the analysis showed that online patient health care information is not on the right level of detail for hospital personnel needs TrakCare and is not sufficiently maintained as detailed patient records. Also, the computer systems for patient access are not convenient and not easy to use by the health personnel. It is not easy to learn how to use computer systems to access TrakCare patient data.

### **5.2.4 Easy for data integration**

It is observed that there exist unexpected inconsistencies and mismatch of data when online records are compared to paper records. The general perception from the analysis is that the exact definition of data fields relating to some specifics is not easy to find out in TrackCare. However, some personnel can easily obtain data on particular diagnostic test/ procedures even on the first time, but it is not so for most of the hospital personnel. In general, it is deduced that the respondents perceive that data needed by the hospital personnel are displayed in a readable and understandable form. This displays mixed reactions among personnel about how easy it is to integrate data from TrackCare information management system.

### **5.2.5 Availability of data that serve the purpose**

On assessing whether data is available for patient treatment, it was discovered that according to participants' perceptions, data is presented in a readable and useful format in TrackCare. The only problem is that it is not easy to get access to the data that the health personnel need for patients' care.

### **5.2.6 Reliability of data in clinical care**

The issue of data being subjected to frequent problems and crashes was not highlighted during the survey. It was perceived by some respondents as being prevalent and some perceived it as sometimes happening. This reflects that the hospital personnel cannot 100% rely on TrackCare information management system data because sometimes the data is subjected to problems and crashes.

### **5.2.7 Patient data accuracy**

The accuracy of the data from TrackCare is not that plausible. The general perception by respondents on patient data accuracy is that the data is not always accurate. There are times when it is accurate while sometimes it is not.

## **5.3 DISCUSSIONS**

This study aimed to evaluate the impact of information management systems (IMS) on healthcare service delivery in the Dr RSM district of the NWP in South Africa. The objectives of the study were to examine how information management systems adoption impact on the healthcare service delivery in South Africa, and to investigate the extent to which improved healthcare service delivery depends on the IMS operational behaviours and examine whether the adoption of IMS, promote healthcare service delivery in Dr RSM district of NWP.

### **5.3.1 Whether TrackCare adoption promote improved healthcare service delivery**

Incites from Akinboade *et al.* (2012), posit that the administration of health records aims at improving quality, genuineness and data security both on paper and electronically. Electronic healthcare promotes evidence-based medicine, good record keeping and therefore reduce costs, improve quality (Fernandez - Aleman *et al.*, 2013). As a result, promote improved healthcare service delivery. From the survey data analysis, it was found that there are several issues related to the

adoption of TrackCare information management system that compromise the quality of patient data and information kept. The issues include non-plausible data accuracy, difficulty in data interpretation, and that patient data which is stored in many different forms that it becomes hard to interpret and other reasons. Therefore, improvement of quality, data genuineness and data security both on paper and electronically cannot be guaranteed considering the reported inconsistencies when online records are compared to paper records.

### **5.3.1 How TrackCare adoption impact on improved healthcare service delivery**

It is reported in 5.2.1 that it is not easy in Trackcare to match the patient and his/her data. Also, according to the survey responses, patient data is stored in so many different forms and places. This makes it difficult to know how to use them effectively. This, therefore, lead to elongated and delayed necessary medical treatment for patients in these hospitals as nurses, doctors and clinical associates experience increased workloads due to the slow adaptation to information technology processes. As a result, in this case, the adoption of TrackCare can be seen as hurting healthcare service delivery. Incites from Akinboade *et al.* (2012), propose the need to fully equip the administrators and management staff with all the critical resources and knowledge by training them the healthcare IMS (Trackcare for instance) to enable them to effectively use the resources.

### **5.3.2 Healthcare service delivery and TrackCare operational behaviours**

The need for quick access on needed data, easiness to interpret different data field and forms and the accuracy of the patient data from TrakCare are the bases for improved healthcare. However, these attributes are not embraced since the introduction of TrackCare as a Laboratory information management system. This impacts negatively on healthcare service delivery.

## **5.3 CONCLUDING REMARKS**

The introduction on IMS is aimed at significantly decreasing errors and losing records, the magnitude of record-keeping work, consumption on paper co-ordinations and recovery of stole away bills. Fernandez- Aleman *et al.* (2013) posit that the reduction in costs, improved quality care, promotion of evidence-based medicine and improved record-keeping method and mobility are the benefits of

Electronic Health Records (EHRs) IMS in record keeping. However, apart from having the potential to deliver such merits, the introduction of TrackCare IMS has shown several negative issues surrounding operational behaviours like data inconsistency, inaccuracy, non-plausible data and data which is difficult to interpret. These negatively impact on improved healthcare service delivery. Incites from Donomichiello (2015) and Tavares (2018) advocate for improved quality of health delivery due to the adoption of an e-health management information system like TrackCare. The reasons behind this dissatisfaction may include health personnel, administrators and management staff who have less IT skills (Ahmad, 2014) resulting in inefficient and underuse of the IMS.

#### **5.4 RECOMMENDATIONS**

The study revealed interesting issues surrounding the adoption of an IMS like TrackCare. According to Hsein (2015), there are many factors which affect the impact of the adoption of an IMS on service delivery. These include personnel attitude, physicians' autonomy, trust, perceived risk and a subjective aspect. Up and until the health personnel are properly oriented, well trained and properly educated on the technical operational behaviours of the IMS, the merits of using an IMS will never be fully realised. The researcher feels that more informed insight could be obtained if the study had a larger population and sample for generalization of the results

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## APPENDICES

### APPENDICE I

**Table 4.2: Item-Total Statistics**

ITEM	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q4.	91.79	211.346	.434	.558	.764
Q5.	91.39	215.287	.360	.473	.768
Q6.	91.30	215.648	.272	.405	.773
Q7.	90.93	219.639	.225	.438	.776
Q8.	91.42	219.104	.271	.352	.773
Q9.	90.63	220.798	.214	.356	.776
Q10.	90.69	219.774	.187	.450	.779
Q11.	90.17	225.366	.162	.398	.778
Q12	90.93	212.197	.408	.459	.766
Q13.	89.91	220.582	.303	.622	.772
Q14.	90.22	213.891	.362	.769	.768
Q15.	90.69	220.928	.211	.708	.776
Q16.	90.93	207.338	.470	.547	.761
Q17.	90.80	208.591	.455	.459	.762
Q18.	90.93	212.042	.367	.454	.767
Q19.	90.83	207.066	.474	.505	.761
Q20.	91.13	216.506	.336	.402	.770
Q21.	91.16	201.719	.535	.620	.756
Q22.	90.83	205.151	.440	.567	.762
Q23.	90.24	209.955	.389	.384	.766
Q24.	90.09	233.951	-.088	.534	.793
Q25.	89.88	231.596	-.036	.368	.789
Q26.	89.59	209.009	.439	.608	.763
Q27	90.39	210.937	.343	.434	.769

**Table 4.3: Total Variance Explained**

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.659	19.411	19.411	2.766	11.524	11.524
2	2.819	11.748	31.159	2.746	11.442	22.966
3	2.637	10.988	42.147	2.581	10.753	33.719
4	1.782	7.427	49.573	2.350	9.794	43.512
5	1.385	5.771	55.344	2.014	8.391	51.903
6	1.139	4.745	60.090	1.735	7.231	59.134
7	1.094	4.560	64.649	1.324	5.515	64.649
8	.944	3.932	68.581			
9	.864	3.602	72.183			
10	.848	3.533	75.717			
11	.765	3.186	78.903			
12	.666	2.776	81.679			
13	.637	2.656	84.335			
14	.616	2.568	86.902			
15	.484	2.019	88.921			
16	.468	1.951	90.872			
17	.424	1.768	92.639			
18	.383	1.597	94.236			
19	.316	1.317	95.554			
20	.271	1.129	96.682			
21	.249	1.039	97.721			
22	.223	.928	98.650			
23	.188	.784	99.434			
24	.136	.566	100.000			

Extraction Method: Principal Component Analysis.

**Table 4.4: Rotated Component Matrix<sup>a</sup>**

	Component						
	1	2	3	4	5	6	7
Q4.			.704				
Q5.			.688				
Q6.			.462			.447	
Q7.			.670				
Q8.			.673				
Q9.						.749	
Q10.						.736	
Q11.							.859
Q12.				.456			
Q13.	.823						
Q14.	.900						
Q15.	.805						
Q16.	.495						
Q17.				.616			
Q18.				.717			
Q19.		.583					
Q20.					.496		
Q21.		.783					
Q22.		.797					
Q23.		.579					
Q24.					.642		
Q25.					.656		
Q26.					.651		
Q27.				.699			

**Extraction Method:** Principal Component Analysis. **Rotation Method:** Quartimax with Kaiser Normalization.

a. Rotation converged in 14 iterations.

## APPENDICE II

Figure 4.6: Box –whisker plots for overall responses

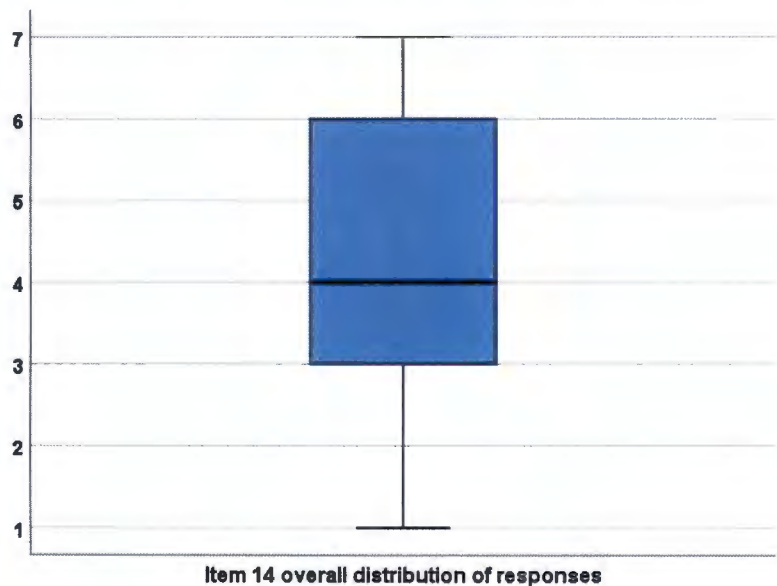
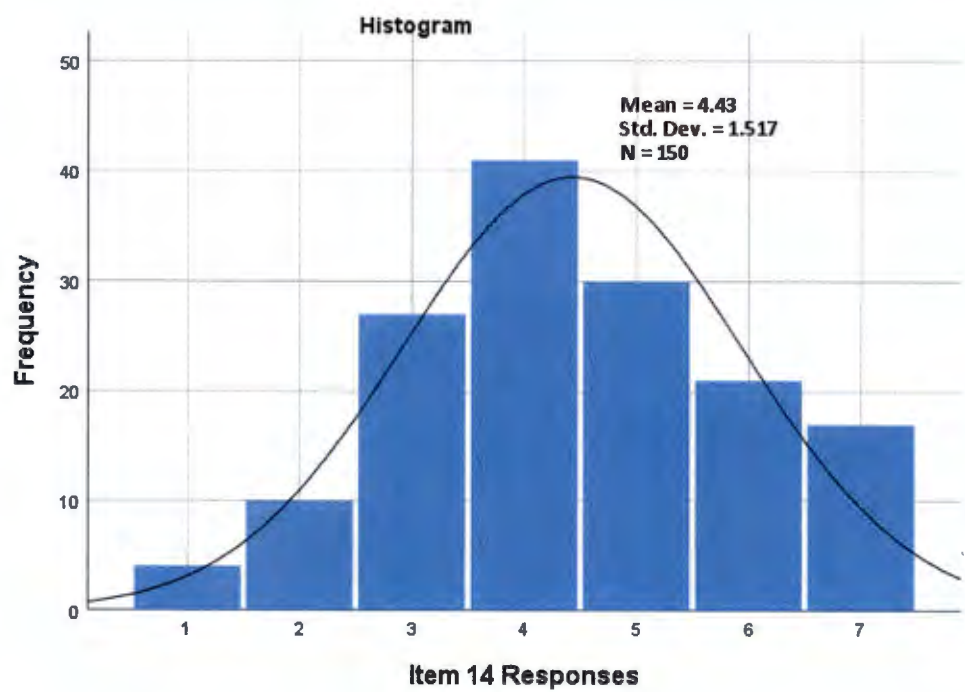
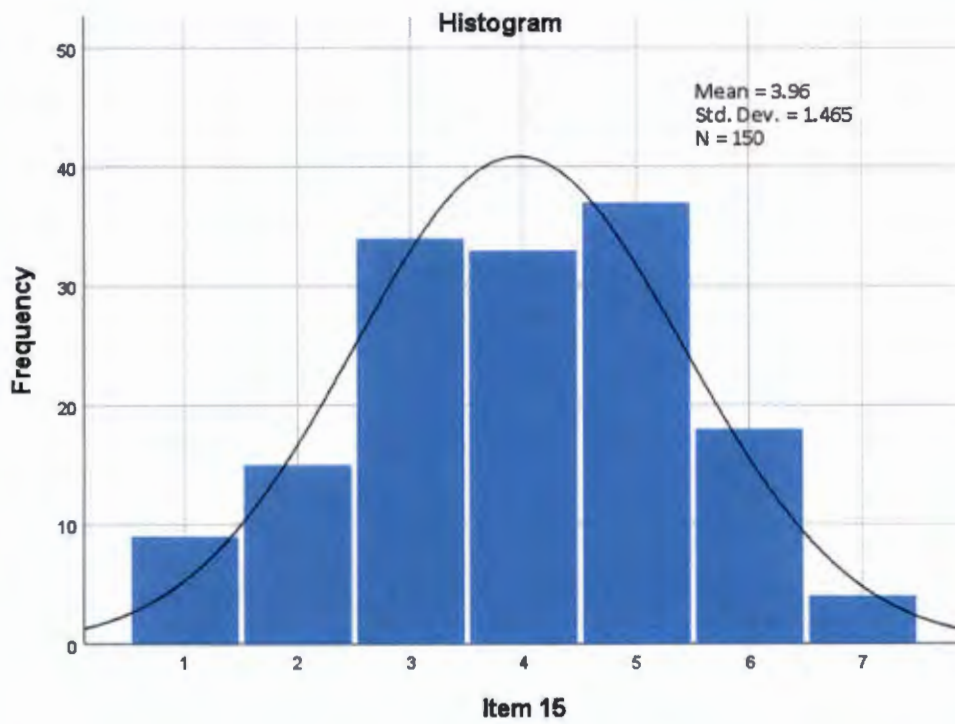


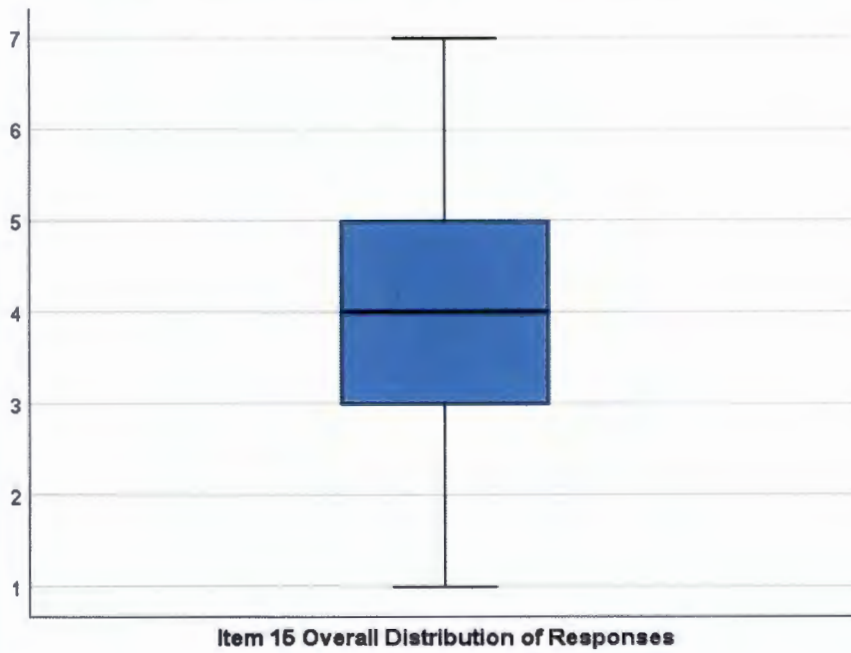
Figure 4.7: Histogram for overall responses



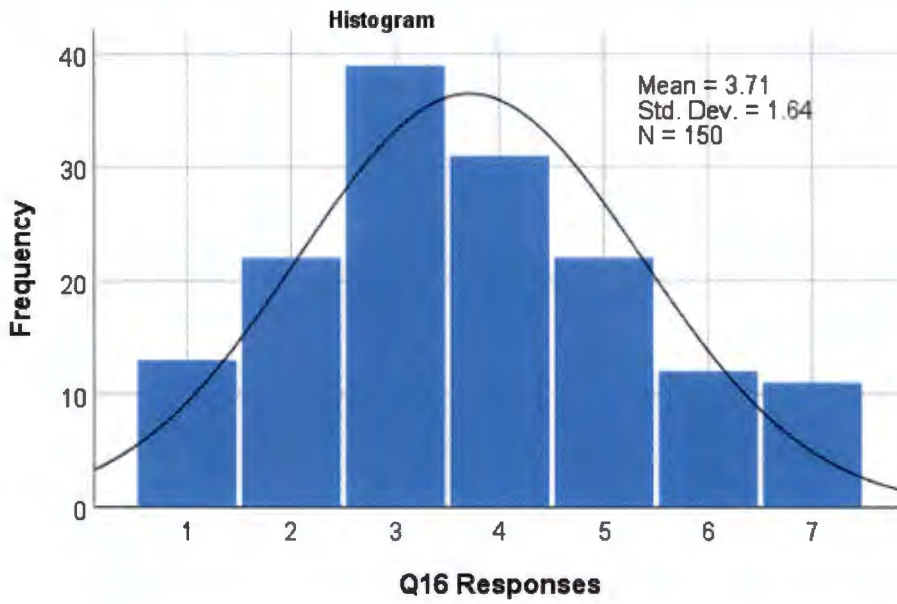
**Figure 4.8: Histogram for overall responses**



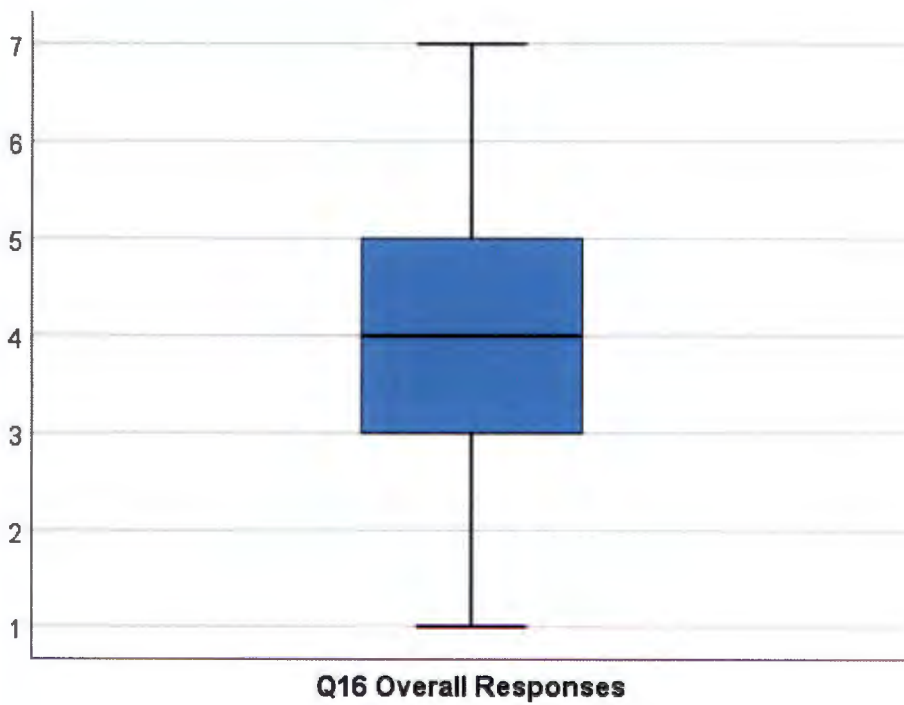
**Figure 4.9: Box –whisker plot for overall responses**



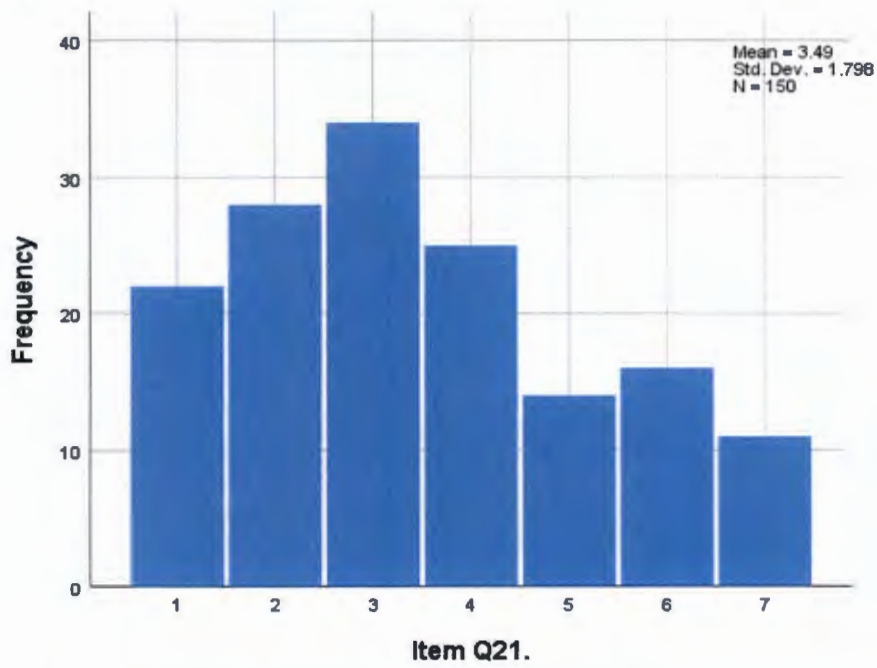
**Figure 4.10: Histogram for overall responses**



**Figure 4.11: Box – whisker plot for overall responses**



**Figure 10.13: Histogram of responses**



**Figure 10.14: Histogram of responses**

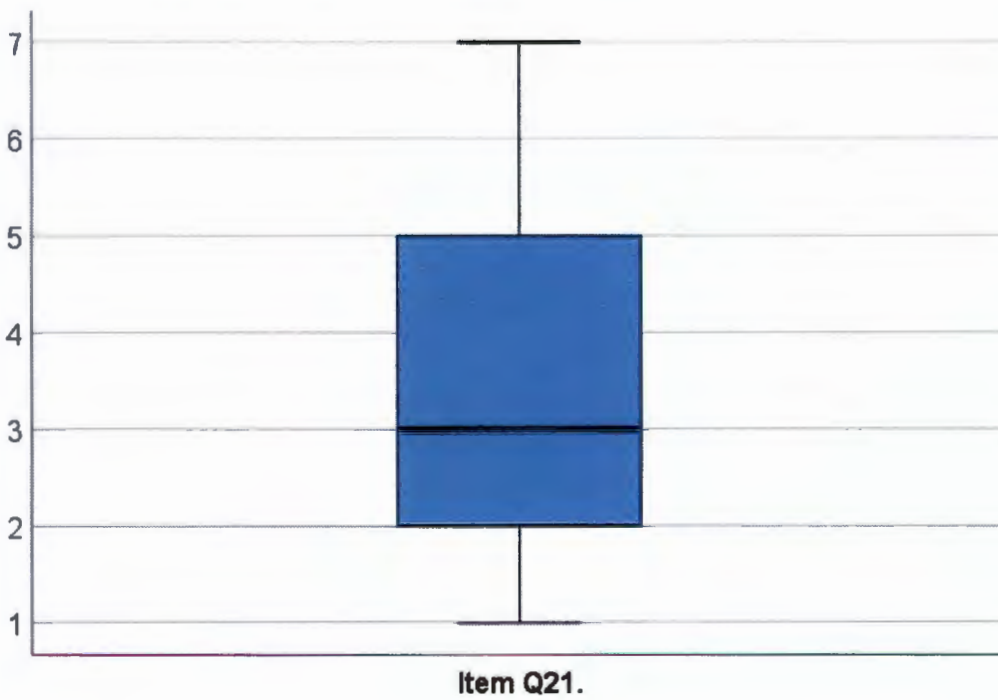


Figure 10.15: Histogram of responses

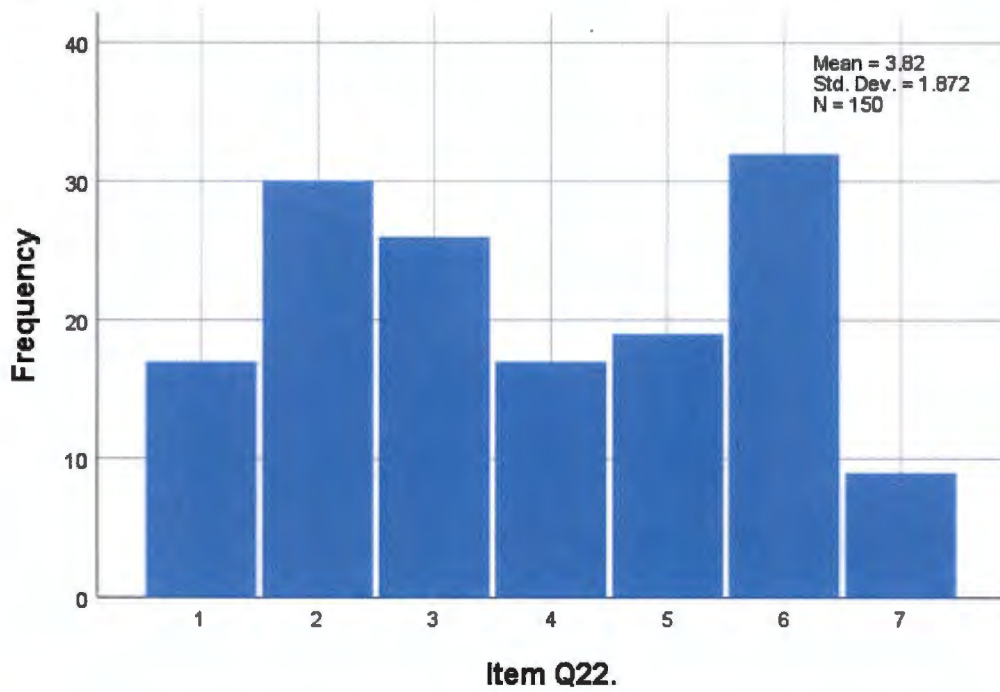
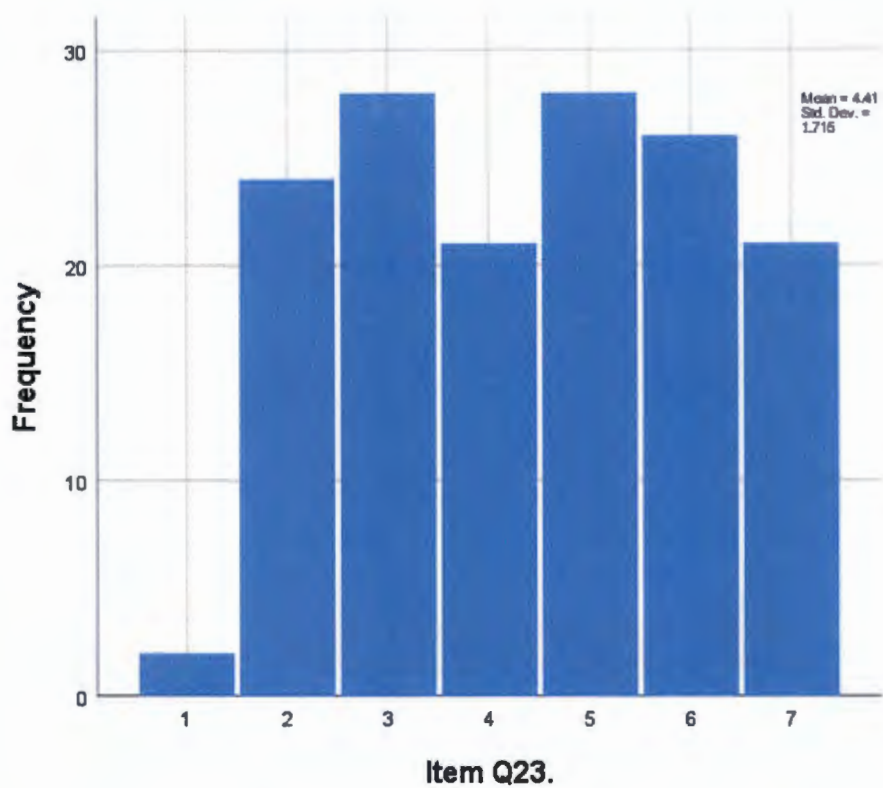


Figure 10.16: Histogram of responses



**Figure 10.17: Histogram of responses**



**Figure 10.18: Box-whisker plot of responses**

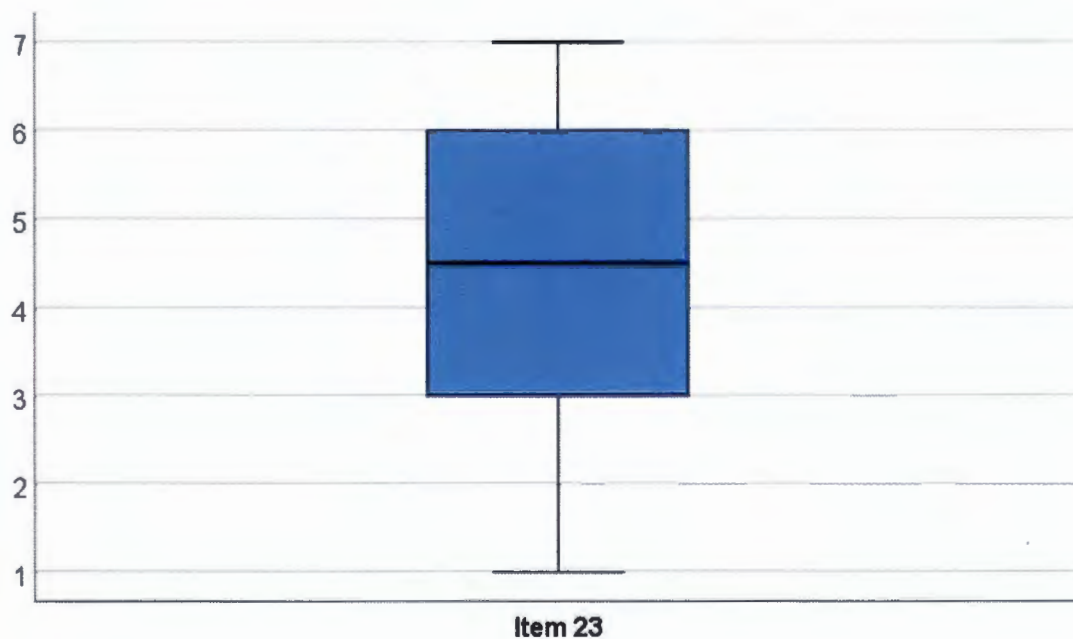
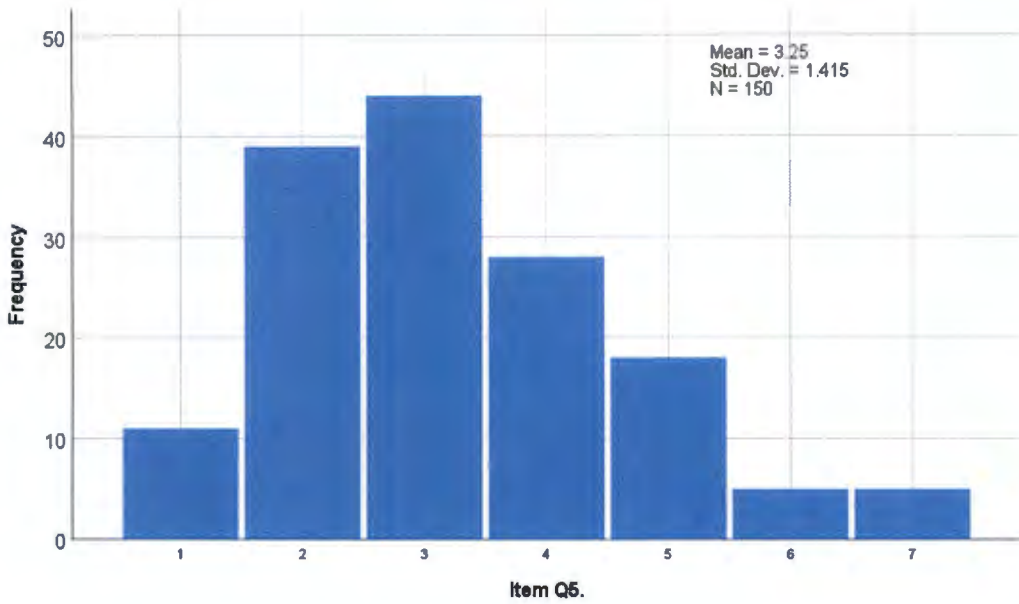


Figure 10.19.1: Histogram of responses



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Figure 10.20: Histogram of responses

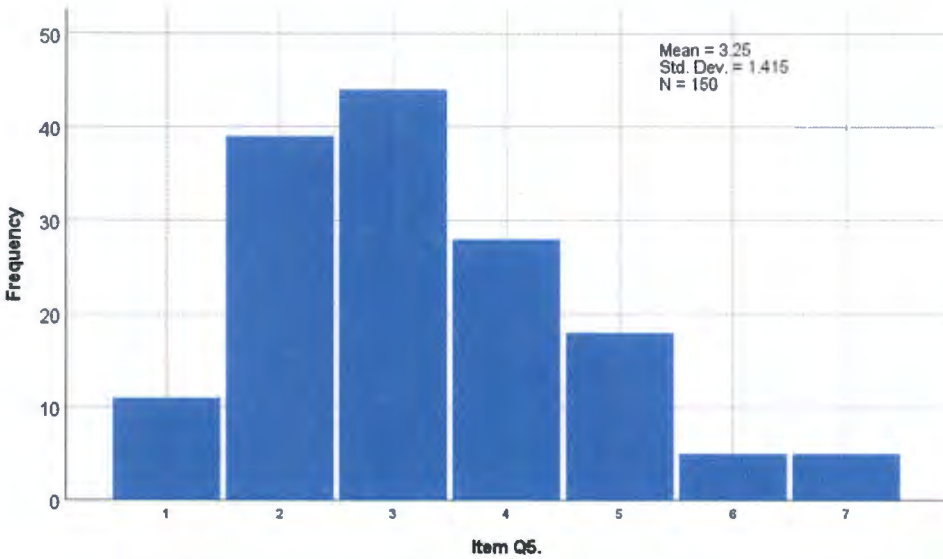


Figure 10.21: Histogram of responses

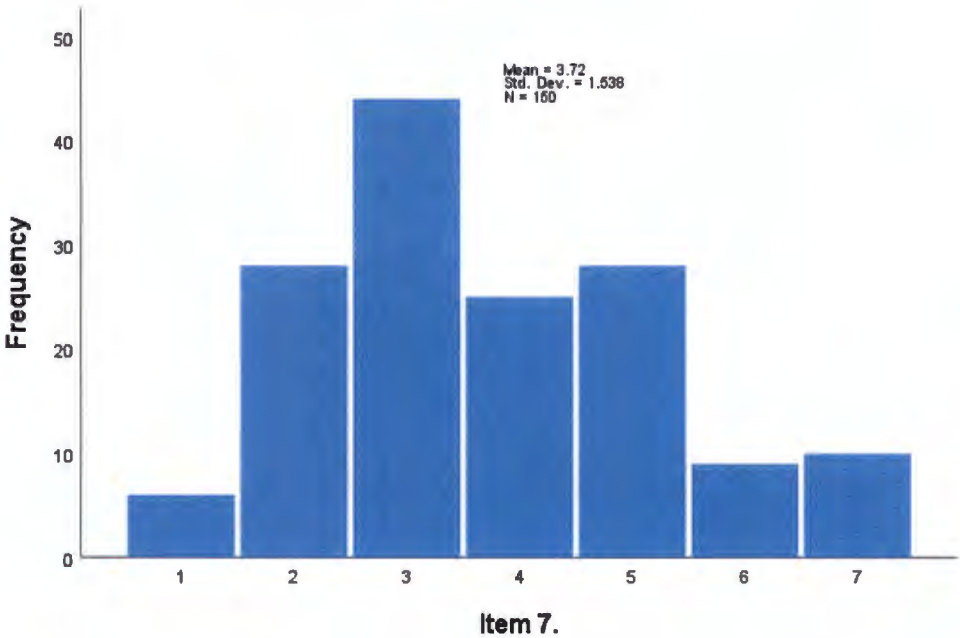


Figure 10.22: Histogram of responses

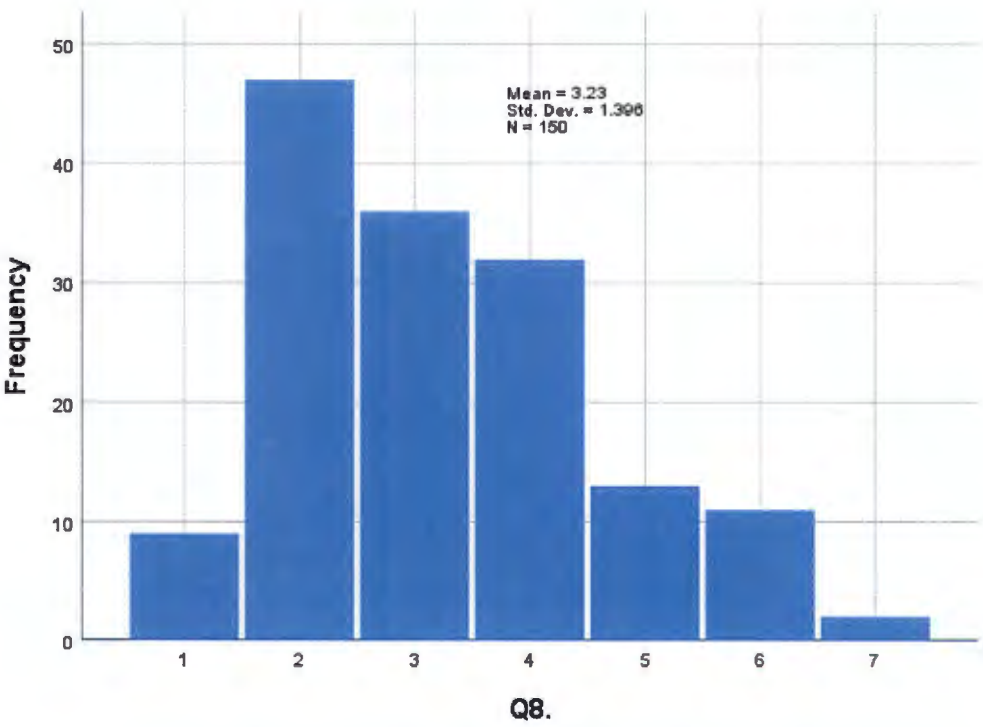


Figure 10.25: Histogram of responses

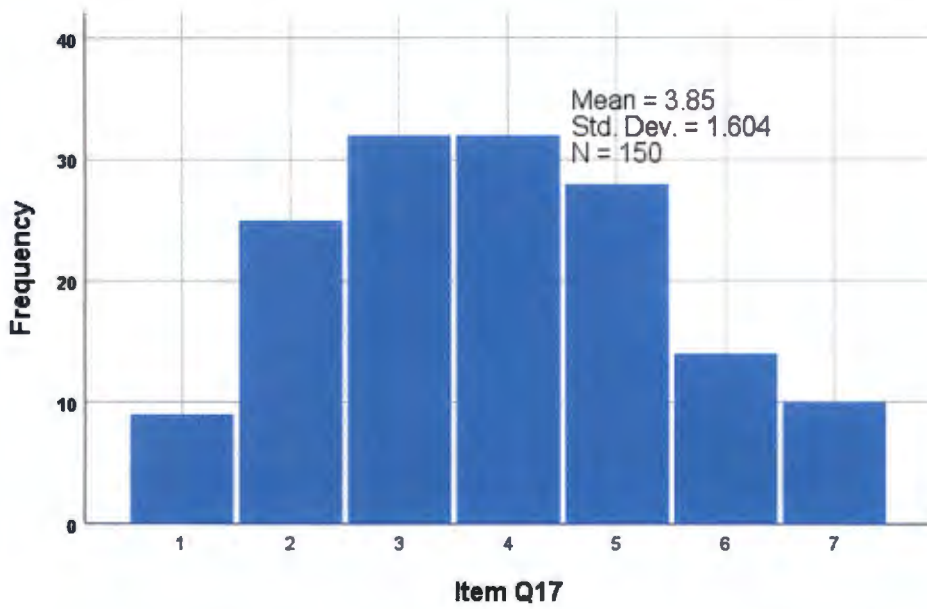


Figure 10.26: Box -whisker plot

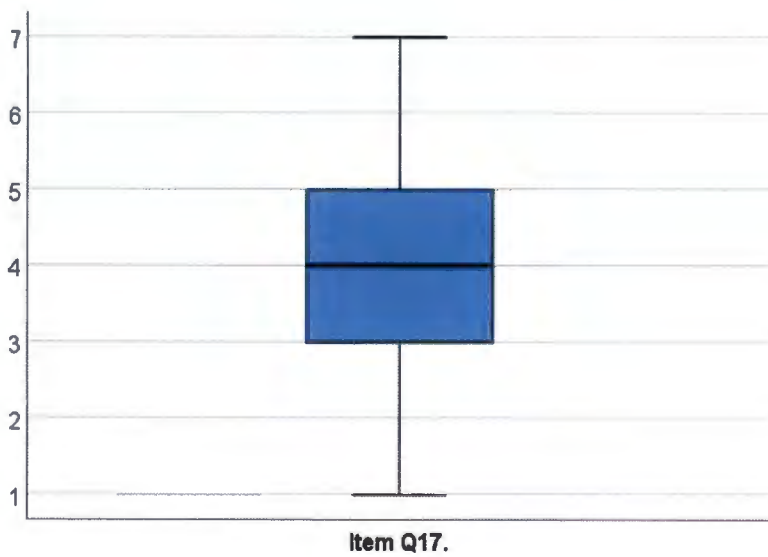


Figure 10.27: Histogram of responses

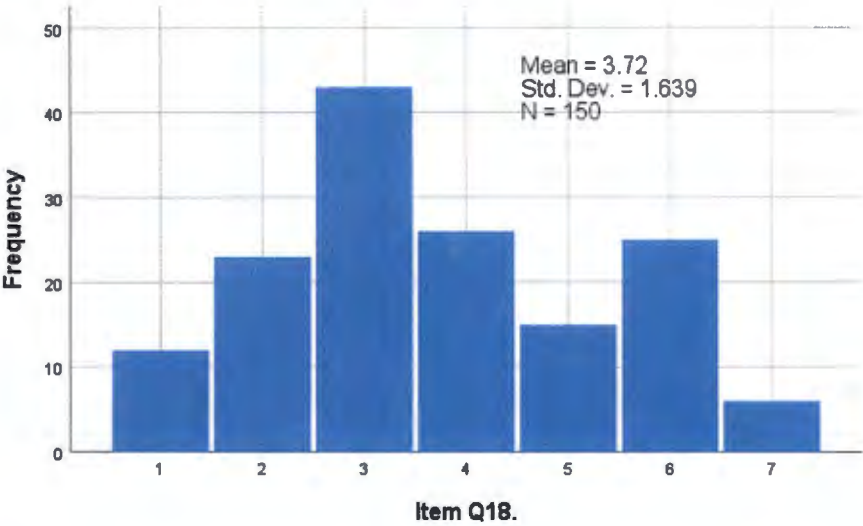
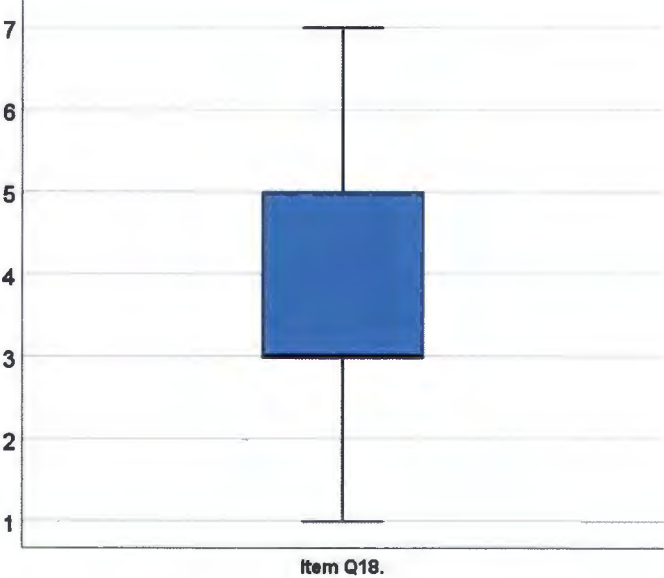
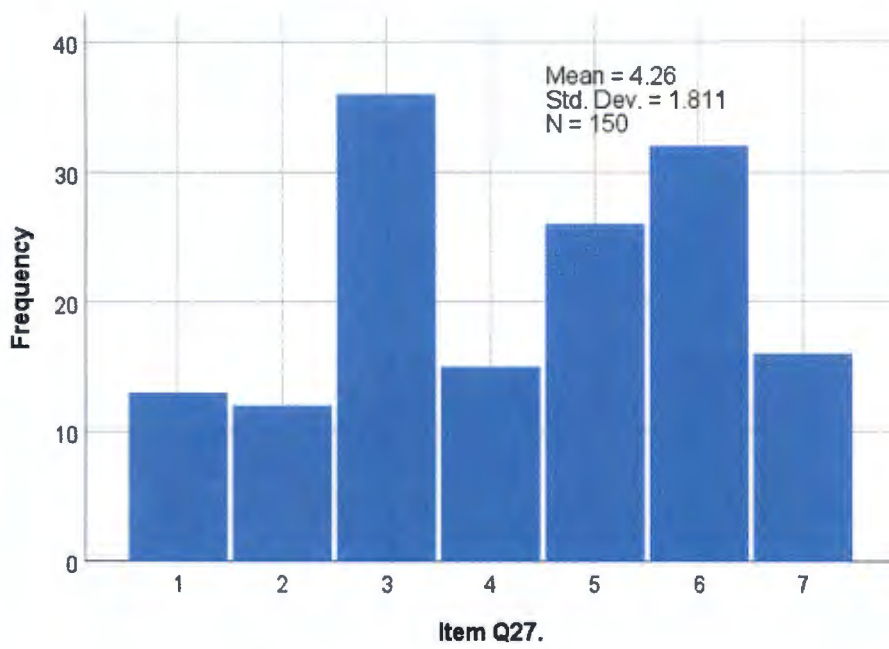


Figure 10.28: Box –whisker plot



**Figure 10.29: Histogram of responses**



**Figure 10.30: Box –whisker plot**

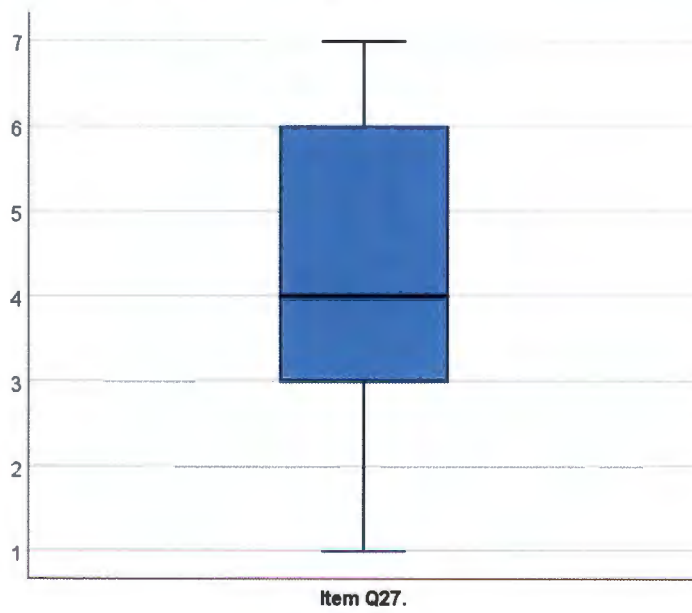


Figure 10.33: Histogram of responses

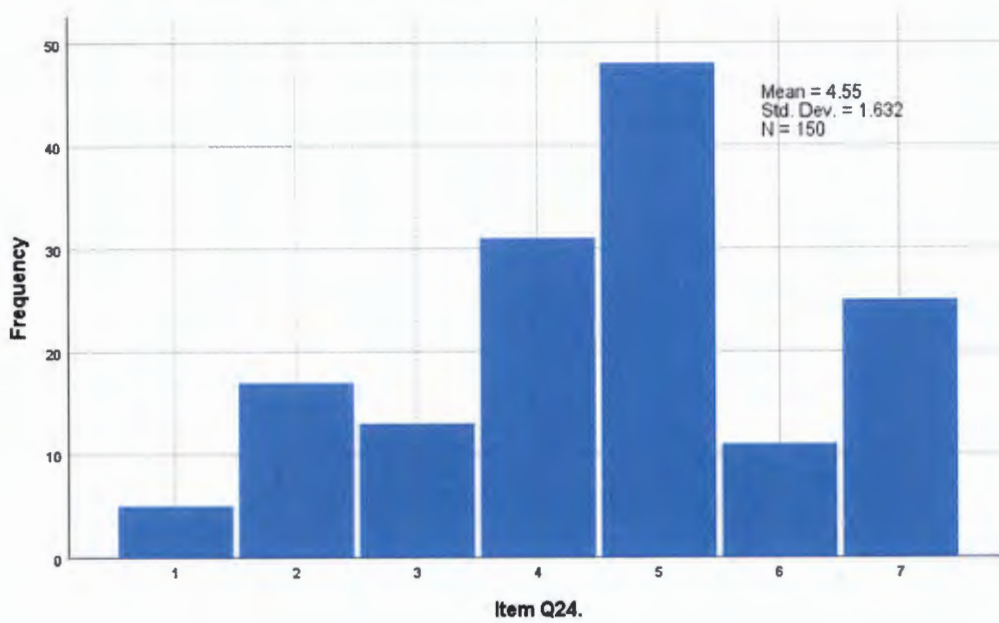
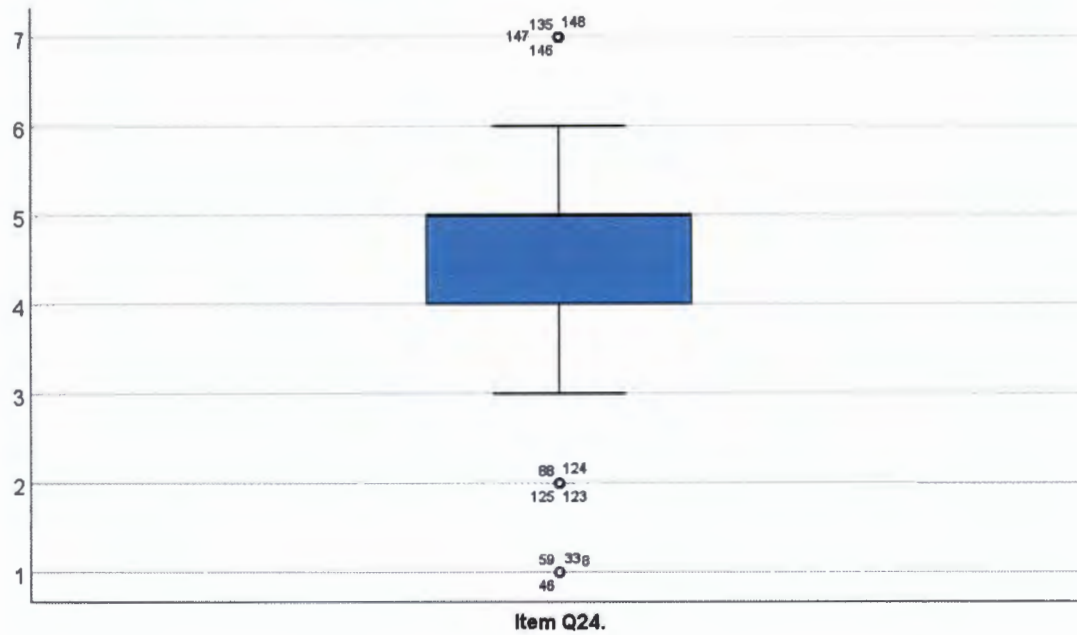
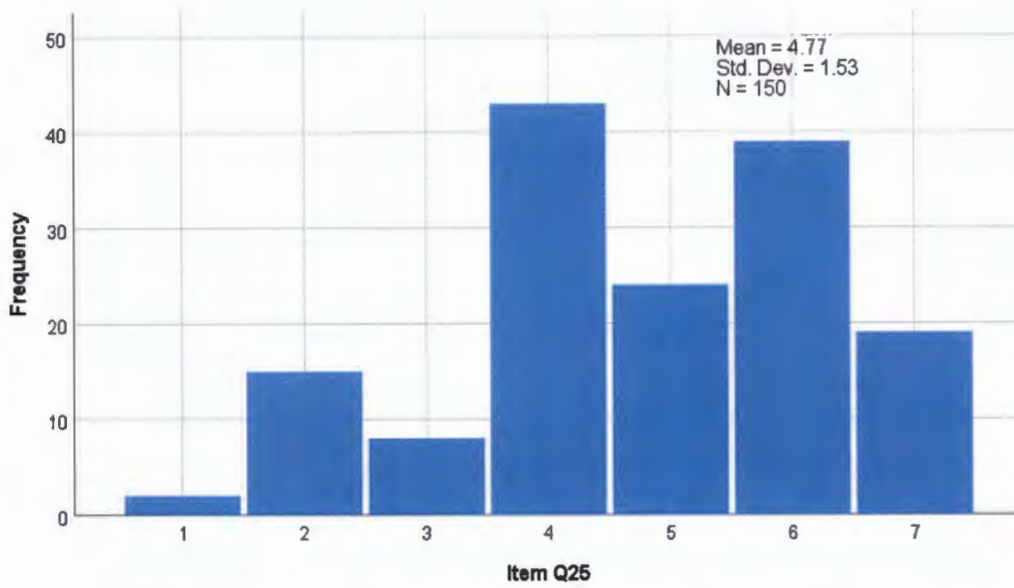


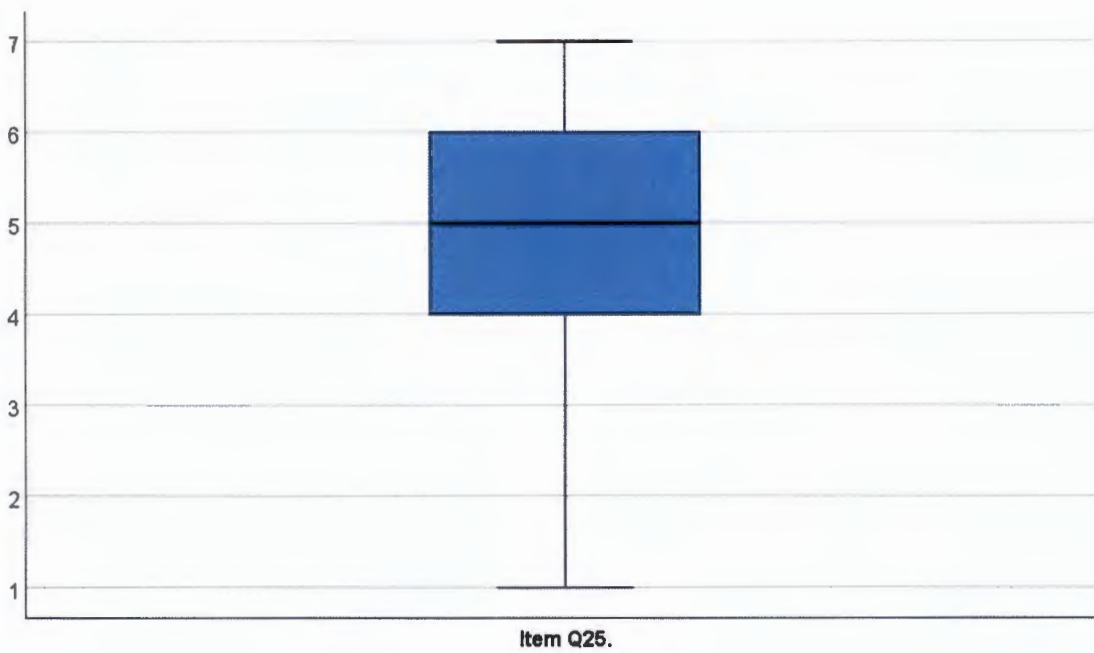
Figure 10.34: Box -whisker plot



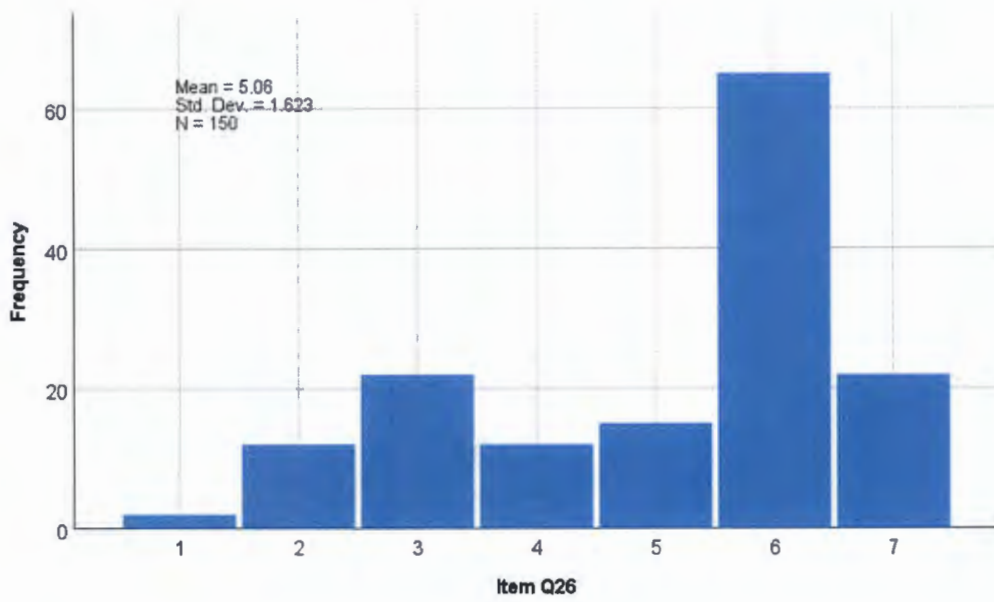
**Figure 10.35: Histogram of responses**



**Figure 10.36: Box –whisker plot**



**Figure 10.37: Histogram of responses**



**Figure 10.38: Box –whisker plot**

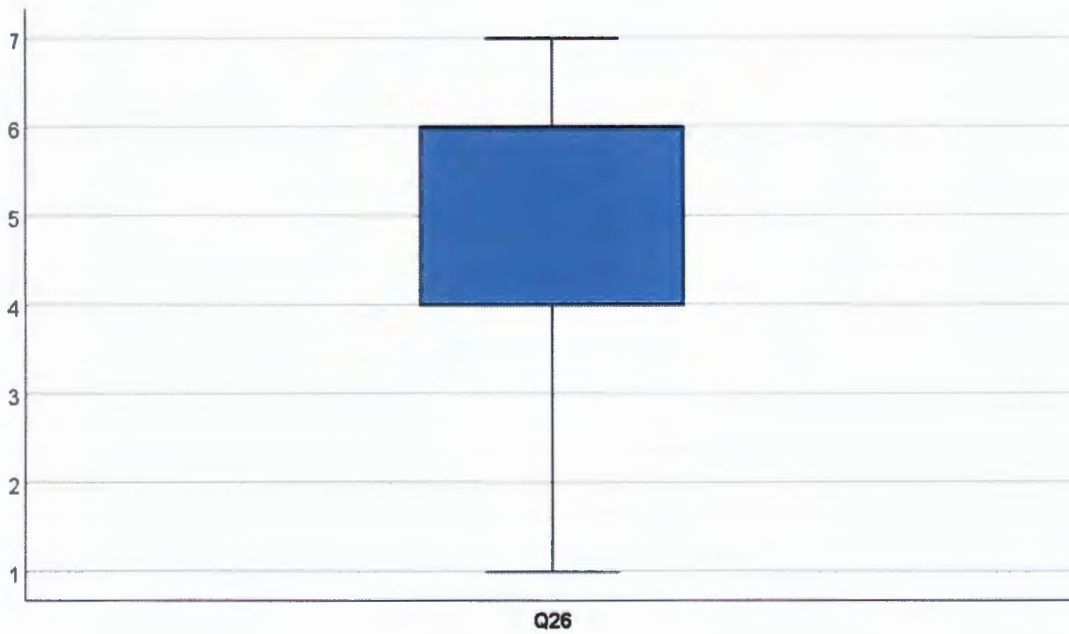


Figure 10.41: Histogram of responses

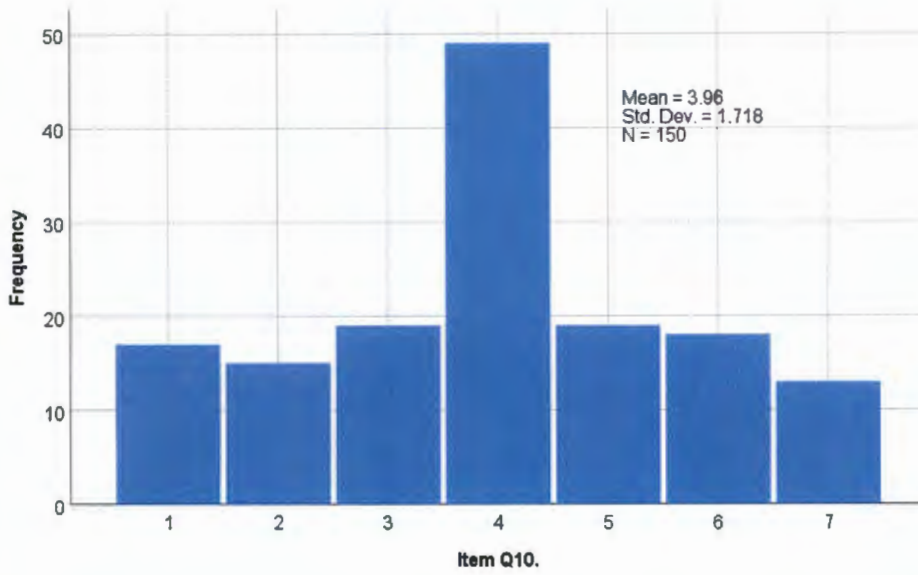
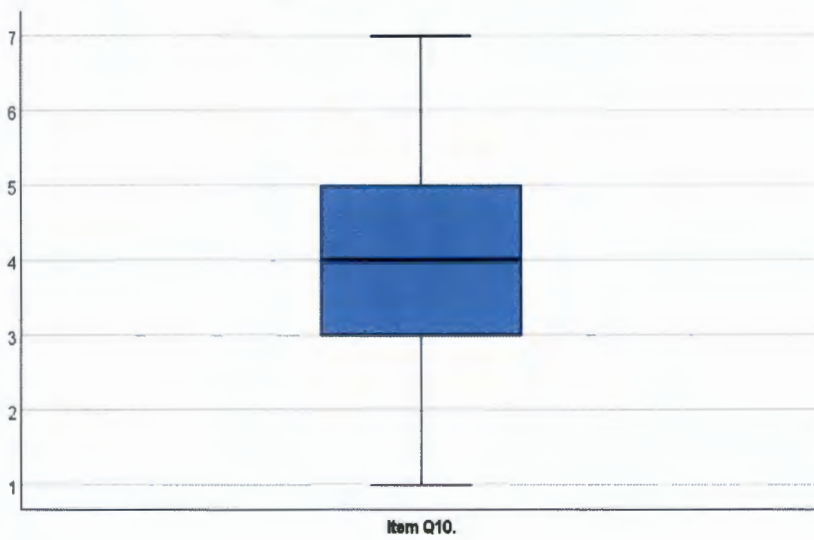


Figure 10.42: Box -whisker plot



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## APPENDICE III

### ETHICAL CLEARANCE



#### ETHICS APPROVAL CERTIFICATE OF PROJECT

Based on approval by the Human Resource Research Ethics Committee (HRREC) on 05/06/2017, the North-West University Institutional Research Ethics Regulatory Committee (NWU-IREC) hereby approves your project as indicated below. This implies that the NWU-IREC grants its permission that, provided the special conditions specified below are met and pending any other authorisation that may be necessary, the project may be initiated, using the ethics number below.

<b>Project title:</b> The Impact of Incompatible Information Management Systems on the Healthcare Service Delivery in South Africa
<b>Project Leader/Supervisor:</b> Dr S Kopang
<b>Student:</b> GA Digopo
<b>Ethics number:</b> <b>N W U - 0 0 4 9 B - 1 7 - A 9</b>
<b>Application Type:</b> Master's
<b>Commencement date:</b> 2017-05-24
<b>Expiry date:</b> 2020-05-24
<b>Risk:</b> <b>NA</b>

#### Special conditions of the approval (if applicable):

- Translation of the informed consent document to the languages applicable to the study participants should be submitted to the HRREC (if applicable).
- Any research at governmental or private institutions, permission must still be obtained from relevant authorities and provided to the HRREC. Ethics approval is required BEFORE approval can be obtained from these authorities.

#### General conditions:

While this ethics approval is subject to all declarations, undertakings and agreements incorporated and signed in the application form, please note the following:

- The project leader (principal investigator) must report in the prescribed format to the NWU-IREC via HRREC:
  - annually (or as otherwise requested) on the progress of the project, and upon completion of the project
  - without any delay in case of any adverse event (or any matter that interrupts sound ethical principles) during the course of the project
  - Annually a number of projects may be randomly selected for an external audit
- The approval applies strictly to the protocol as stipulated in the application form. Would any changes to the protocol be deemed necessary during the course of the project, the project leader must apply for approval of these changes at the HRREC. Would there be deviations from the project protocol without the necessary approval of such changes, the ethics approval is immediately and automatically forfeited.
- The date of approval indicates the first date that the project may be started. Would the project have to continue after the expiry date, a new application must be made to the NWU-IREC via HRREC and new approval received before or on the expiry date.
- In the interest of ethical responsibility the NWU-IREC and HRREC retains the right to:
  - request access to any information or data at any time during the course or after completion of the project.
  - to ask further questions, seek additional information, require further modification or monitor the conduct of your research or the informed consent process.
  - withdraw or postpone approval if:
    - any unethical principles or practices of the project are revealed or suspected,
    - it becomes apparent that any relevant information was withheld from the HRREC or that information has been false or misrepresented,
    - the required annual report and reporting of adverse events was not done timely and accurately,
    - new institutional rules, national legislation or international conventions deem it necessary.
- HRREC can be contacted for further information via [Ethics@nwu.ac.za](mailto:Ethics@nwu.ac.za) or 018 299 2873

The IRECR would like to remain at your service as scientist and researcher, and wishes you well with your project. Please do not hesitate to contact the IRECR or HRREC for any further enquiries or requests for assistance.

Yours sincerely

**Prof LA Du Plessis**  
Digitally signed by  
Prof LA Du Plessis  
Date: 2017.06.08  
15:17:58 +02'00'

**Prof Linda du Plessis**  
Chair NWU Institutional Research Ethics Regulatory Committee (IRECR)



**health**  
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 North West Province  
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**POLICY, PLANNING, RESEARCH, MONITORING AND EVALUATION**

Name of researcher : Mr. G.A. Digopo  
 North West University

Physical Address: TALUNG NHCS  
 (Work/ Institution) TALUNG DISTRICT HOSPITAL  
TALUNG, 8584

Subject : Research Approval Letter- The impact of incompatible Information Management Systems on Health Care service delivery in South Africa.

This letter serves to inform the Researcher that permission to undertake the above mentioned study has been granted by the North West Department of Health. The Researcher is expected to arrange in advance with the chosen facilities, and issue this letter as proof that permission has been granted by the Provincial office.

This letter of permission should be signed and a copy returned to the department. By signing, the Researcher agrees, binds him/herself and undertakes to furnish the Department with an electronic copy of the final research report. Alternatively, the Researcher can also provide the Department with electronic summary highlighting recommendations that will assist the department in its planning to improve some of its services where possible. Through this the Researcher will not only contribute to the academic body of knowledge but also contributes towards the bettering of health care services and thus the overall health of citizens in the North West Province.

Kindest regards

Mr. L.P. Moasi  
 Acting Director: PPRM&E

LEPAPNA LA BOITERANEHO  
 DEPARTMENT OF HEALTH  
 Kgofung P.O. Box 719016 809 2708  
 Mmabatho: 2735  
 5 OCT 2017  
 NORTH WEST PROVINCE  
 REPUBLIC OF SOUTH AFRICA

04/10/2017  
 Date

Researcher

05/10/2017  
 Date

Healthy Living for All

## APPENDICE IV

### 1 QUESTIONNAIRE

#### SECTION A: DEMOGRAPHICS (PLEASE MARK BY AN X)

1. What is your gender?	Male	1
	Female	2
2. What is your age?	Under 30	1
	31 - 40	2
	41- 50	3
	51 and over	4
3. What is your job title?	Professional nurse	1
	Doctors/ Clinical associate	2

**For this sections B, C and D, mark with an “X” to express your perception against each questionnaire item follows;**

1 = strongly disagree, 2 = partially disagree, 3 = disagree, 4 = neutral, 5 = partially agree, 6 = agree and a 7 = strongly agree.

#### **SECTION B: IDENTIFICATION OF NEEDED DATA IN TRAKCARE**

Items	1	2	3	4	5	6	7
4. Online patient health care information is on the right level of detail for my needs							
5. The organization sufficiently maintain detailed patient records.							
6. The computer systems for patient access are convenient and easy to use.							
7. It is easy to learn how to use the computers systems to access the data.							
8. can count on the system to be “up” and available when I need it.							
9. The data is subject to frequent system problems and crashes.							

**SECTION C: INTERGRATING AND INTERPRETING ACCESSED TRAKCARE DATA**

Items	1	2	3	4	5	6	7
10. Patient data is accurate enough to support clinical care.							
11. There are accuracy problems in patient data.							
12. Unexpected inconsistencies exist when online record are compared to paper records.							
13. The variety of terms used for the same idea or procedure sometimes makes it impossible to compare or aggregate data from online and paper sources							
14. Patient data is stored in so many different places and in so many forms, it is hard to know how to use it effectively							
15. Many different systems files exist with slightly different data, hard to understand which to use in a given situation.							
16. It is easy to find out what data the organization maintains on a given patient.							
17. Easy to obtain data on a particular diagnostic test/ procedure, even on first time							
18. The exact data definition of data fields relating to my tasks is easy to find out.							

**SECTION D: ACCESSING IDENTIFIED TRAKCARE DATA**

Items	1	2	3	4	5	6	7
19. I can get data quickly and easily when I need it.							
20. It is easy to get access to the data that I need.							
21. I am getting the help I need in accessing and understanding the data.							
22. It is easy to get assistance when I am having trouble finding or using data.							
23. There are times when supposedly equivalent data from online and paper sources is inconsistent							
24. Data is upto-date enough for my purposes.							
25. I can't get data that is current enough to meet my needs.							
26. Data is presented in a readable and useful format.							
27. Data that I need is displayed in a readable and understandable form.							

Thank you for your participation in this survey