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CLINICIANS KNOWLEDGE AND PERCEPTIONS OF POINT OF CARE TESTING (POCT) IN SELECTED HOSPITALS IN THE FREE STATE, SOUTH AFRICA

By

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A mini-dissertation submitted

In partial fulfilment of the requirements for Master's in Public Health

SUPERVISOR

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30 August 2022

DECLARATION

I, Edgar Jeffrey Watkins (201928122), hereby declare that this dissertation is my original project and was not presented to another University for conferring a degree.

Signature……

Date: 30 August 2022

CERTIFICATION

This mini-dissertation entitled ‘Clinicians knowledge and perceptions of point of care testing (POCT) in selected hospitals in the Free State, South Africa’ was completed under the supervision and guidance of Dr. KE Oladimeji at the University of Fort Hare, East London.

Signature……...

Dr KE Oladimeji, MPH, PHD (Supervisor)

Date: 30 August 2022

ACKNOWLEDGEMENTS

I am grateful to the Lord guidance throughout the research process.

I am grateful to my Supervisor, Dr Oladimeji, Elizabeth Kelechi, for her guidance, critical engagement in the study

My heartfelt appreciation goes to:

- My dear friend and colleague, Johannes Mokgatle, who has always been there to encourage me, even when times get tough.
- My family and friends, for their support as I undertook my research project. Without their encouragement and encouragement, the process would have been much more difficult.
-

My deepest thanks go to my wonderful wife, Eggy Joice Zanele Watkins, for her support, inspiration, and guidance; and to my children, Ethan and Ellesen, for supporting my studies.

ABSTRACT

Point of care testing (POCT) improves access and equity to health diagnostic services in resource-limited settings like South Africa, where some health facilities do not have on-site laboratories. With recent technological advancements, most traditional laboratory tests can now be conducted on-site at primary health clinics (PHC), hospital wards and clinics. One advantage of the POCT device is that it can be used by a non-medical laboratory expert at the patient's bed side during hospitalizations or near the patient in the doctor's consultation rooms. This results in a shorter turnaround time for the availability of test results when compared to that from a specimen sent to a traditional clinical laboratory. Despite the benefits of POCT, many clinicians (doctors and nurses) avoid utilizing POCT for quality assurance reasons. Clinicians believe the results from a POCT device may not be as reliable as the results from tests performed by a medical laboratory scientist in the traditional clinical laboratory. This study used a concurrent mixed method research design to explore clinicians' POCT knowledge and attitudes in a subset of hospitals in the Free state of South Africa. The study population comprised of consenting medical professionals from the ten (10) selected Free State district hospitals (study sites). The findings demonstrated that hospitals in urban areas have easier access to laboratory services. There were two (2) urban study sites that had on-site laboratories which achieved faster Turn-Around-Time (TAT). The participants indicate that they are aware of POCT and routinely use it, but there are far fewer POCT tests available than laboratory tests. When diagnostic options are scarce, point-of-care testing (POCT) can provide a more accurate diagnosis than traditional methods. The improved health care provision and reduced incidence of health complications is the end result. According to the participants, having access to POCT diagnostic services has shown promise in

addressing challenges that sometimes present with laboratory-based methods, particularly in settings with limited access to hospitals or when laboratories cannot be accessed. Further, clinicians argue that errors in the usage of POCT may occur due to the quality of these POCTs and improper documentation of the test results by the clinicians. Therefore, poor utilization of POCT by clinicians can be improved if implemented with pre-set strict selection goals and processes to ensure that the right POCT is selected for the right purpose that would reduce resource expenditure by the hospitals and improve patient experiences and health outcomes.

DEDICATION

This thesis is dedicated to my family, Eggy, Ethan, Ellessen, Kel-Darren and Angela Watkins.

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LIST OF ABBREVIATIONS

ASSURED - Affordability, Sensitivity, Specificity, User-friendliness, Rapid performance, Equipment and Deliverability

CD4 - Cluster of Differentiation 4

CLI - Clinical Laboratory Interface

CRP - C-reactive Protein

FBC - Full Blood Count

FSDOH - Free State Department of Health

HbAC1 - Hemoglobin A1c

HIV - ` Human Immunodeficiency Virus

LTFU - Loss-to-follow-up

NHLS - National Health Laboratory System

OPD - Out Patient Department

PHC - Primary Health Care

POCT - Point of Care Testing

QDA - Qualitative Data Analyser

RPR - Rapid Plasma Reagin

SMS - Short Message Services

SPSS - Statistical Package for the Social Sciences

TAT - Turn-Around-Time

U&E - Urea and Electrolytes

UFH - University of Fort Hare

WHO - World Health Organisation

MANCOFS - Mangaung Nursing College OFS

QA - Quality Assurance

QC	-	Quality Control
KP	-	Knowledge and Practice (KP)
FDA	-	American Food and Drug Administration (FDA
SAPHRA	-	South African Health Products Regulatory Authority
SANAS	-	South African National Accreditation System

CHAPTER 1

INTRODUCTION AND BACKGROUND TO THE STUDY

1.1 INTRODUCTION

Clinicians (doctors and nurses) are responsible for the diagnosis of patients. When necessary, they will order a laboratory test from the clinical laboratory scientist because they recognize the value of laboratory tests in screening to confirm a diagnosis and support patient care (Schroeder, Guarner, and Amukele, 2018). Obtaining accurate results as soon as possible is necessary and sometimes a life-saving concern for doctors and nurses to make an informed diagnosis to facilitate speedy patient management. Traditionally, a specimen is sent to the clinical laboratory for testing. Such a laboratory may be situated on-site, resulting in a specified turn-around-time of test results depending on the nature of the tests requested and the operating hours of the laboratory. If the laboratory is off-site, the turn-around time is much longer since transport must be arranged to dispatch the specimen to the laboratory, and the test results must be transported back to the hospital if there is no electronic access to the test result. Thus, clinical laboratory tests play an important role in patient management, both for routine tests and tests in the health facility's emergency department.

POCT is the testing of the patient specimen at the patient's bedside or near the patient in the consultation rooms instead of sending it to a clinical laboratory. The major

advantage of the POCT is the quick turnaround time for the availability of the test result and also the fact that conducting the POCT does not rely solely on clinical laboratory-trained experts, they can be executed by clinicians. Consequently, test results become available while the patient is still in the health facility, thereby resulting in quicker access to test results that allows for quicker clinical decision-making and suitable patient management (Kazmierczak, 2011). A recent 2019 study conducted in the province of Kwazulu-Natal, South Africa, provides evidence that POCT alleviates some diagnostic challenges and test result delays linked with clinical laboratory methods in low- and middle-income countries (Katoba, Kuupiel, and Mashamba-Thompson, 2019). In addition, POCT also assists in reducing time-dependent variations in an analytic test like glucose that may be affected by time delays when samples are transported to the laboratory. Lastly, POCT test methods generally need lesser specimen volumes than those required for clinical laboratory testing.

Despite the ease of usage and benefits of POCT, many clinicians are concerned that the results of POCT may not be as reliable as the results of clinical laboratory tests and, as a result, avoid performing the POCT. According to the argument, this type of testing may result in errors due to a lack of understanding of the importance of quality assurance, control, and areas of documentation, charting results, and training of clinicians performing POCT (Shaw, 2016). As a result, poor utilization of POCT can be improved if strict selection goals and processes are implemented to ensure the right POCT is selected for the right purpose, which improves positive patient experiences and reduces hospital resource expenditure.

The following seven (7) countries have robust POCT policies and guidelines, which were often developed collaboratively by general practitioners, nurses, and

clinical laboratory pathologists; Canada, France, the United States of America, Germany, Spain, Ireland, and the United Kingdom. These policies and guidelines cover areas of assessment and selection of appropriate devices for specified clinical tasks and settings, training and competency of operators, patient and sample identification, secure recording of results, quality control of the device and external quality assurance. In the South African context, there has been limited research on POCT utilisation and selection with the involvement of clinicians.

1.2 PROBLEM STATEMENT

Regardless of widely available literature that POCT has distinct advantages, there is limited use of POCT by clinicians. This poor utilization of POCT may be due to inadequate knowledge and uninformed perceptions of the value of POCT among clinicians, which can negatively affect patients' and clinicians' experiences (Shaw, 2016). Poor utilization of POCT denies the patient and health system the benefits of POCT, including improved patient outcomes, reduced number of clinic visits, and less loss-to-follow-up (LTFU) (Hardy et al., 2016). However, it is acknowledged that POCT brings barriers such as user errors, doubt about the accuracy of POCT, internal and external quality control, and administrative and technical oversight, and may be justifiable reasons for clinicians not to use POCT on a larger scale than they currently do. It may lead clinicians to believe that traditional laboratories provide more reliable specimen testing results. The purpose of this research proposal is to identify clinicians' knowledge and perceptions of POCT, as well as the benefits and barriers that contribute to poor utilization of POCT.

1.3 RESEARCH AIM AND OBJECTIVES

Based on the research problem, the specific objectives of the research are:

1) To evaluate the current POCT practices of clinicians in selected hospitals in the Free state, South Africa

2) To explore how the knowledge and perceptions of clinicians influence the use of POCT in selected hospitals in the Free state, South Africa

1.4 RESEARCH QUESTIONS

The following research questions guided the study and research approach:

1) What are the current practices of clinicians when they perform POCT in hospitals?

2) How does the level of knowledge and perceptions of clinicians regarding POCT devices influence the use of POCT?

1.5 IMPLICATIONS OF THE STUDY

The findings of the study will provide insight into clinical managers in following processes designed for the selection of POCT while identifying constraints of POCT. It will furthermore enlighten and alert hospital clinical managers on the risk factors associated with POCT when proper selection mechanisms are not followed. The understanding of POCT selection processes as gained from this proposed study can be a starting point in conceiving operational policies to control the proliferation of POCT and make sure that it is used for the correct intentions. It can also add value to nationwide studies in the implementation of the South African National Department of Health (NDoH) Point of Care Testing Framework, which states that some selection criteria must include a clinical needs assessment, operational needs assessment, and

financial needs assessment. This may advise policymakers to devise appropriate regulations to manage POCT since it is well known that there may be good health care governing policies. Still, implementation is not practised thoughtfully at the point of patient care. As a result, this research is envisioned to be of great value to departments of health as a guideline for how current and future policies on POCT can be implemented more effectively.

The results of the study can add to the body of knowledge and will also assist in distinguishing between the knowledge and perceptions of clinicians relating to POCT. The rapid availability of POCT results after the initial assessment of the patient may lead to improved efficiency and patient experiences (Goldstein et al., 2018). The study can open up future research opportunities by highlighting the existing lack of POCT policy and may propel the approval of the proposed South African National Department of Health Point of Care Testing Framework.

1.6 LIMITATIONS OF THE STUDY

`from the Free State Department of Health district hospitals.

1.7 DEFINITION OF KEY CONCEPTS

Point of Care Test – Also referred to as near-patient testing, are diagnostic tests performed in the ward, clinic or in the presence of the patient. They are portable, provide quick test results, use smaller sample volume and can also be used for patient self-monitoring" (Miller Louise Kimberley, 2016).

Clinical laboratory tests / Traditional laboratory tests – "A clinical laboratory is a laboratory where tests are done on clinical specimens to get

information about the health of a patient in order to confirm a diagnosis, treat, and prevent disease" (Michel, 2019).

Clinicians – Clinicians are health care professionals that may diagnose, treat and care for patients in a clinic, hospital, at home or in a private medical practice where they work directly with patients rather than in a laboratory or as a researcher (Cawley, 2010).

Turn-around-time (TAT) – Laboratory TAT is the time taken from requesting diagnostic tests to the point when the results become available to a clinician (Bhattarai & Manandhar, 2018). It is a sign of service satisfaction and is a key performance indicator for clinical laboratories. The shorter the TAT, the better it is to allow the clinician to make a quick decision on what steps to follow in terms of diagnosis, screening or treatment monitoring.

POCT Selection - POCT selection is the process followed to identify which POCT devices or technologies are suitable to obtain a test result that will assist the clinician in making an informed scientific decision for patient management (Kosack, Page, Klatser, 2017b). It includes defining the test purpose, identifying the cost of the tests as well as the time-based cost of clinicians or laypersons who will perform the tests, studying the market, determining the tests optimal diagnostic accuracy, determining the tests diagnostic accuracy in practice and monitoring the test when in everyday use. Mainly, POCT must improve the experience of both the patient and the clinician.

1.8 STRUCTURE OF THE DISSERTATION

Chapter One provides the background to the study. It also outlines the problem statement, objectives and significance of the study and provides a list of definitions of key terms.

Chapter Two provides a review of the literature relevant to the study. It also establishes the theoretical framework of the research in order to ground the inquiry.

Chapter Three describes the methodology of the study and offers a detailed discussion of the research methods used. It also outlines the data collection instruments, sampling method and data analysis employed in the study.

Chapter Four presents a discussion of the data, through the data analysis, based on the objectives of the study.

Chapter Five provides conclusions based on the findings of the data analysis. This chapter also offers recommendations in line with the problem statement and objectives of the study.

CHAPTER 2

LITERATURE REVIEW

2.1 THE DIAGNOSTIC TESTING ENVIRONMENT OF THE CLINICAL LABORATORY

A clinical laboratory or medical laboratory is a laboratory where medical technologists and medical scientists perform clinical pathology tests on a clinical specimen to gain clinical information about a patient to assist a clinician in making an appropriate diagnosis that will assist in the treatment and prevention of disease (Bayot and Naidoo, 2020). These laboratories are healthcare services that provide a wide range of laboratory tests as well as processes for generating data that translates to a test result. The tests are performed by highly trained professionals using state of the art equipment.

Clinical laboratory testing is important to improving quality healthcare outcomes and containing long-term health expenditure by early detection and diagnosis of disease. South Africa uses a highly centralized laboratory system with tests performed by the] for all public healthcare facilities and a few large diagnostic companies that render laboratory services to private healthcare providers. This means that all Primary Health Care clinics and most district hospitals sent their specimens via an NHLS organized courier to the nearest laboratories, which are located in the cities and bigger towns (Engel et al., 2015). Results are conveyed back to the healthcare facilities by the NHLS courier, SMS, and the Internet. Emergency and critical results are also conveyed telephonically. In the Free State, nine of the clinical laboratories are situated

on the same premise as the hospital and serve all hospitals and clinics in the Free State. The remaining 23 district hospitals and the one specialized hospital do not have laboratories on-site. Engel et al. (2015) also noted that healthcare facilities without laboratories on-site reported delays in printed results from centralised laboratories. Typical delays were transport-related, including long distances, poor road infrastructure, bad weather conditions, shortages of couriers and damaged samples.

2.2 THE DIAGNOSTIC TESTING ENVIRONMENT OF POCT

POCT has several definitions, which include near-patient testing. Thus, the POCT is characterized as an investigation performed at the bed site or near the patient. Test results become available within a shorter time than if the specimen were sent to a traditional clinical laboratory (Shaw, 2016a). This allows clinicians to make a quick and educated choice about patient care. Point of care testing is defined as "testing that is performed near or at the site of a patient with the result leading to a possible change in the care of the patient" (Warade, 2014). With technological advancement, many traditional laboratory tests can now be performed in primary health care (PHC), hospital wards and clinics. POCT near the patient or at the bedside allows access to rapid test results with ensuing real-time clinical decision-making. It offers convenient testing service to the patient, with fewer calls for follow-up and hospital appointments, without the need for taking more or extra specimens. The patient usually saves money by not having to travel to different locations and appointments. POCT improves access to healthcare by reducing barriers such as distance, as it is easier to walk or drive to your nearest facility where you can be tested and treated in one visit rather than two or more. As a result, there has been a rapid proliferation of POCT worldwide, especially in countries with limited laboratory testing

facilities. Ideally, a good POCT device should have a short time to results (< 15 minutes), it must be portable, require small sample volumes, be multifunctional, use self-contained reagents, be self-calibrated and can connect to other systems or networks.

POCT is user-friendly enough to be used at the PHC level and in remote settings with no traditional laboratory infrastructure. It can also be used by community health workers who do home visits to patients' houses, particularly for stigmatized illnesses like HIV. This will allow the screening and treatment process to be completed during a single visit depending on the test's algorithm for diagnosis and management of a specific condition, thus improving access to care, counselling, and patient outcomes. By offering accurate results on disease prevention, POCT can increase public health organization's capacity to reach targeted populations. This would improve public health by bridging the gap between traditional laboratories and health facilities without laboratories. As an example, the use of a C-Reactive Protein or Erythrocyte Sedimentation Rate POCT enables timely initiation of sepsis treatment within the first 3 to 6 hours after consultation in the emergency department. It has improved mortality rates by 16% (Dellinger et al., 2013). Therefore, POCT assists in increasing early goal-directed treatment to decrease the high morbidity and mortality of sepsis. The term early goal-directed therapy often refers to sepsis and septic shock but can also be used in cardiogenic and anaphylaxis and other intensive care management. This can only happen when there is a 24-hour laboratory on-site or if clinicians use POCT. Although POCT is frequently more expensive than traditional laboratory testing, when the hourly rate of the clinician's person-hours for testing is added, the benefits of POCT outweigh any downsides. As a result, it is expected that

the advancement of POCT will alter the way emergency medicine is practised (Rooney and Schilling, 2014).

2.3 PROCESS DIFFERENCES BETWEEN CLINICAL LABORATORY AND POCT

With the advent of POCT, clinical decision making can be sped up considerably by ensuring timely and accurate results from the laboratory. In order to maintain quality standards and meet accreditation requirements, however, it is necessary to invest in equipment, staff training, and connectivity to a laboratory information system that is linked to a hospital information system (Florkowski et al., 2017). In the past, POCT has been found to be less sensitive and specific than laboratory analyzers and has less stringent certification requirements. The large volume of tests that are conducted at centralized laboratories are subject to stringent quality assurance and quality control process which are performed by trained laboratory staff.

In a traditional clinical laboratory setting a patient provides a sample to a clinician for testing. The sample is then shipped to a central lab for processing. Depending on the complexity of the laboratory test, results are usually generated within 1-2 days and a report is sent back to the clinician. This information allows the clinician to make better decisions about their patient's care. The clinician shares the test result with the patient- whether in person, by phone, email, or through a patient portal. It can take up to a week from when the patient provides the sample until the results. (Truvian, 2020). At traditional clinical laboratories, clinicians can obtain improved diagnostic testing services that will help improve the quality of chronic disease clinical care when the result is not considered urgent and the clinician can wait for an hour or a day to make a diagnosis or treatment decision. The drivers for

change will involve new emerging diagnostic technologies and personalized medicine, which will lead to increased productivity by means of an improved throughput. The routine clinical laboratory has developed a number of increasingly automated and effective instruments, including clinical chemistry, immuno-chemistry, common haematology testing, and even very complex assays. These instruments are executed using high throughput instruments following sophisticated automation, making them ideal for use in medical investigations (Trenti, 2021).

There are clear benefits and drawbacks to both POCT and laboratory testing. POCT can help the clinician to determine the best course of treatment for a patient, be safer than laboratory testing, have lower costs, provide a quality healthcare experience that includes top-notch medical care and exceptional patient experiences. However, core laboratory testing is more sophisticated, follows scientific methods for laboratory testing, and is fully integrated with the necessary technology to ensure accurate results (Clifford, 2018b). There are clearly situations where each approach works best. Nonetheless, the gap between POCT and core laboratory testing is gradually closing as new software technology emerges to integrate the two methods seamlessly. Ultimately, the choice of which method to use will come down to the specific situation and the preferences of the treating clinician.

The basic steps for performing tests in a clinical laboratory involve the clinician consulting with a patient in the ward or outpatient clinic and deciding to perform a laboratory diagnostic test based on an assessment. Next, a specimen is collected and taken to the laboratory by a colleague or the clinician. The laboratory registers the test request into its laboratory information system and processes the test. Often if this laboratory is a satellite laboratory, the specimen was rerouted to a central laboratory

where the test was performed. This adds to the time it takes to process the specimen and obtain a result. When a result is available, it is printed and delivered to the ward or hospital clinics via the clinical laboratory's or hospital's messenger service if the laboratory is on-site or couriered to the hospital if the laboratory is off-site for the clinician to access, evaluate, and decide on appropriate clinical care. In many Free State Department of Health (FSDOH) hospitals, clinicians can also access results electronically, which assists in shortening the time to access the results. Contrarily, the basic steps for performing a POCT include the clinician consulting with a patient in the ward or outpatient clinic and, based on an assessment, deciding to perform a POCT if the appropriate POCT device is available. The clinician then performs the tests in the ward or outpatient in the presence of the patient or near the patient and registers the tests manually in a specimen register. The results become available and are recorded in the patient file and specimen register. The clinician evaluates the result and decides on the best clinical care. As earlier mentioned, Point of Care Testing can be performed by clinicians or lay-persons with minimal training as opposed to the highly trained professionals in a clinical laboratory with expensive state of the art equipment, which eventually results in lower cost. However, the cost must not only be viewed as a comparison between the price for the laboratory test and the price for the POCT. Opportunity costs must also be considered, which include costs to the patient, time to clinical decision-making that leads to timely clinical care and optimised treatment outcomes. In-hospital costs include daily patient expenditures when a patient stays in the hospital for one or two days to await test results. The goal of Point of Care Testing is to break the tradition of performing some tests in clinical laboratories by performing them in the ward or clinic. Especially since such tests do not need to be performed by highly trained clinical laboratory staff. Instead, any clinician with basic

training on how to perform a POCT can carry out the test. This supports Lisa-Jean Clifford's report that "the largest benefit of POCT is that it can be done rapidly and performed by clinical personnel who are not trained in clinical sciences" (Clifford, 2018). When the two processes are compared, it is clear that clinicians should use POCT when there is no clinical laboratory on-site or when the laboratory is not open 24 hours a day. This conclusion is also valid when there is a 24-hour laboratory on-site, but the required test is not performed there, and the specimen must be referred to another laboratory where the test is available.

2.4 IMPORTANCE OF CLINICIAN'S KNOWLEDGE AND PERCEPTIONS OF POCT

Proper implementation of POCT needs basic knowledge of clinical laboratory tests that are used to make the diagnosis of diseases. Clinicians must be involved in the selection of the POCT device so they can assent to use POCT. POCT may cause errors emanating from a lack of understanding of the importance of quality assurance, control and areas of documentation, charting results, training of clinicians performing POCT, patient identification and where to chart electronic results (Shaw, 2016). A clinician's knowledge and perceptions of POCT can be used to determine the known situation, confirm or disapprove of an assumption and provide alternative insights into situations (Spring, 2014). Though it is not the intention of this study, the study can also be used to determine a baseline of the POCT knowledge and utilization status in the Free State Department of Health (FSDOH) for future assessments and assist in improving its efficiency for healthy debates and education activities to change behaviour.

To get the most accurate and comprehensive information on healthcare, all stakeholders must be involved in future studies. This includes patients, clinical teams,

laboratory medicine practitioners, health insurers and politicians. By understanding everyone's perspective, the NDoH can create the best possible POCT options for the South African healthcare system. Moreover, patient-centric POCT research could be prioritized to ensure that the needs of those affected by POCT are met. This can include surveys, interviews and focus groups to gain a better understanding of patient experience, as well as their preferences for testing and management options. Additionally, research into potential barriers to access, such as cost and availability, could be conducted in order to identify any challenges and create effective solutions. Further evaluation of current POCT protocols should also be undertaken to ensure accuracy and reliability.

By ensuring that all stakeholders are involved in research, the NDoH can create an effective and comprehensive healthcare system that meets the needs of all South Africans. Through careful analysis and evaluation, the NDoH can identify any issues and create efficient solutions that will improve the quality of healthcare in the country. With accurate information and data, the NDoH can ensure that POCT is correctly implemented and that everyone has access to quality healthcare.

Thus, knowledge and practice (KP) survey information is important to assist in planning, implementing and evaluating programs after collecting data from respondents to assess what they know about POCT, how they think POCT devices should be chosen to meet their clinical diagnosis tasks and the constraints of POCT. Such a study intends to identify available information and commonly held perceptions and identify unknown elements influencing attitudes that contribute to how groups practice health. KP assessments may additionally analyse communication approaches that are important to outlining practical activities, messages, and solutions

from respondents for improved services (Stop TB Partnership, 2018). The clinician's knowledge and operation of POCT must be convincing, focused and effective to enhance healthcare delivery (Onovughakpo-Sakpa et al., 2015). The perception of participants refers to how they interpret what POCT means and how POCT should be implemented with an emphasis on how to select a POCT devise. This is based on the knowledge they have of clinical laboratory tests or POCT.

Knowledge, perceptions, and barriers to POCT usage studies have identified several factors that clinicians reported, including clinical decision-making, test accuracy, result documentation, training, cost-effectiveness and loss to follow-up. Jones et al. (2013) indicated that POCTs are becoming increasingly available, but few are implemented in primary health care (PHC) settings. They reviewed qualitative studies of primary care clinicians' attitudes towards POCT to understand clinicians' attitudes towards POCT and identify facilitators and barriers to POCT utilisation. They concluded that there are several perceived barriers and benefits of POCT in primary care, which implied that for POCT to be more commonly used, clinicians must first understand the accuracy of POCT and the changing effect on clinical care pathways. Furthermore, there is some evidence that, despite the fact that POCT allows clinicians to make on-the-spot clinical decisions, some clinicians are hesitant to use POCT because they believe it is less accurate than clinical laboratory tests (Hardy et al., 2016). In a 2014 survey conducted by the Canadian Society of Clinical Chemists, it was found that paper charting of results is prone to transcription errors and lends itself to inconsistency (Shaw, 2016a). All manual tests like a dipstick, pregnancy, and card tests require the tedious task of entering all results manually, which makes the process of data management difficult and not traceable when a patient visits a different facility from where the original tests were done (Warade, 2014). Clinicians perceive the

manual entering of results into patient files as an additional step that takes them away from patient care. As a result, health facilities do not have 100% compliance with results documentation. Some clinicians also want to see more POCT implemented but are mindful of the time constraints of performing the tests. To maximize the benefits of POCT and minimize barriers, the views of clinicians must be considered when implementing POCT, and they (clinicians) should be involved from the start of the process. Also, attention must be paid to - testing environments, skilled personnel, the healthcare needs of the local community, constant availability of testing consumables, simple testing methods and documentation of test results.

2.5 LABORATORY RESULTS AND HEALTHCARE CHALLENGES

The dominant worldwide model of clinical laboratory testing remains the centralized laboratory, where increasingly more of the analytical procedures are automated to allow for the analysis of large quantities of the specimen at a comparatively lower cost (St John and Price, 2014). This trend is very well established in haematology and biochemistry and is currently extending to many other disciplines, including microbiology and anatomical pathology. In South Africa, the National Health Laboratory Services (NHLS) are responsible for the provision of clinical laboratory services to all public health facilities in all provinces. With the expansion of Primary Health Care in South Africa comes the need for more laboratory tests, but the traditional laboratory has a slow turn-around-time for providing test results for tests that are also available as POCT, which means patients must return a few days later for a second and sometimes a third visit to obtain results and for the clinician to decide on the appropriate type of treatment. This has a financial bearing on the health facility, personnel time, documentation and the patient's travel and opportunity costs. More

importantly, it delays treatment when necessary and often leads to loss of follow-up because many patients do not return for a second visit to access the results and allow the clinician to consult patients on their health status and start treatment where necessary.

It is estimated that at least 52% of tests performed on OPD's during the year 2018 can be performed by using POCT to service the 488 145 patients seen in the Free State Department of Health (FSDOH) OPD's (FSDOH Annual Report 2017-2018, 2018). This headcount includes follow-up visits, but the follow-up numbers are unavailable except for priority programmes. Both hospitals and clinics can minimize these follow-up visits to assess clinical laboratory results. Consequently, the patient admissions and Out-patient Department (OPD) clinical pathway can be shortened for registration of patients, searching for files, re-examining patients and associated person-hours spent by the healthcare workforce for the mentioned activities.

Statistics from ReferralMD estimate that 3 out of 10 laboratory tests are reordered because the original result cannot be traced back to the patient file (ReferralMD, 2016). This may be caused by staff not correctly filing the results from the NHLS as quickly as possible. In the FSDOH, all laboratory results are required to be in the patient file within 24 hours of delivery to the wards, casualties and OPD. In casualties and OPD, the file will already be back in the admission department (unless the patient is referred to a ward for admission) and they must do the filing, but this often does not happen. Clinicians must rely on electronic results or reorder the test. It is important to note that it is not all clinicians that have access to electronic results. Test results can be lost at any point along the continuum of care, including when

patients are transferred between departments in the hospital. This leads to increased costs, missed opportunities for diagnosis and treatment, and possibly death.

POCT was not widely used prior to 1990 with the exception of common tests like urine dipstick, pregnancy, rhesus factor, glucose, and haemoglobin, but since 2010 there has been a rapid expansion of POCT of 12% to 15% annual growth rate and many more tests being made available by manufacturers (Warade, 2015). Technological advancements in biosensors, wearable devices, and smartphones are inclined to change the entire spectrum of the POCT market (Goldsteinresearch.com, 2016). POCT is important to public health because when it improves access to health, especially in instances where clinicians decide not to perform laboratory tests since they may have to wait for days to receive results. POCT also means access to some form of testing rather than no testing at all, and it lowers the cost for the public service, patient, and family.

POCT tests currently used in the FSDOH district hospitals are Glucose / Hemoglobin / Pregnancy / HIV / RPR / Urine Dipstix / Blood gases. POCT technologies currently available in the South African market and performed as clinical laboratory tests by all district hospitals and PHC Clinics includes Cholesterol / Lactate / Troponin T / Urea & Electrolytes / Mini-FBC / Creatinine / CRP / HbAC1 /CD4 / Viral load / Anti-coagulation / Rhesus Factor.

2.6 POCT OPPORTUNITIES AND CHALLENGES

In resource-limited settings, which include hospitals that do not have laboratories on-site or that are located far from laboratories, POCT improves access and equity to health services. When POCT is used as part of a complete health management plan, it provides improvements in patient care, workflow

efficiency, expedites decision-making, and significant financial benefits (Larsson, Greig-Pylypczuk and Huisman, 2015). However, it must not be assumed that implementing POCT will result in the same advantages in all circumstances. The task at hand is to assess the present condition and compare it to the planned outcome if POCT is implemented.

The World Health Organisation (WHO) provides guidelines for POCT development (Kosack, Page, & Klatser, 2017b). These guidelines are known as ASSURED and include the measures of Affordability, Sensitivity, Specificity, User-friendliness, Rapid performance, Equipment and Deliverability of results to the end-user. In reality, it is not easy to deliver on all the ASSURED criteria and a paper by (Hsieh et al. (2011) discusses that acceptable compromises and adaptability must be made in certain circumstances. Clinicians may not all need the above criteria to be satisfied in the absence of an alternative that will allow them to make quick and sometimes life-saving decisions when necessary. While there are numerous testing platforms developed concerning POCTs, independent validation and application remain very limited (Pang et al., 2017). To ensure compliance with POCT standards, it is important to be aware of the specific challenges that POCTs face. These challenges can be overcome by using strategies such as proper planning and documentation, maintaining accurate records, and ensuring that all relevant parties are informed about the project (Shaw, 2016). POCT reagents are expensive and can lead to errors during the three phases of examination: preanalytical, analytical, and postanalytical. Clinical staff who are not oriented to the variables affecting all three phases of examination create more errors (Manocha and Bhargava, 2019). As more POCT become available more medical personnel need to be trained and assessed. Education and training are essential for any successful POCT program, but it can be

a challenge to keep a large number of staff up to date on their skills. Regular competency updates are crucial to maintaining a high level of quality in your POCT program (Wiencek and Nichols, 2016b). Challenges to POCT usage include inaccurate and unreliable results, which are major drawbacks when analysis procedures are not strictly followed. Inadequate quality of analysis, improper record-keeping, the incapacity of results interpretation, failure to detect irregular results, unsanctioned testing and inappropriate processing are areas that affect patient test results and subsequent care. Preanalytical sources of hemolysis in blood specimens may be due to incorrect procedures, such as improper collection or handling. However, most cases of hemolysis are the result of preanalytical sources related to incorrect testing methods or failure to adhere to established laboratory practices (Lippi et al., 2011). A hemolyzed test result can mean that the red blood cells in your sample have burst, making it difficult to get a definitive result. With finger-prick blood samples, users cannot visually detect haemolysed, icteric and lipemic samples.

2.7 SUCCESS FACTORS FOR THE IMPLEMENTATION OF POCT

Like any other health program, POCT implementation must be carefully planned and executed and take many factors into account. The following discussion will examine success factors that clinicians must consider for POCT with a limited risk of failure. The World Health Organisation (WHO) policy & perception guide on the selection of diagnostic tests propose 6 steps in selecting a test. They derived this six-step approach from the literature they conducted and from their experience in implementing diagnostic tests in clinical laboratories as well as POCT. The Washington State Clinical Laboratory Advisory Council POCT guidelines propose a seven-step guideline for POCT selection and implementation. Table 1 below shows

the differences and similarities between the WHO and Washington State Guidelines. These are explained as important aspects of the appropriate selection of POCT.

Table 1. Comparison of the WHO and Washington State Guidelines

The WHO policy & perception guide on the selection of diagnostic tests	**POCT Guidelines - Washington State Clinical Laboratory Advisory Council**
(1) Defining the test purpose (2) Studying the market (3) Studying regulatory approval (4) Determining the tests optimal diagnostic accuracy (5) Determining the tests diagnostic accuracy in perception (6) Monitoring the test when in everyday use	(1) Obtain a mandate to start the POCT program (2) Select members of the POCT committee (3) The committee develops a POCT program (4) Review sites for POCT testing (5) Evaluation of proposed tests (6) Implementation (7) Evaluation of the POCT program

Defining the purpose of the tests is crucial since this will impact a lot of the subsequent steps. Important factors include the condition or disease to be diagnosed, whether one or a series of tests was performed as a diagnostic procedure if we need quantitative or qualitative results, where the tests were performed and who was performing the test. To enhance clinical utility, we must consider the actual site or building of testing to ensure environmental factors do not negatively impact a test result.

2.8 CONCEPTS OF ACCURACY AND PRECISION

Concepts of accuracy and precision are the foundations of reliability of test results and provide healthcare providers with confidence in using the clinical laboratory. POCT is also subject to accuracy and precision, and many clinical laboratories also use POCT for low-volume tests where expensive equipment for high-throughput is not required. Optimal test diagnostic accuracy means the amount of agreement between the results of the test being evaluated also known as the index test and the results of a laboratory reference standard or test (Linnet et al., 2012). The general method is to utilize a prospective cohort design of patients suspected of having a specific disorder of interest. Each patient is subjected to the same reference standard tests and index.

The manufacturer information on accuracy is designed around studies of specificity, sensitivity and predictive values for the presence of the target condition. Limitations of the diagnostic accuracy for the test in question are also emphasized. Test accuracy in detecting patients with the target condition differs among settings and patient groups (Cohen et al., 2015). Estimated test specificity and sensitivity compared to the reference standard may be inconsistent and systematically deviate from test results obtained in the ideal situation leading to incorrect endorsements about the test and negatively impacting patient outcomes or healthcare policy. Actual in vitro diagnostic test performance and the ease of the test performance must be considered during pre-selection.

End-user level evaluations provide information on the performance of a test under real-life conditions and may disclose valuable features not detected during the phase of accuracy and precision testing. Nurses and doctors may influence testing in the intended environment of hospital wards or PHC clinics by their POCT training per

specific tests and by environmental conditions such as high temperature, humidity, and dust. Monitoring a test's performance in routine use is important. Proficiency testing, quality control, and end-user supervision must be performed regularly and documented. Another important aspect of long-term quality assurance is post-marketing surveillance.

The scientific rigor of laboratory test methods is essential to ensuring accuracy and reliability in clinical practice. To meet this criterion, the American Food and Drug Administration (FDA) reviews the evidence for commercial tests to ensure that they are safe and effective. In South Africa we have the South African Health Products Regulatory Authority (SAPHRA) with several operational units which is meant to play the same role as the FDA however, SANAS is the only body in South Africa authorized to carry out accreditations in respect of Calibration and Good Laboratory Practice Act mandate (Act 19 of 2006). SANAS ensures that laboratories operating within the country meet the highest standards of quality and integrity.

In order to effectively manage and control the quality of medical devices, SANAS and SAHPRA have signed a memorandum of understanding (MoU) in 2017 to work together on the implementation of regulations pertaining to medical devices and in-vitro diagnostics. This MoU focuses on SANAS helping SAHPRA accredited conformity assessment bodies (C with the task of ensuring that medical device quality management systems are up to par.

The aim is to ensure in future that all tests conform to the following:

- The test is able to accurately detect or measure the substance it claims to detect or measure. and

- The substance's detection can provide significant information about the health of a patient, aiding in the diagnosis, treatment, and monitoring of their condition.

POCT is a great way to reduce errors in your testing process, but it's important to keep quality and risk management in mind (Gous et al., 2016). NHLS should be used in conjunction with provider external quality assurance (EQA) material and validations to ensure the quality of POCT usage by non-laboratory trained staff. In the future, EQA will be an important part of ensuring quality management throughout the POCT process. However, in order to scale up services currently offered for POCT sites, it may be necessary to develop or modify EQA protocols. This may include developing guidelines for proper POCT storage, personnel training, and POCT quality management processes. In addition, the FSDOH should continue research into the most appropriate ways to monitor and evaluate patient outcomes associated with POCT use. The FSDoH should consider documenting POCT orders, charting POCT results, and training and certifying individuals in performing POCT in order to empower end-users. When connecting POCT instruments with the electronic medical record, important factors to consider include whether communication should be unidirectional or bidirectional, how patient demographic information should be linked with POCT software, and the importance of positive patient identification. Charts of POCT results in the electronic medical record also take into account where they will best be used to improve care.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

Research approaches are blueprints and methods for research that span the steps from broad assumptions to comprehensive methods of data gathering, analysis, and interpretation. The long-term strategy of obtaining responses to the questions being examined and for dealing with several of the troubles experienced during the research process is well documented and used. In this research work, rather than putting forward an argument about whether the qualitative or quantitative technique works for a public health research study or otherwise, the focus of the researcher was to perform research that requires a mix of approaches to adequately answer the research questions. Sometimes both qualitative and quantitative approaches require researchers to consider having a total understanding of the public health problems they are faced with in a complicated setting where policy decisions are made today that impact the health of large communities for years into the future (Kaur, 2016).

Therefore, this chapter details the methodology used to conduct this study to attain the following objectives earlier listed in chapter one:

1) To evaluate the current point of care testing (POCT) practices of clinicians in selected hospitals implementing POCT in the Free state, South Africa
2) To explore how the knowledge and perceptions of clinicians influence the use of POCT in selected hospitals implementing POCT in the Free State, South Africa

3.2 DESCRIPTION OF THE STUDY AREA

The Free State Department of Health FSDOH has 33 hospitals that all provide POCT, of which 26 are district hospitals situated across four districts and one metropolitan area. The study was conducted in ten (10) district hospitals located in ten (10) different towns within the province and employing a total of 344 doctors and nurses, as well as, 2 clinical associates to make a total of 346 employees eligible for participation in the study. These hospitals account for 158 669 of the totals of 974 648 FSDOH headcounts and admissions for the financial year 2019-2020, which equates to 16.2% of all hospital services. The ratio of the service package of the 10 hospitals is similar to the ratio of the service packages of the other district hospitals. Two of these district hospitals have laboratories on-site. Of the 10 hospitals, only one is situated in a town with private hospitals within a 20 km radius, while the rest of the hospitals are in towns without private hospitals. The period within which this study was conducted in the study sites was from March 2020 to July 2020.

3.3 RESEARCH DESIGN

A concurrent mixed method research design was applied in this study to investigate clinicians' knowledge and perceptions of POCT in selected hospitals implementing POCT in the Free state, South Africa.

The rationale for using the mixed-method design

Mixed methods study design is a research methodology that combines quantitative and qualitative research. It is one of the three major research paradigms chosen by researchers for the depth of knowledge entailed in qualitative studies as well as the more generalized, certain information provided by quantitative studies. In this study, the qualitative data was collected through semi-structured interviews. The

quantitative data was collected through surveys and participant demographic information. The mixed-method approach is able to produce insights that are not found from either a qualitative or quantitative study alone because of the combination of perspectives. (Creswell & Tashakkori, 2007).

In recent years, the use of qualitative and quantitative methods in research has become more common because mixed methods are able to provide reliable and precise data that are less susceptible to bias and rigidity. Mixed-method approaches enhance triangulation and completeness and compensate for the potential weaknesses in the qualitative design and minimise the limitations of both designs. This study primarily involved an explanatory approach, which is split into two subsections. First, it followed a quantitative model of data collection and then progressed to qualitative paragraphs. This was the most suitable approach to analyse all of the quantitative data and then have a better understanding of what the qualitative data was explaining in answering the research question. Explanatory design started with quantitative data collection and analysis, followed by qualitative data collection and analysis. With the explanatory design, the researcher takes particular quantitative results into account that require supplementary evidence.

In order to explore in-depth the quantitative data, the researcher then gathered qualitative data from participants. Explanatory design is the simplest of all mixed-method designs (Creswell & Clark, 2007). The advantages of the explanatory research design include:

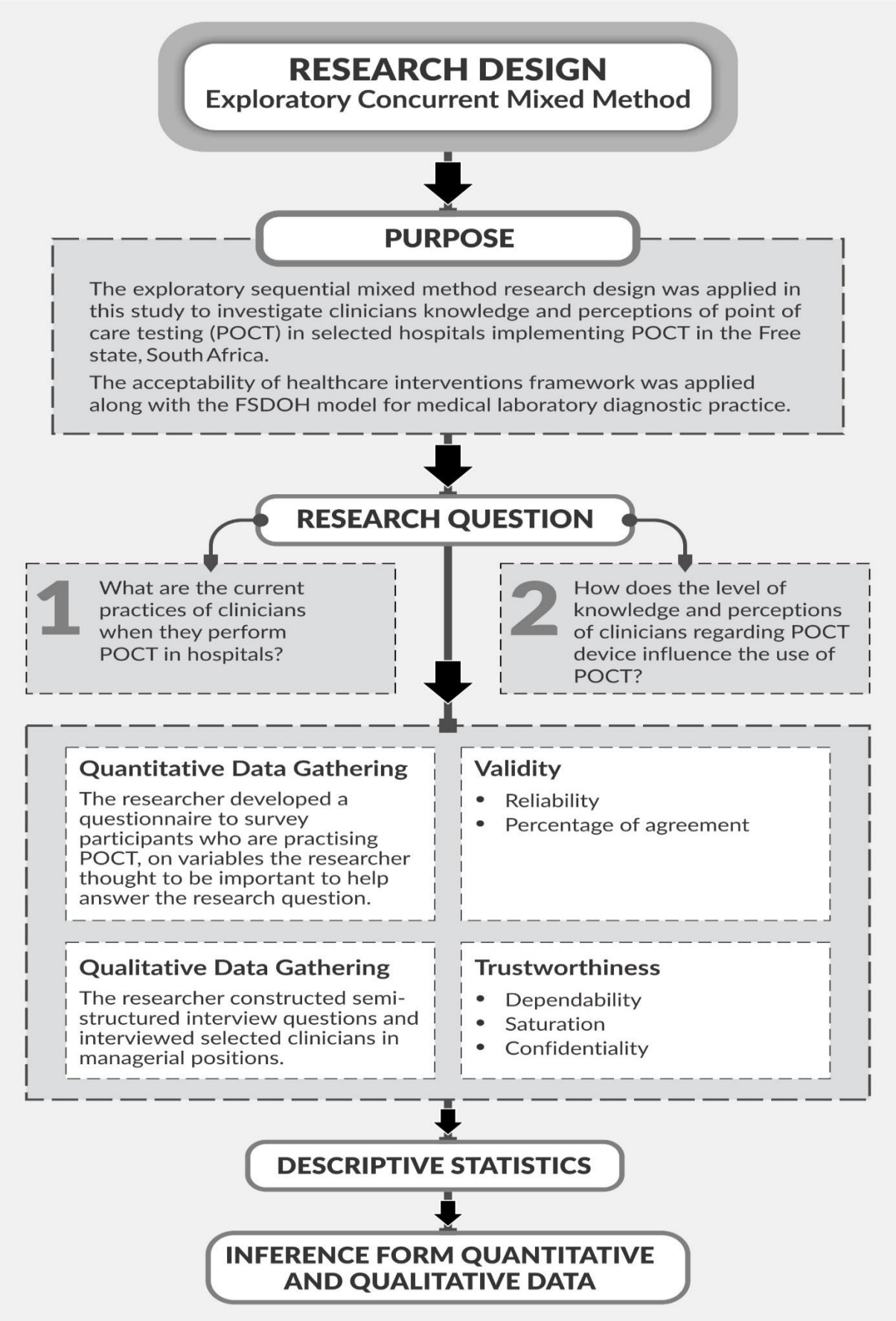
- The two-stage research methodology is easy to execute because the researcher focuses on one type of data collection at a time. The researcher can use a survey to collect quantitative data and use interviews to collect

qualitative data. The in-depth interview will help the researcher gain more insight into the topic.

- The final report can be described in two parts for the reader to get a clear breakdown of what the research findings are.

The variations between quantitative and qualitative research design involve the nature of data collected and the technique of analysing this data. Using the two (2) methods, the researcher was able to gain a comprehensive and in-depth understanding of copyright violations at higher organizations of learning. The reason for utilizing triangulation in a study is associated with the requirement to match the findings of one method with those of the other. The research design also allowed the researcher to explore the barriers and facilitators of POCT usage by clinicians in greater detail. This could provide a comprehensive and all-inclusive understanding of the clinician's experiences on POCT from the gathered information. The data from the qualitative and quantitative methods did not stand in isolation from one another and did not have any recipes or prescriptions for analyses and integration as reflected in Figure 1 Research Design –Concurrent Mixed Method.

Figure 1. Research Design - Exploratory Concurrent Mixed Method



3.4 STUDY POPULATION

A study population is usually described as a description of individual people in the population, as well as the primary variables and units from which assumptions can be deduced for the population to represent an aggregation or collection of participants or other aspects from which assumptions can be made (Lavrakas, 2008). In a researcher's pursuit to add value to scholastic arguments and understanding of studied social phenomena, they collect information or data from individuals who come from the study population, which is the group of people having several attributes of interest which makes it reasonable to understand why study findings are credited to the population either by connecting them to specified individuals in the population or the entire population (Mensah and Uteng-Abayie, 2017).

Even when a population is composed of a broad number of events or objects, it is unattainable or frequently impractical to collect data with respect to each member of the population. However, it is impossible to use the whole population in this and most research studies, but a representative sample was selected for the function of this study. From their findings with respect to the sample, researchers make generalizations with respect to the population from which the sample was picked (Allen, 2017). Accordingly, the population of the research in this study is defined as the large group of clinicians in district hospitals from which a smaller-sized representative group of clinicians is sampled or extracted. Data collection from various participants will allow for data triangulation, allowing for data comparison and validation.

The study population involved consenting doctors and nurses from the selected 10 district hospitals (study sites) in the Free State. All 10 hospitals use Glucose, Hemoglobin, Pregnancy, Urine Test strips, Rhesus Factor for blood transfusion

purposes and HIV Rapid Tests as POCT, and they refer the rest of the tests to the nearest clinical laboratories.

The quantitative aspects involved only clinicians who are responsible for the day-to-day management of patients. The qualitative part of this study focused on clinicians in management positions, including Chief Executive Officers, Chief Medical Officers and Heads of Nursing Services, who are decision-makers and well informed about the activities in their hospitals and, as well as, understand the dynamics of POCT at a provincial level.

3.4.1 Sampling

In research, the population is the whole set of people, occasions, or items that display the behaviours and/or exhibit the attributes of interest to a researcher. Researchers need to create a technique to pinpoint a representative subgroup of a broader population which is called a sample, and the procedure of picking this subgroup from the population is the sampling technique (Tam, Lo and Woo, 2020)

As there are various types of sampling techniques/methods, the researcher requires to comprehend the distinctions to choose the correct sampling technique for the study. A sample is a group of participants, items or objects that are drawn from a big population for measurement of specified variables and must be representative of the population to assure that researchers can easily hypothesize the findings from the research study sample to the larger population (Baran and Jones, 2016). A scientist must consider several factors when selecting a sampling technique, including the research questions, the research method, and insights about the population interest, the size, similarity, time, resources, and requirements of similarity. The degree of self-confidence required for research conclusions, as well as generalizability (Elfil and

Negida, 2017). The sampling technique ought to be as thorough as possible to assure minimal inaccuracies and predisposition and to improve optimum representativeness (Mensah and Uteng-Abayie, 2017).

Sampling techniques are classified into probability or non-probability techniques (Tyrer and Heyman, 2016). Typical kinds of probability techniques consist of convenience sampling, random sampling, systematic sampling, stratified sampling, and cluster sampling. Non-probability sampling techniques utilize a method through which the sample is chosen based upon the opinion of a researcher rather than utilizing random selection. Typical kinds of non-probability sampling techniques consist of purposive sampling, quota sampling, snowball sampling, and self-selection sampling (Negid and Negida, 2017). Probability sampling, as opposed to non-probability sampling, allows for a randomized selection system. Participants in non-probability sampling are selected because of the purposive personal opinion of the investigator. With non-probability sampling, the prospect of each research participant being picked is unknown.

Sampling for the quantitative research part of this study

This study used stratified random sampling, separating the sample into categories with shared characteristics, such as age, sex, race, education, profession or work experience (Etikan and Bala, 2017). These groups can be merged, classified, and combined in various ways, and each stratum is a subset of the overall data set that can be classified by one or more of these characteristics. A random sample is taken from each stratum of society and the advantage is that it assures representation of all groups in the population needed. As long as all the necessary groups are represented in the sample, then this technique can be useful for collecting data on a

specific group or topic. Sampling with stratified random sampling means that you can estimate the characteristics of each stratum. This will reduce variability and the need to use systematic sampling. This technology requires accurate information on the proportions of each stratum in order to work. The problem is that the necessary demographic data for such a system is not always available or reliable.

Sampling for the qualitative research part of this study

The researcher adopted a purposeful sampling approach for this study, which aimed to answer the research questions by constructing a survey based on an exploratory sequential design. The reasons for using purposeful sampling in this study were to compare differences between contexts and individuals better and to explore participants' perceptions so that we could design and implement the quantitative phase of this study. A purposeful sample is appropriate in qualitative studies in order to allow you better explore and understand the researched phenomenon (Merriam, 2009). It is an exploratory, naturalistic study that does not need a large number of participants. Qualitative data is collected through interviews, observations and document analysis. It helps researchers understand attitudes, feelings or beliefs about a particular phenomenon. Purposeful sampling is an effective way for researchers to collect data. It is done when the researcher wants to discover, understand, and gain insight from which they can learn the most. The initial qualitative or quantitative sampling procedure will typically influence the next one (Creswell, 2014).

3.4.2 Sampling Size

According to Stangor (2011), the sample size is the number of observations used for calculating estimates of a provided population. A smaller sample size

decreases expenses and available time and allows researchers to collect enough details about a whole population without needing to include each member of the population.

3.4.3 Quantitative research part of this study

By also using quantitative research design, the researcher sought to understand the current status of POCT usage by clinicians. This was done through descriptive research methodology. The Epiinfo® and the Raosoft® software system was used to estimate the sample size for the quantitative arm of the study. Tables 3.1 and Table 3.2 show how the sample size was determined with a 50% expected frequency, a 4.99 % acceptable margin of error, a 95% confidence level, and a design effect of 1. It was ideal to have a higher sample size to achieve a lower margin of error and higher confidence level. However, this attainment of higher precision is more expensive and time-consuming. The non-response rate or incomplete questionnaires and or questionnaires from un-motivated participants were set at 10%, resulting in 23 additional participants, thereby leading to a final sample size estimation of 244. Confidence levels are used to support quality research communication and integrated research findings. A 95% confidence level, a range of values calculated from a sample observation, is more likely to contain the true population value with a better degree of uncertainty than a confidence level of 80%.

Table 3.1: Sample size determined using the Epiinfo® software.

Confidence level	Total Sample
95%	243
97%	273
99%	322

Table 3.2: Sample size determined using the Raosoft® software.

Margin of error	Confidence level	Sample size
5.95%	90	197
4.99%	95	244
3.80%	99	323

Qualitative research part of this study

The qualitative research design method used the phenomenological method to explore how clinicians came to make decisions based on their own subjective experiences rather than purely logical reasons. Through this methodology, we were able to better understand why clinicians make the decisions they do and what factors influence their behaviour. A total of 18 participants were interviewed. The ten (10) hospitals have a total of eight (8) clinical managers and ten (10) nursing managers since some hospitals share the same clinical manager, but each hospital will have its own nursing manager. This means that 100% of the possible participants were interviewed since the number was manageable. The results of the study are thus not based on a sample but rather on a census of all possible participants. The distribution was completely random and had no apparent pattern. This provided the researcher

with comprehensive data because it was not based on just a sample of the possible participants. Participants were interviewed until saturation was reached.

3.5 DATA COLLECTION

Data collection techniques are essential because the method and analytical method used by researchers determine how the gathered information is used and what descriptions it can produce (Teherani et al., 2015). The data collection technique that an investigator chooses should match the research study problems and objectives of the research study. The selected technique needs to offer the optimum variation with a minimal level of mistakes and methods that are accurately overseen as the objective. When selecting a data collection approach, a typical risk to the Hawthorne effect, viable, credible and precise data that includes choice predisposition, background, maturation, tests, attrition and uniqueness or investigator effects need to be contemplated (Henry et al., 2015).

3.5.1 Quantitative data collection

3.5.1.1 Survey Questionnaire (quantitative data collection tool)

A range of approaches exists for researchers to select from and depends upon a variety of aspects, involving the objective of the research study, the kind of research study questions to be addressed, and the accessibility of resources so that the readers of the study can critically examine the suitability of the conclusions from research studies (Ponto, 2015). Questionnaires are one of the most popular instruments of data gathering for the objectives of both assessment of the pattern of observed parameters of the person, or statistical study, survey questionnaire style and screening techniques are backed by considerable literature reviews and scholarly articles (Bavdaz et al.,

2019). Researchers can also define questionnaires as a strategy for eliciting the emotions, beliefs, experiences, understandings, or attitudes of a sample of people. The benefits of questionnaires include lower financial expenses and time involved in interviews. Therefore, questionnaires may yield data that is more comparable than details acquired through an interview.

The questionnaire for this research study contained Pre-Likert scale open ended and closed ended questions and a ranking scale with pre-determined feedback options. The questionnaire was piloted with six Provincial Laboratory Services from 6 different provinces in South Africa. This pre-test assisted the process of determining the questionnaire's efficacy in gathering reliable data. Cronbach's alpha coefficient with a value of 78 for internal consistency was used to indicate if the combined questions measured the same construct. In order to ensure the quality of data analysis, the questionnaire responses were subjected to predetermined screening techniques, and only questionnaires that passed the screening were analysed. The final version of the revised questionnaire based on the pilot carried out was designed as an online survey which will be further explained in the data collection procedure. The questionnaire consisted of questions that would answer the study objectives, the purpose of the research, a consent form and instructions on how to complete the questionnaire and indicate how long the questionnaire would take to complete. Clinicians were provided with the option of either completing the online (Google Forms) or paper-based questionnaire.

3.5.1.2 Quantitative research data collection procedure

Data was collected online through self-administration of the study's questionnaire, which was designed as aforementioned, using Google Forms. However, due to network or connectivity issues indicated by some of the participants,

paper-based questionnaires were also distributed for self-administration by consenting participants at the facilities; and retrieved by the primary investigator for capturing on the online platform. Hospital Chief Executive Officers, Clinical Managers and Heads of Nursing were sent the link to the online questionnaire to share the link with nurses and doctors in their hospitals for online completion if they preferred this over the self-administered questionnaires. There are a number of reasons why online survey questionnaires were included as an option for this study:

1. Convenience and flexibility – questionnaires could be accessed and completed by participants at any time and from any location with internet access.
2. Speed and efficiency – data could be collected and collated quickly and easily, with no need for printing or postage.
3. Cost-effectiveness – online survey questionnaires are a low-cost research tool.
4. Accuracy – responses were automatically collated and stored, meaning there was no risk of human error.

The researcher included paper-based questionnaires in this study because of several practical advantages that the researcher considered, which included firstly that people without tablets or mobile phones could complete the survey without any problems. Secondly, it was easy to distribute the survey to a sizeable pool of respondents thanks to our free courier service and to invite Clinical Managers and Heads of Nursing to print additional copies if required in their hospitals. Thirdly, they were suitable for respondents who are not technologically savvy and are not comfortable with completing online questionnaires. In addition, paper-based surveys could be used where the target population is not easily accessible online, such as in rural areas where most of the participants were situated.

The researcher had to choose between self-administered questionnaires, which are filled in by the respondent on their own, and researcher administered questionnaires, which are administered by a researcher in the form of an interview and he eventually decided on self-administered questionnaires. It helped to reduce the costs of data collection, like travelling all the way to meet up with participants, and participants were able to answer at their convenience; hence there was no need to set up interview appointments, and the researcher was not present to inject bias in the way questions were asked.

3.5.2 Qualitative data collection - Interviews

There are numerous qualitative approaches which are designed to have a detailed and comprehensive understanding of the problems through their textual analysis, and some of the most typical types are observations and interviews (Jamshed, 2014a). The data collection tool, also known as the question guide, is structured with open ended questions in qualitative research interview processes, requiring tape or other electronic recordings of the interviews. The recorded conversations are then transcribed, coded and analysed to produce findings. Qualitative interviews can be used to explore a specific topic by gathering information from a small number of people in detail.

Key in-depth interviews and focus groups are the most typical approach for information collection used in qualitative health care research study and can be utilized to investigate the views, practical experiences, opinions and motives of participants in a qualitative research study (Adhabi and Anozie, 2017). Additionally, qualitative researchers can examine the attitudes, beliefs and views of participants through participant observation. However, interviews are a fundamental approach utilized in

qualitative research studies, and many authors hold in-person interviews as the gold standard or the presumed ideal method to carry out interviews with participants (Oltmann, 2016).

Qualitative data was collected through extensive interviews to provide an in-depth variation of discussion and remove the temptation for investigators to negate the unwanted elements of the interview, such as data that goes against the researcher's hypothesis. This is considered an important aspect of extensive interviews for the investigator to gain more details regarding the participants' personal experiences, perspectives and behaviour. The researcher considered that by using the in-person interview method, individuals might experience some discomfort about being readily available and meeting at the agreed-upon time and location, which in turn might bring prejudice to the participants and result in hurried responses for compliance. Interviews were conducted in English in pre-booked offices and boardrooms after obtaining informed consent. The Key Informant interviews (KIIs) were conducted in a setting with little distraction, preferably at the participants' office. Before the interview started on the set date, there were formalities of introductions, going through the interview guide, setting the expected interview time of approximately 45 minutes and participants were asked if they had any questions before we proceeded with the interview.

The interview guide was helpful in making sure that participants understood that qualitative interviews are more like discussions than common interviews, but that the researcher directs the discussion in order to gather data from participants and get answers that will be used in the research study. A voice-recorder was used to record the interviews and discussions verbatim, and this was transcribed using Otter.ai software to protect against bias and to provide a permanent record of what was and

what was not said. Each interview and group discussion were documented during and after with field notes in a diary. For the purpose of assisting with data analysis, these field notes included observations, thoughts, and interview ideas.

The Clinical Managers and Heads of Nursing at the identified hospitals were contacted via email to introduce the researcher and provide an overview of the research study, to share the permission letters from the FSDOH Head of Department and the hospital Chief Executive Officers, and confirm their participation and confirm dates and venues for interviews. They were invited to ask for any clarity related to the research and to share the communication with clinicians. They were chosen because of their professional expertise in both traditional diagnostic laboratories, POCT implementation and management in their respective provinces. A summary of interviewer context for interviews conducted are depicted in Table 3.3 and Table 3.4 provides a data sourcing summary.

Table 3.3: Summary of interviewer context for interviews conducted

Components	**Challenges and opportunities**
Time and financial costs	was expensive and time-consuming, which limited the number of interviews.
Geographical distribution	The Free State province is relatively large, and the researcher travelled 1800 km over a duration of two months.
Sensitive or controversial topics	When required, the researcher was mindful not to raise major subjects outside the structured questions but did look for clarity on some questions from participants. There were no uncomfortable or awkward minutes throughout the interviews.

Technology problems	The voice recorder did not pose any challenges, but the researcher had a second smart device all set in the event of issues would occur. Some of the towns had a network challenge, and the researcher needed to utilize the second smart device, which had a much better network connection.
Interviewer safety	All interviews were conducted in workplaces that the participants selected and were safe and relaxing.
Note taking	A voice recorder was utilized, but the researcher did make a few notes on paper but attempted to ensure that the note-taking was not interfering and could record non-verbal language and hints.
Nonverbal language and cues	There were no uncomfortable or awkward minutes got from non-verbal language and hints.

Table 3.4: Data sourcing summary.

Data Sources	Qualitative	Quantitative
Setting	10 hospitals in the FSDOH	10 hospitals in the FSDOH
Participants	Chief Executive Officers who are clinicians, Chief Medical Officers and Heads of Nursing	Doctors and Nurses responsible for day-to-day patient care
# Of participants	10	100
Instruments	One-on-one interviews (KIIs)	Questionnaires
Scales / Questions	6 Questions	15 Likert style Questions

3.6 DATA MANAGEMENT AND ANALYSIS

3.6.1 Quantitative Data Management and Analysis

The Statistical Package for the Social Sciences (SPSS) version 24 of 2016 was used for the management, organization, and analysis of the data as a comprehensive set of tools for the statistical analysis of data (IBM® SPSS® software 2016). Electronic copies of survey responses were kept in a password-protected Google Drive account and exported through MS Excel to SPSS for data cleaning and analysis. Descriptive data analysis was performed starting with the demographical data from the first 6 questions of the instrument, followed by the analysis of the performance data from the remaining 15 questions of the instrument and will summarize features of the sample

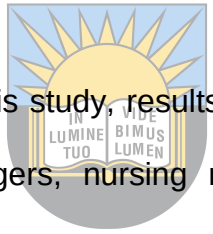
by examining variables one at a time without explaining relationships between the variables. Likert-style questions were used, and measured items were provided with codes of 1 to 5. Calculations were made for means, medians, modes, and interquartile ranges. The level of statistical significance was set at 0.05, and inferential statistics like the Chi-Square and logistic regression were used when appropriate to assess the strength of relationships between the outcome and explanatory variables.

3.6.2 Qualitative Data Management and Analysis

Transcripts of recordings during interviews were analysed to develop themes that represent the data collected to address the research questions. The QDA Miner Lite software was used to perform qualitative data analysis, to quickly and easily analyse text to find insights and patterns (Provalis Research, 2020). This involved coding and categorisation by dividing obtained data into bits called codes. Codes were used according to the 6 main areas on the questionnaire. This was followed by coding after examining words, phrases or sentences used in open-ended questions. A separate list of the codes was created with a short definition of the attributes of the codes. After coding of non-structured parts of the questionnaire and line-by-line coding, the codes will be categorised logically and allocated labels. The categories might be provisional since there may be amendments as further analysis progress. If necessary, the labels can be amended to improve clarity, discarded as codes are re-categorised, and others may be regrouped together. The investigator combines both methods and data sources to find out the true answer to the question and eliminate bias. Data from both qualitative and quantitative methods can substantiate a finding (Creswell, 2013). Data from both qualitative and quantitative methods was used to access the same phenomena.

3.6.3 Data Integration

In order to better analyse a topic and cover a wide range of perspectives, the argument that mixed methods researchers use in their research could be helpful. The argument is that mixed methods research means using a range of methods in their study in order to get the most accurate picture possible. This means collecting information through observation, interviewing and statistics. The argument goes on to state that more than one methodology would increase validity because it would be difficult for any one method to produce a certain outcome without the other (Bryman, 2007)



Following the purpose of this study, results may yield valuable information to be considered by clinical managers, nursing managers (who are leaders and policymakers) and clinicians who routinely perform POCT for future decision-making. As readers can see, to answer the research questions in the study, data from both phases were combined and analysed in different ways. The qualitative and quantitative phases of research work in tandem to advance the study. Qualitative data is used to create the quantitative scenario instrument, which is then used in the quantitative phase of research or both phases can be carried out simultaneously. This method of integration is known as instrument development or development rationale. Instrument Development is a term that is used to describe the process of developing an instrument or set of instruments, and it usually involves the development of a research instrument to measure a construct (Kalkbrenner, 2021). The qualitative and quantitative phases of the study interacted with each other after both of them had been completed. The qualitative phase is important because the researcher begins to see

how the data collected in the quantitative study were interrelated. The rationale for using mixed methods was because their results converged and corroboration was easily achieved (Bryman, 2007). The investigator combines both methods and data sources to find out the true answer to the question and eliminate bias. Data from both qualitative and quantitative methods can substantiate a finding (Creswell, 2013). Data from both qualitative and quantitative methods was used to access the same phenomena. By using both methods, the researcher is able to determine if there is a correlation between findings.

3.7 VALIDITY AND RELIABILITY

3.7.1 Validity

A major concern about the validity of the constructed instrument was that no existing instruments could be used to estimate validity. This made it difficult to determine the extent to which the instrument measured what it purported to measure. Additionally, because there was no validation data available, it was impossible to determine the degree of internal consistency of the items on the instrument.

Face and content validity were obtained through the piloting of the interview questions and making changes recommended by experts in the field of POCT.

3.7.2 Reliability

This research used data analysis to assess the reliability, consistency, and variables within the instrument. The study found that the reliability of the data depended on the consistency of the measurements and the variability of the measurements. The reliability increased as the consistency increased and as the variability decreased. In addition, it was found that the instrument was most reliable when the measurements were consistent, and there was little variability among them.

To ensure reliability, the investigator also did some research by looking at documents and other resources to compare what was said in interviews with what was found and establish even more information about POCT. The following is a list of the types of documents that were used in the research (1) Policy and procedure documents, (2) Documents related to quality management, (3) Documents related to accreditation, (4) Documents related to staff training and (3) Documents related to patient test results. The researcher satisfied himself that the following types of reliability were achieved (Trochim, 2020) (1) Inter-rater or inter-observer reliability helped to assess how reliable and consistent different people are at estimating the same detail and (2) Internal Consistency Reliability was used to assess the consistency of results across items within questions.5

3.8 Trustworthiness

Researchers need to be aware of biases when they are constructing and distributing findings. This framework was used to guide the selection of data and to ensure that the final analysis was meaningful and accurate (Nakkeeran, 2010). Once the data had been collected, it was carefully examined and sorted. The coded data was then organized and presented in a way that was clear and easy to understand.

The researcher took all the necessary measures to maintain trustworthiness. These measures included (1) Using pseudonyms to protect the identity of participants, (2) Maintaining strict confidentiality of data, (3) Debriefing participants about the research process and any possible risks and (4) Informing participants that they could withdraw from the study at any time.

The researcher wanted to make sure that they felt safe and comfortable sharing their thoughts with me and knew that their information would be kept confidential. The

researcher asked the participants to sign a research consent form. By signing the consent form, participants agreed to have their in-person interview session audio recorded.

This research is trustworthy because the researcher interviewed participants until no new data or themes were discovered (saturation) and articulated explicitly the basic assumptions the researcher had for the study as well as his personal biases. Participants who were interviewed had the option of requesting an audio file or a transcript.

3.9 ETHICAL CONSIDERATIONS

Research ethics are about the moral merits of a project, looking at the degree to which professional, sociological and legal obligations are met by research methods. (Weinbaum et al., 2019). The research proposal was submitted to the Research Ethics Committee of the Free State Department of Health, through which the researcher was enrolled as a post-graduate student.

Ethical clearance was also obtained from the University of Fort Hare University. The investigator obtained consent from the research participants. Informed consent means that participants have appropriate information regarding the study, are capable of understanding the details and have the power of free choice, therefore empowering them to consent or decrease participation in the study. The investigator introduced himself to the respondents by showing his title and position and presenting consent from the FSDoH to conduct the study. Explanations of the nature and aim of the study and the value of their involvement were also provided as indicated in the consent form, which can be seen in appendix 1. The respondents were ensured that involvement in the study was voluntary and that refusing to comply would not result in

any disadvantages or penalties for the participants. The researcher gave the participants his contact address in case they needed to call him for clarity relating to the research and their involvement in the study. The researcher dedicated himself to maintaining privacy and confidentiality, and the participants were assured that privacy and confidentiality would be preserved. Privacy occurs when even the investigator cannot associate a participant with the details of that individual. Confidentiality is preserved when participants are protected in a study, and specific identities are not associated with the information offered and are never publicly divulged. The investigator marked the questionnaires by offering each a number to help in data catching and examining during the data management stage.

CHAPTER 4

DATA PRESENTATION AND RESULTS

4.1 INTRODUCTION

In this chapter, we present the quantitative and qualitative results of the survey and interviews, respectively. We explored the enablers and barriers of Point-of-Care Testing, along with some benefits and potential drawbacks. As a reminder, the purpose of this study was to evaluate the current POCT practices of clinicians and to explore how the knowledge and perceptions of clinicians influence the use of POCT in selected hospitals in the Free State, South Africa.

4.2 QUANTITATIVE DATA FINDINGS

4.2.1 Sociodemographic description of participants in the quantitative survey

Out of the 276 individuals that took part in the survey 60.1% (n=166) of them are females, while 37.7% (n=104) of them are males, and the remaining 2.2% (n=6) did not disclose their gender.

The age group distribution of participants is provided in Table 4.1. It can be observed that 31.9% of the participants are between the ages of 21 and 30 years, 32.6% are between the ages of 31 and 40 years, 21.4% are between the ages of 41 and 50, 13% are between the ages of 51 and 60 years and two individuals are 61 years and above.

Table 4.1: Sociodemographic description of participants in the quantitative survey

	Age and Gender demographics	**Number (N)**	**Frequency (%)**
Gender	Not Stated	6	2.2
	Female	166	60.1
	Male	104	37.7
Age Group (Years)	Not Stated	1	.4
	21 – 30	88	31.9
	31 – 40	90	32.6
	41 – 50	59	21.4
	51 – 60	36	13.0
	61 and above	2	.7

4.2.2 Description of professional, experience and clinical setting of the participants

It can be observed that one of the participants is a clinical associate, 13.4% of the participants are doctors (n=37), and the remaining 86.2% are professional nurses (n=238).

Participants' work experience in years since qualifying for their profession is provided in Table 4.2. It can be observed that 30.8% of the participants (n=85) have working experience of 1 to 5 years, 15.9% have work experience of 6 to 10 years, 15.9% have work experience of 11 to 15 years, 6.2% have work experience of 16 to 20 years, and 21.7% have work experience of 21 years and above.

Table 4.2: Description of professional, experience and clinical setting of the participants

	Sociodemographic characteristics	**Number (N)**	**Frequency (%)**
Profession	Clinical associate	1	0.4
	Doctor	37	13.4
	Professional nurse	238	86.2
Work Experience	Not Stated	2	0.7
	1 – 5	85	30.8
	6 – 10	68	24.6
	11 – 15	44	15.9
	16 – 20	17	6.2
	21 or more	60	21.7
Hospital Setting	Not Stated	2	0.7
	Rural	177	64.1
	Semi-rural	16	5.8
	Semi-urban	25	9.1
	Urban	56	20.3

In terms of the settings of hospitals, 64.1% of the participants (177) consider their hospital setting to be rural, 5.8% of them (16) consider their hospital to be semi-rural, 9.1% consider their hospital setting to be semi-urban, and 20.3% consider their hospital setting to be urban.

4.2.3 POCT coordination, awareness and testing at selected hospitals

Only 15,6% of participants confirmed that they have a clinician in the hospital who is responsible for POCT.

In terms of familiarization with POCT, like pregnancy and glucose tests, etc. which are now often performed by doctors and nurses instead of sending a specimen to a clinical laboratory, there was a majority agreement among our participants. Two (2) individuals said they were unfamiliar with POCT while 270 individuals said they were familiar with POCT.

In accessing laboratory tests, 1.8% of the participants do not use any means or ways, 13.8% access the laboratory through off-site means, 38.8% access the laboratory through off-site and POCT, 9.8% access the laboratory through onsite and 32.6% access laboratory through on-site and POCT.

Ninety eight point two percent of participants agree that they use laboratory services routinely, while 72.4% (n = 197) of participants also use POCT. Table 4.3 depicts coordination, awareness, testing, and TAT

Table 4.3: POCT coordination, awareness and testing at selected hospitals

	Responses	**Number (N)**	**Frequency (%)**
Specific person allocated to manage POCT	I don't know	107	38.8
	No	126	45.7
	Yes	43	15.6
	Not stated	4	1.4

Familiarity with a POCT like	No	2	.7
	Yes	270	97.8
How you access laboratory services	None	5	1.8
	Off-site	38	13.8
	Off-site and POCT	107	38.8
	On-site	27	9.8
	On-site and POCT	90	32.6
Average waiting times for a U&E result	Not stated	6	2.2
	Less than 1 hour	4	1.4
	1 hour – 4 hours	88	31.9
	5 hours – 8 hours	59	21.4
	9 hours – 12 hours	31	11.2
	12 hours – 24 hours	26	9.4
	24 hours – 48 hours	56	20.3
	48 hours and longer	6	2.2
Average waiting times for an FBC result	Not stated	8	2.9
	1 hour – 4 hours	73	26.4
	12 hours – 24 hours	34	12.3
	24 hours – 48 hours	61	22.1
	48 hours and longer	8	2.9
	5 hours – 8 hours	50	18.1
	9 hours – 12 hours	36	13.0
	Less than 1 hour	6	2.2
	Not stated	6	2.2

Overall satisfaction with TAT	Neutral	90	32.6
	Not satisfied	49	17.8
	Satisfied	95	34.4
	Very dissatisfied	8	2.9
	Very satisfied	28	10.1
Will POCT improve the availability of test results	Not stated	7	2.5
	Definitely	129	46.7
	Maybe it will	51	18.5
	Most definitely	50	18.1
	Neutral	38	13.8
	No, it will not at all	1	.4

Abbreviations:

- POCT – Point of Care Testing
- U&E – Urea & Electrolytes
- FBC – Full Blood Count
- TAT – Turn-around-time

Average Duration waiting for U&E results

In terms of average duration spent on waiting for Urea and Electrolytes results, it can be observed that 1.4% spent less than an hour waiting, 31.9% spent 1 to 4 hours waiting, 21.4% used 5 hours, 11.2% spent 9 to 12 hours, 9.4% spent 12 to 24 hours, 20.3% spent 24 to 48 hours, and 2.2% spent 48 hours and longer.

POCT awareness and practice

During the examination of the POCT awareness, it was observed that 77.2% of the participants were trained on POCT as opposed to 21.7% who were not trained, 33.7% agreed that they would spend less time on patient care, and this was a concern to them while 64.5% agreed that this would not be a concern to them. A total of 76.1% of participants agreed that they would be prepared to perform more POCT, and 22.5% indicated that they would not be prepared to perform the tests themselves. An overwhelming 84.1% of participants did not mind the fact that POCT results are not available online, while only 13.8% thought that this would be a problem. Table 4.4 shows the stats for training, workload and electronic access to results.

Table 4.4: POCT training and concerns with workload and electronic results

	Yes	No
Have you been trained on the use of any of the POCT?	213 (77.2%)	60 (21.7%)
If you perform more POCT as a clinician, you will have less time to spend on patient care. Is this a concern to you	93 (33.7%)	178 (64.5%)
Are you prepared to perform more POCT yourself?	210 (76.1%)	62 (22.5%)
POCT results are not available online, as is the case with clinical laboratory results. Does this post a major problem?	38 (13.8%)	232 (84.1%)

Reasons for performing POCT

Participants' opinions and perceptions of the reasons for performing POCT have been presented in the frequency and percentage distribution table below. It can be observed that 21 individuals strongly disagree that there is limited access to a clinical laboratory, 79 disagree with this, 24.3% (67 individuals) were of neutral opinion, 78 individuals agree that there is limited access to a clinical laboratory, and 22 individuals strongly agree. It can be observed that 4 individuals strongly disagree that there is an absence of accessible diagnostic laboratory services and POC will increase access to testing and patient care, 24 individuals disagree, 60 individuals were of neutral opinion, 116 individuals agree that there is an absence of accessible diagnostic laboratory services and POC will increase access to testing and patient

care, while 51 individuals strongly agree. In terms of the use of POCT to support in acute or life-threatening emergencies, it can be observed that 6 individuals strongly disagree that they can use POCT to support in acute or life-threatening emergencies, 3 individuals disagree as well, while 40 individuals were of neutral opinion, on the other hand, 133 individuals agree, and 73 individuals strongly agree. On how the use of POCT patient management can lead to changes in a single visit to ensure better patient outcomes and decision making, 2 individuals strongly disagree, 4 disagree with this, while 32 individuals were of neutral opinion, on the other hand, 144 individuals agree, and 71 strongly agree.

Table 4.5 shows the stats for different reasons why clinicians perform POCT.

Table 4.5: Reasons for performing POCT

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
There is limited access to clinical laboratory	21 7.6%	79 28.6%	67 24.3%	78 28.3%	22 8%
There is an absence of accessible diagnostic laboratory services, and POCT will increase access to testing and patient care	4 1.4%	24 8.7%	60 21.7%	116 42%	51 18.5%
I can use POCT to support acute or life-threatening emergencies	6 2.2%	3 1.1%	40 14.5%	133 48.2%	73 26.4%
By using POCT, patient management can be changed in a single visit and ensure better patient outcomes and decision-making	2 0.7%	4 1.4%	32 11.6%	144 52.2%	71 25.7%

By using POCT, my hospital can improve clinical pathways	2 0.7%	12 4.3%	83 30.1%	113 40.9%	62 22.5%

Accuracy: POCT compared with the clinical laboratory

Participants were asked to indicate their response in terms of agreement comparing POCT with clinical laboratory. It can be observed that 69.6% of the participants are aware of the concept of quality assurance (QA) and quality control, while 29% are not aware. It can be observed that 87.3% are aware of the concepts of a test's specificity and sensitivity, while 11.2% are not aware. It can be observed that 87.3% are satisfied that the accuracy of results from POCT is sufficient to be used in your hospital, while 10.9% are not. It can be observed that 13% of the participants have been involved in the selection of a POCT device in a hospital, while 85.5% have never been involved in the selection of a POCT device in a hospital. Lastly, 79.3% of the participants think that clinicians should be involved in POCT device selection in their hospitals, while 18.1% do not think that clinicians should be involved in POCT device selection in their hospitals. Table 4.6 shows the stats for POCT accuracy and includes QA and QC

Table 4.6: POCT accuracy

	Yes	No
Are you aware of the concepts of quality assurance (QA) and quality control (QC)	192 69.6%	80 29%
Are you aware of the concepts of a test's specificity and sensitivity	241 87.3%	31 11.2%
Are you satisfied that the accuracy of results from POCT is sufficient to be used in your hospital	241 87.3%	30 10.9%
Have you ever been involved in the selection of a POCT device in a hospital?	36 13%	236 85.5%
Do you think that clinicians should be involved in POCT device selection in their hospitals	219 79.3%	50 18.1%

4.3 QUALITATIVE DATA FINDINGS

Table 4.7 presents the sociodemographic description of the participants in terms of gender, age groups in years, professions, work experience in years and the hospitals settings where they work.

4.3.1 Sociodemographic description of participants

Table 4.7: Sociodemographic description of participants in the qualitative interviews

	Age and Gender demographics	Number (N)
Gender	Female	11
	Male	7

	Total	18
Age Groups (Years)	31 – 62 and above	
Professions	Doctors	8
	Professional Nurses	10
Work experience (Years)	6 – 21 years	
Hospital Settings	Urban	1
	Rural	9

A total of seven (7) males and eleven (11) females participated in the study. The reason for having more females is a result of the fact that more females enter the nursing profession compared to males. Their age groups varied from thirty-one (31) to sixty-two years and above. Eight doctors and 10 professional nurses were interviewed in one (1) hospital in an urban setting and nine (nine) rural hospitals. The participant's work experience varied between six 21 years, with 61% of the participants having work experience of more than 21 years.

4.3.2 Data Analysis

The major themes and frequency of codes developed from the qualitative analysis are outlined below and presented in Table 4.8. The first iteration of open coding yielded twelve (12) initial codes, which were then condensed into the three outlined themes because it addresses the study research questions.

1. Awareness and Practice, which included (1) Patient and Clinician Advantages of POCT, (2) Patient and Clinician Disadvantages of POCT and (3) Usage of POCT
2. Cost-Effectiveness / Cost Advantages and Disadvantages of POCT
3. Results Recording and Accuracy of POCT

Table 4.8: Frequency of codes

Category	Code	Description	Count	% Codes	Cases	% Cases
Awareness & Practice	POCT Awareness	Participants awareness of POCT	15	6,60%	14	82,40%
Awareness & Practice	Awareness Source	How did participants become aware of POCT	14	6,10%	13	76,50%
Awareness & Practice	Colleagues Awareness of POCT Advantages	Colleagues Awareness of POCT Advantages	24	10,50%	14	82,40%
Awareness & Practice	Colleagues Awareness of POCT Disadvantages	Colleagues Awareness of POCT Disadvantages	5	2,20%	4	23,50%
Operations	POCT Results Recording	How POCT are recorded / documented	17	7,40%	14	82,40%
Operations	Usage	Does the hospital use POCT	12	5,20%	10	58,80%
Operations	Usage Reasons	Why did the hospital opt to use POCT	16	7,00%	11	64,70%

Cost	Cost Advantages	The cost benefits of POCT	22	9,60%	12	70,60%
Cost	Cost Disadvantages	Cost Disadvantages	11	4,80%	8	47,10%
Advantages/ Disadvantages	POCT Advantages	Advantages / Benefits of POCT	53	23,10%	14	82,40%
Advantages/ Disadvantages	POCT Disadvantages	The disadvantages of using POCT	18	7,90%	10	58,80%
Accuracy	QA/QC/Results Accuracy	QA/QC/Results Accuracy	22	9,60%	9	52,90%
			229		133	

4.3.2 Theme 1 – POCT Awareness and Practice

Theme 1 assessed the participants awareness of POCT and how they initially became of POCT. The empirical data exhibit that the interview participants had different sources of awareness about POCT, including learning and knowing in their capacities as student clinicians. Alongside studentship, there are also examples in the context of awareness sources about POCT in South African hospitals during practising and execution of duties as nurses as well as medical studies. Other participants indicated that they learned about POCT through observation in ward rounds and while working in hospitals. It must be highlighted that all the participants were aware and had knowledge of POCT because it is a routine activity in their hospitals and since the participants of the qualitative part of the study are all senior clinicians they are reliable sources of information on POCT awareness.

Verbal responses from participants included the following:

"As a student nurse. We're using POCT during my school training and obviously on the service when we started working in the hospitals" and *"When I was a student at MANCOFS, which a nursing training college. We used these devices as students and continued when I was also employed"* said one Nursing Manager.

"I became aware during my practice when executing nursing duties. And let me say during when I was a student and when specimens go for urine testing and pregnancy test, because in our days, we didn't use these, therefore, we didn't test for glucose. Glucose was being tested at the laboratory. So, it's a student nurse, and it was part of your curriculum, part of your practice that we had to do in the hospitals," said another Nursing Manager.

Another Nursing Manager said, "*The district hospital, I noticed that they were using some of those devices to test in some areas". "Yes, I'm aware of POCT, but I know it as a bedside test. We used to call it bedside tests or bedside investigations*". Such as, *"From training, because in between from training as much as you will be in class, but you still have to practice from the practical area there are other tests that are not going to the lab. From the hospitals, so it was like merging the theory and practice".*

4.3.3.1 Theme 2 – Operations of POCT – Part 1 Advantages

The first part of Theme 2 assessed how the participants were managing POCT operations in terms of usage, the rational for using POCT and the advantages to patient and clinicians.

There are many benefits to using POCT devices in clinical laboratories. POCT devices can provide accurate and timely results, which can help healthcare

professionals to make better decisions for their patients. POCT devices can also help to reduce the cost of healthcare and can improve patient care. However, some people believe that POCT is utilized just because they are available. But on the other side of the coin, most of the empirical data (in a majority of the responses) reveals that the hospital employees comprising of clinicians, nurses, doctors, and other related officials, understood the advantages of POCT. The study found that almost all of the clinicians interviewed were aware of the benefits and advantages of using POCT, and the majority had used or expressed an intention to use POCT in clinical practice. POCT has been regarded as providing patients with timely results, making it easier for healthcare providers to make timely decisions and prescribe medicines that produce significant advantages in the medical field.

POCT allows clinicians to detect and treat medical conditions early, which can improve patient outcomes and often avoid second appointments by providing results quickly. POCT also enables clinicians to monitor patients. The clinicians are most often utilizing this service except for some specified cases where POCT are not available. In this case clinicians will resort to the traditional laboratory. The importance of point-of-care testing cannot be overstated. It has the potential to provide doctors and other medical practitioners with the necessary information they need to deliver better patient care as evident by the statement of participants.

Point-of-care testing has been rapidly growing in popularity in recent years. This is due, in part, to the increasing demand for faster and more accurate diagnoses. POCT can also be used to monitor a patient's progress over time. This helps to ensure that patients are getting the correct treatment and that it has the desired effect. POC testing can also help to identify early signs of disease, which can help to improve the

chances of a successful outcome. In addition, POCT is a source of aiding in the assessment of the disease earlier and prescribing the desired and required treatment to assist the patients spontaneously. POCT devices and testing are simple and easy to conduct, which is also one of its benefits to the patient management system. In terms of usage of POCT devices, their implementation and improvement of the services, the empirical data found that all (huge majority) of the participants (interviewed) reflected that they regularly use such system for diagnosis. Among them, some of the participants specifically highlighted the diseases for which they were frequently using and utilizing this service, which included HIV, pregnancy, and glucose (on glucometer) tests.

Verbal responses from participants included the following:

You know, I think my colleagues are just using it because they are available. I don't think anybody has ever looked at it as if it's a benefit".

“I think many of my colleagues will be 99% aware of the benefits of this and use it”.

"Yes, they are aware of the benefits. They do them, they know them well and the percentage that I can give is 96%".

"Currently, in this institution, all my doctors are aware of this. And because of that, we do it weekly."

"Yes, of course, and everyone's using like glucose, Hb machines they are also doing the pregnancy test. So, say 100%."

"Yes, everybody, especially the professional nurses."

"I'm sure we are aware because all of us are using them. So, I think it's almost everyone at the hospital unless maybe in an isolated case with a doctor decide to send the specimen to the lab for certain reasons, specific reasons."

"we have different kinds of categories, we'll be having the unit managers, which are the most people that I think I'll say 100% of them that are aware of the benefits because they are controlling all the consumables" "the unit managers because it's the one that is in control of the services, and the securement of the machines"

"So, for me, those tests have an advantage because they can give me a hint immediately, I don't have to wait for some days, unlike the person who is in Bloemfontein, who can, you know, access the results quicker than."

"it helps us to know what kind of treatment if we can start only patients, once we know that the test has been done. So, we know the next step to take into to help the patient".

"The patience may stay longer in hospital unnecessarily, because of the delayed interventions, because of the time that was taken to do these tests" and *"If you get the result immediately would that help you to the treat patients quicker".*

"It comes a little bit cheaper than when we sent it to the lab. And it saves the hospital a lot of things because even making the diagnosis for the patient is faster."

"I think the benefits are that you get the results faster, it costs less and patients can be treated promptly".

"The POCT devices are simple to use. They are much cheaper. And they are easily available. You can get the results immediately. You don't have to wait to get the results from the lab. So that's the reason we are using it".

4.3.3.2 Theme 2 – Operations of POCT – Part 2 Disadvantages

The second part of Theme 2 assessed how the participants were managing POCT operations in terms of usage, the rational for using POCT and the disadvantages to patient and clinicians.

Although nothing can be perfect in medical and laboratory science, there might be weaknesses either as part of the POCT technology or the person operating the POCT technology. The data reflects that the machines and equipment often break down though this may not be the case for cassette-based test kits which does not use machines. Such breakdowns make it difficult to continue the service. In addition, the consumables, parts, and maintenance are expensive. Maintenance of the devices and equipment is derived and identified as among the disadvantages of POCT services, where the readings might be different and wrong if functioned and operated by wrong, unskilled, and out-of-expertise persons.

Verbal responses from participants included the following:

"Yeah, I think, I think the colleagues are aware of this. We teach about the disadvantage of not doing the test correctly or what may happen to the patient if the test is not performed correctly. So, we make sure that they are upskilled, and in-service training we make them to be upskilled and have knowledge of how to do the tests".

"We don't really have the disadvantages because most of the POC devices that we are using the reliable. We don't experience problems with them. Unless, if we see that the machine is not functioning well is then that you can decide that we are not using this machine, we rather opt for taking blood and sent to the lab, but not that much of a disadvantage".

"When we get the results quicker, everything is quicker. So, most of the time its advantages, not disadvantages" and *"when we discuss I haven't had any of the disadvantages".*

"It will be whereby the machine is broken or whereby there are no consumables when they are out of stock, maybe, from the suppliers."

"And disadvantage would be when there's an error. Or the machine or the machine is not working."

"Maybe the availability of supplies. When it comes to the consumables that come with the machines and the machines themselves are sometimes also difficult to source, and even when you break one, you're struggling to get a new one."

"It is a disadvantage if people have not been taught and they do not know how to use POCT" and "*does the person who is doing the test have the skills")*

"we do not maintain it and give us wrong readings. It means we're talking about the lives of patients here".

"We do rapid test for HIV, rapid test for glucose, rapid pregnancy test, amongst others".

"I used the glucometer pregnancy test, HIV test RPR".

"Yes, we do. We have a mobile machine; we have sugar machines we recently installed an arterial blood gas machine in the emergency department".

4.3.3.3 Theme 2 – Operations of POCT – Part 3 Results Recording

The third part of Theme 2 assessed how the participants were managing POCT operations in terms of recordkeeping of results.

The study also recorded responses about the results recording, accuracy of the POCT devices results and overall usage of POCT. In this context, mixed approaches have been identified in all the concepts of maintenance of POCT devices, result recording, accuracy checks and usage.

The data exhibits that different methods are used while recording the results of POCT. According to the data, various hospitals use a variety of methods for recording POCT results, including patient files, clinical notes, observation charts, progress reports, nursing records, and standard templates, and they also record results on referral letters when necessary. All of the above will eventually be found in a patient's file. It depends on the case, disease, and condition of the patient that how to record and manage the results. The nursing records are also maintained, which are supposed to keep and records in the form of progress reports.

"*we usually document them on the clinical notes, some machines like the arterial blood gas machine prints out results for us, so we attach those results to the clinical notes.*

Otherwise, we copy them if the printing facilities are not available with the machine or due to technical issues. We copy them, and obviously, our signature would attest to the fact that your colleagues are aware of these POCT results"

"nursing records, like in the progress report every way whereby we are supposed to record them, but mainly it's in the Progress Report. In some of the admission of patients, when we assess the patient, we do record it in the assessment on admission record, or else it's in the progress report, basically, or in the triage form".

4.3.3.4 Theme 2 – Operations of POCT – Part 4 Accuracy of Results

The fourth part of Theme 2 assessed the opinions of participants on accuracy of results.

Accuracy of the results has been the strongest concern for clinicians to assist with an accurate diagnosis, treatment and monitoring. Two kinds of responses have been recorded in this regard, which reflects that neither the results are completely wrong, biased, unauthentic and untrustworthy, nor these are completely reliable and valid. The quality assurance has always been the major worry for service recipients while utilizing POCT. One participant expressed concern that such devices may produce the wrong result due to technical reasons, when the POCT device is not properly maintained.

"The accuracy is the real reliability of the machine".

"most of the machine that we're using is not that complicated".

"We are usually taught, or given the quality assurance by the protect manufacturer, then we know how to assure quality. And again, even with the control. We know how to control it"

"I think the laboratory will always be the golden standard. I always compare it to the laboratory when someone brings me a device."

"I say how reliable is it compared to a laboratory test, is it within 5% to 10% range is it within 15% to 20% range, and so the accuracy is the main worry"

"my main worry is always how reliable is this test, and that's the first thing that I research on when someone brings me a device, I do not want to give a machine that may endanger the life of a patient, by giving a wrong result to very unreliable results".

"I think the main issue is the reliability of the results. The quality assurance when it comes to those tests.

"Sometimes, it gives wrong results because of failure to maintain the machine as it is supposed to"

"It's believed that the test can be done once, and the results will be accurate. Sometimes with the tests that we do, sometimes we feel you have to repeat the same test."

4.4.1 Theme 3 Part 1 – Cost Advantages of POCT

Theme 3 assessed the cost advantages of POCT awareness amongst participants

When analysing the advantages and disadvantages of POCT costs, empirical data shows that the advantages outstrip the disadvantages. The point confirms (to a high extent) that POCT has more cost advantages when compared to its negative cost implications. A huge majority of the beneficiaries and operators have positive comments regarding POCT's existence in the hospital by producing positive results and facilitating better patient health outcomes. These cost advantages extend beyond the price of a POCT test, it includes the cost of patient care and early detection of diseases which are cheaper to manage.

It is widely believed that POCT is a reliable and fast service with a more cost-effective nature. The expenditure and investment are less burdensome, while the results, outcomes and benefits are beyond the expectations as expressed by participants. POCT is considered cheaper than the conventional lab testing system. It saves money not only for the patients but also helps the state to provide cheaper and timely services to the masses. There are also other costs that must be considered with sending specimen to the traditional laboratory which includes transport and drivers. The interview participants also reflected that it is more cost-effective in terms of saving on transport charges and time. Patients' specimens must be transported to laboratories using drivers, vehicles and fuel, which results in spending more time and money, which both are avoidable with the use of POCT. When the laboratory is on-site, the cost is much less because a clinician or porter just needs to walk to the laboratory.

Besides the operational advantages and disadvantages of the POCT already discussed, the researcher focused some questions on cost-related advantages and

disadvantages as part of the cost-effectiveness theme. This includes POCT cost-effectiveness, as may be perceived by patients. In this connection, such tests are considered more advantageous when compared to lab-based tests because they are immediate, urgent, and instant and patients do not have to return to out-patient clinics for results that will be available a few days later. The information reveals that patients are provided with instant hints about their illness. It is one of the highest benefits of POCT that patients' time is preserved because of rapid diagnosis, which helps start the treatment instantly to avoid any complications due to delay of diagnosis. In addition, with the use of POCT in hospitals, patients' average length of stay in hospitals has been made lesser when compared to previous times. Laboratory testing tends to keep the patients for longer periods in the hospitals whilst waiting for results, which turns to overloading the hospitals and drawing more cost burdens on hospitals. It is also believed that longer lengths of stay in hospital beds lead to more waste of time and money. In this context, the provision of POCT may reduce the length of stay, which in turn reduces the waste of money and lessens the burden on hospitals. It is also believed that longer lengths of stay in hospital beds lead to more waste of time and money. In this context, the provision of POCT may reduce the length of stay, which in turn reduces the waste of money and lessens the burden on hospitals. This approach is more cost-effective for the entire society, not just for the patient. This approach is more cost-effective for the entire society, not just for the patient, as is evident in a participant's comment as POCT benefits most of the patients who come from lower social classes income, especially those living in rural areas with fewer hospitals and long distances to travel on multiple occasions because of outstanding or missing clinical laboratory tests. The data also reveal that it helps to simplify diagnosis for

doctors, allowing them to spend less time seeing patients and starting physical examinations all over again.

Verbal responses from participants included the following:

"They are fast and reliable, and they are cost-effective. You don't need to buy expensive machines because the lab, it's more expensive. These devices and we don't need to buy them".

"We are saving time and money".

"POCT is cheaper because remember that with the lab for us, it's also transporting the specimen. Remember, it's not only the transport but also the vehicle and to give overtime".

"when the patient is diagnosed earlier and managed sooner. And again, it's so cost-effective cheaper than laboratory tests". It's a source of life-saving, money-saving and time-saving for patients who get an early diagnosis, in little time with the saved money, for example, "For the patient, he gets the treatment on time rather than waiting for two hours. So, it's life-saving for patients".

"When the patient is ready, they say no, I Don't have transport. They usually stay in the waiting area in wait for the results to come the following day, but they don't come. I'm sorry they don't come the following day, why they do the way in the waiting area because National Hospital is very far".

"It's time and money; these are the two main benefits".

"You can discharge or make discharge decisions quicker admissions decisions quicker" and "

"The patience may stay longer in hospital unnecessarily, because of the delayed interventions, because of the time that was taken to do these tests in the lab".

"To reduce the average length of stay, thus reducing average length of stay result in financial benefit for the hospital".

"It's easy, especially for medical aid patients. Remember, if you're doing the blood tests and they're sent to a lab, if you are a private patient, it's charged separately. But for us in a rural area where we found mostly the people who are not working and are dependent on social grants. It will be a benefit to us".

"These tests a far cheaper than laboratory testing, with faster results, reducing the burden on patients and avoiding diagnosis, treatment and monitoring."

"*It comes a little bit cheaper than when we sent it to the lab. And it saves the hospital a lot of things because even making the diagnosis for the patient is faster".*

"*It is simple to diagnose and it is cost financially and cost-effective. They are quick, and patients spend less time in the hospital as a result ".*

"*Like, for instance, if we're talking about Hb. If you are using the Hb machine in our institution is cheaper, but if you are sending Hb to the laboratory, it is not cost-effective because there will be a transport cost included in case of emergency".*

"the more your patient is in the ward, the more you will have to provide care and care equals money. So, if your efficiency improves quicker, then they can go and continue recuperating at home. And that cuts your costs".

4.4.2 Theme 3 Part 1 – Cost Disadvantages of POCT

Theme 3 assessed the cost advantages of POCT awareness amongst participants

The cost disadvantages of POCT are also recorded in interview data which reflect that POCT is not simply a technology of perfection. Rather it can be a disadvantageous position in some instances. The forms of disadvantages consist of the non-functionality of the system, lack of reliability of results, and expensive instruments and their maintenance. While a significant number of participants pointed to the fact that they had no evident disadvantages to using POCT, the data reflected that its primary disadvantage is when the system breaks down and the hospitals suffer from a shortage of the availability of POCT services. There are also thoughts that the results might not be up to the mark, and the patients are compelled for retesting and reconfirmation from labs, which increases the cost and decrease the cost-effectiveness. Furthermore, it is also reflected that the maintenance of POCT is more expensive, which fades down its worth.

"when we have shortage" and *"There is not enough money to buy it. And then sometimes we find that the machine, it's not functional at that time").*

"And in some cases, even after confirmation with lab results, we still get the same results that we got initially".

I think the only cost disadvantage is if the result is not reliable and we know that the machine is not reliable. We had to take a formal test every time we had some instances where we used a haemoglobin machine that didn't give us satisfactory results. You could see there are discrepancies between the clinical picture and what

the machine is giving you. So, you have to send a formal blood sample to the laboratory, and that's a waste of money. Why should they do a POCT if I know that I'm going to verify it again with a formal blood test every time? POCT compared with the clinical laboratory".

"I feel that I need to confirm my results with a laboratory test because then it means I would have done the same test twice. It is a disadvantage".

"The consumables are very expensive. For the maintenance is very expensive" and *"Some of them are very expensive. It just depends on the company's or suppliers".*

4.5.3 Triangulation

By combining both quantitative and qualitative research methods, the researcher was able to expose the realities of two different groups of participants. The researcher found that qualitative data collected from semi-structured interviews (N = 18) and quantitative data collected via questionnaires (N = 276) produced similar findings. This exploratory mixed-methods design was a great way to answer the research questions that were posed for this study and allowed for a more holistic understanding of the data. By triangulating independently derived results, this study was able to improve the reliability and validity of its responses to both research questions. This rigorous process ensured that the data represented a more accurate reflection of reality. The consensus was reached on all identified themes, categories and dimensions, which further contributed to triangulation and removing all the biases that could have interfered with using a single study approach. This made it easier to verify and validate findings.

The quantitative leg of the study focused on understanding the context of the clinicians who perform POCT, why they perform POCT or why they do not prefer POCT, how they perceive their involvement in POCT and their understanding of QA, QC, POCT sensitivity and specificity as well as challenges and opportunities that they could identify with POCT implementation. From the quantitative leg of the study, the researcher developed the three themes (1) POCT Awareness and Practice, which included Patient and Clinician Advantages of POCT, (2) Patient and Clinician Disadvantages of POCT and (3) Usage of POCT. All the qualitative data were coded and thematically analysed with the use of QDA Miner Lite software. The analysis was done separately on the qualitative and quantitative parts of the study to confirm and support the findings of each part. The researcher reached his goal of ensuring that the conclusions reached were as accurate as possible and the data collected were compared and contrasted and then analysed to identify any patterns.

CHAPTER 5

DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

5.1 INTRODUCTION

The researcher found that the objectives of the study were met and that the research questions were answered based on the findings of the study. The purpose of this study was to examine the current POCT practices of clinicians in selected hospitals implementing POCT in the Free state, South Africa and to explore how the knowledge and perceptions of clinicians influence the use of POCT in selected hospitals implementing POCT in the Free state, South Africa

5.2 DISCUSSION

5.2.1 Hospital setting and POCT management

The study demonstrated that hospitals in urban areas have easier access to laboratory services. Additionally, the two urban study sites that were identified both had on-site laboratories and received better service in terms of Turn-Around-Time (TAT). There was also high satisfaction with the laboratory's services since these hospitals have their specimen for testing delivered to the on-site laboratory in minutes. However, the wards usually wait for a ward round to be completed and send all specimens to the laboratory at once. Emergency specimens are delivered to the laboratory individually within minutes. Different hospitals name their wards differently as a result the questionnaire only mentioned the most common names but participants were allowed the opportunity to input other wards into a text box which allowed the

researcher to type these into the results. Most specimens are usually collected from Male and Female General Wards, Casualties/Emergency, Out-patients and Paediatrics. The laboratory will prioritise all specimens that are sent from Casualties/Emergency and specimens marked as urgent. Only 15,6% of participants confirmed that they have a clinician in the hospital who is responsible for POCT. This is a poor proportion of skilled health profession and could explain why some hospitals perform better in POCT management than others. Once a stable and readily accessible skilled health professional is in charge of POCT management, it is likely that POCT will be used more effectively and there will be fewer stock-outs of consumables for conducting medical laboratory tests. This eliminates some of the disadvantages that are mentioned by participants including formal training needs since the POCT coordinators can manage both formal and informal training and conduct training themselves or collaborate with suppliers of POCT to conduct training (Clifford, 2018).

5.2.2 Accessing laboratory services

Accessing laboratory services is aligned with the awareness of participants and demonstrates that they are aware of POCT and actively use POCT routinely though the POCT tests available are much fewer than what is available in laboratories. The POCT that they use is specially aligned to communicable and non-communicable national programmes of South Africa. However, there is also a use of less obscured tests that are used for screening, diagnosis and monitoring. It must be noted that out of the 10 hospitals that formed part of the research study, only 2 had laboratories on-site. However, all hospitals have POCT available and use this when they think it is appropriate.

5.2.3 Turn Around Time - Average Duration waiting for U&E and FBC results

The average waiting period for the most popular tests of Urea and Electrolytes (U&E) and Full Blood Count (FBC), which is a reflection of the test Turn-Around-Time (TAT) for the laboratory departments of Biochemistry and Haematology, shows a shorter TAT in the two hospitals with online laboratories and one of the hospitals without an onsite laboratory but are within 20 kilometres of the laboratory. This is based on proximity where clinicians or their support staff can easily walk to the laboratory to drop off specimens for testing or in the case of the one hospital which is within 20 kilometres from the nearest laboratory, which has a twice per day courier service to the specific laboratory that serves them. Additionally, if this hospital has emergency specimens to be tested, it is more affordable and less resource-intense in terms of transport, fuel and drivers to drop the specimen at the laboratory. They always take all specimen that needs to be dropped off that is waiting for the next courier schedule. This also means specimens are delivered to the laboratory for quicker testing. Despite these three hospitals having a shorter TAT, their participants still indicate that they would prefer to have more POCT available. This is because the two laboratories serving the three hospitals do not operate on a 24-hour basis. They operate on a 12-hour basis maximum during weekdays and eight hours during weekends with a call-out system for the remaining hours. Such call-outs would make a laboratory technologist available within approximately one hour to perform the test, which is usually an emergency. Hence the laboratory technologist is called out to test the specimen.

Lean-based reorganization of both laboratory and clinician specimen collection, transport and quicker results checking processes can lead to a significant improvement in process efficiency that leads to decreased TAT. Systems engineering

approaches might have even more wide-reaching benefits for healthcare by improving quality and capacity while lowering waste and costs. The FSDOH is implementing and monitoring a Clinical Laboratory Interface (CLI) in all its facilities, including the 10 hospitals that participated in the research. When properly implemented as a system engineering process, the TAT decreases automatically. Total laboratory automation and CLI help in the efficient management of large volumes of samples, reducing TAT and, when combined with electronic results access, results in increased satisfaction with the results from a laboratory, although the TAT will still not be shorter compared with POCT. In summary, the closer proximity to a laboratory to a hospital and the impact of implementing the CLI results in a better TAT for test results and overall satisfaction level.

5.2.4 Level of Satisfaction with overall Turn-Around-Time of the clinical laboratory provider

A total of 35.2% and 10.4% of the participants indicated that they were satisfied and very satisfied with the laboratory's TAT, respectively. Further analysis revealed that the hospitals that account for the total number of these satisfied participants are the two hospitals with on-site laboratories and the other (1) hospital with laboratory at a distance of roughly 20 kilometers. Responses on how satisfied they were by participants in the remaining hospitals without onsite laboratories ranged from neutral to unsatisfied.

POCT and systems engineering approaches might have even more wide-reaching benefits for healthcare by improving quality and capacity while lowering waste and costs (Stahl et al., 2015). As a lean-based reorganisation to improve TAT, quality and cost efficiencies, the FSDOH is implementing and monitoring a Clinical

Laboratory Interface (CLI) in all its facilities, including the 10 hospitals that participated in the research. When properly implemented as a system engineering process, the TAT should decrease automatically.

5.2.5 Participants' thoughts on POCT improving the availability of test results

Only one participant thought the availability of POCT will not improve the TAT of POCT results. On closer look, it was found that this participant was working in a hospital with a laboratory on-site which indicates that they already have a reasonably good TAT. A total of 64% respondents indicated that the availability of POCT can improve the availability of test results significantly with a shorter TAT as compared with the traditional medical laboratory. This discourse confirms what Themes (2016) stated that POCT improves patient care and reduces waste of traditional tests being sent to the traditional and patients not returning for results or results being lost due to potential inefficiencies with filing systems. Besides, it improves convenience for both patients and clinicians. Rapid, near-patient testing allows for timely diagnosis and treatment of patients, which can improve patient outcomes. POCT also allows for the early detection of outbreaks and the tracking of epidemics. The successful use of POCT relies on being able to demonstrate a significant improvement in the time it takes to obtain test results. A faster result compared with the laboratory could provide a clinically significant advantage in decision-making (Wiencek and Nichols, 2016). A good TAT for POCT relies on the fact that the results of tests are completed within minutes, rather than hours or days.

5.2.6 POCT awareness and practice

In all ten hospitals that were included in this study, POCT is performed by doctors and nurses which made them good sources of information, especially about how and where it is used in their respective facilities.

A total of 77.2% of participants reported that they have been trained on the use of POCT, only 21.7% reported that they have not been trained. There are no tangible reasons provided by the clinicians reporting that they have not been trained but the researcher is of the view that not all clinicians regularly perform POCT or may perceive training as formal training instead of on-the-job training. A total of 64.5% of clinicians indicate that it is not a concern for them to perform POCT though this may reduce the time that they can spend with the patient during consultations but only 22.5% are prepared to perform more POCT. This suggests that they welcome more POCT but do not want to perform it themselves. In the current FSDOH system, there are no other officials appointed to specifically perform POCT, however, other clinicians like nursing assistants may also perform POCT. Furthermore, a total of 84.1% of participants did not have an issue with POCT results not being available electronically. This is probably true since as determined by the qualitative results, heads of nursing and clinical managers indicated that all POCT results are captured in patients' files immediately after the test is performed. Most of the staff (42/68, 62%) indicated that they knew who was managing POCT in their respective locations.

In addition, the study found that clinicians are all aware of POCT, have knowledge of it and they have been using it since they were students at university or nursing colleges. However, they did not receive proper training except for demonstrations by the suppliers of POCT and other clinicians who went through the demonstration processes themselves. Despite no formal training, they are comfortable

with performing POCT's and appreciate the benefits of POCT. They practice POCT daily depending on their job descriptions and professional qualifications. They were able to list the POCT that they are currently using and some requested that more tests should be made available. This makes the researcher draw a conclusion that if awareness about POCT is not high enough among clinicians, it could lead to its underutilization. A lack of training and knowledge about POCT devices could lead to low utilization rates.

Awareness and training exposure could be a factor in helping clinicians understand the importance of POCT and how to use it appropriately. The training of staff at the POCT site is extremely important to provide accurate and reliable information. At the time this study was conducted, no national guidelines or policies were guiding the practice and training of POCT in South African hospitals that hospitals could rely on. There was a draft policy but the clinicians and hospital managers would not have been aware of it.

Participants stated that the demand for POCT in the clinic and hospital settings have increased rapidly in recent years at their institutions due to the following; the need to reduce costs and risks associated with transporting patients and samples, the need for rapid diagnosis and treatment of acute conditions, improving patient satisfaction by providing results while both the clinician and the patient are still in the clinic or hospital and to reduce costs through reduced lab testing and specimen transport time. They also appreciate the fact that you can do POCT on fingerpicks and urine which makes specimen collection less complicated and harmful because of the small blood sample they need to perform POCT.

5.2.7 Accuracy: POCT compared with the clinical laboratory (an overview based on the findings discussed)

Quality assurance is a key factor in the success of any POCT. To provide accurate results for patient care, quality assurance is a key factor that needs to be taken into consideration. Quality assurance is a process that ensures the accuracy and reliability of the data collected during testing. Quality assurance also ensures that all processes involved in providing testing services adhere to guidelines and standards set by regulatory authorities such as FDA or ISO 13485 (Spitzenberger, Langer and Gassner, 2018). Quality control (QC) is a term used in both the manufacturing and laboratory testing industries to describe those measures that must be included in each assay to verify that the test is working properly. This includes an assessment of the accuracy, precision, sensitivity, specificity, reproducibility, and robustness of a test. QC and QA are important branches of quality management and apply to both medical laboratory tests and POCT. In this research study, it was found that most participants are not aware of the concepts of QA and QC, which can be a drawback when POCT tests results are not accurate, and clinicians performing the tests will not understand what type of troubleshooting is required. POCT are usually accurate, but there are some instances where they can produce false results. That is why it is important to have quality assurance for these tests and make sure that they produce accurate results for patient care.

Sensitivity is the ability of a test to identify patients with a disease correctly. In medical testing, this is usually expressed as a percentage (www.pathology.health.nsw.gov.au, n.d.). For example, if a test has 50% sensitivity, it will correctly identify half the patients with the disease. Specificity is defined as the ability of a test to identify people who do not have the disease correctly. A high

specificity test will not give a false-positive result, meaning that it will only identify people who have the disease. The sensitivity and specificity of POCT results are crucial to the diagnosis and treatment plan. The accuracy of point-of-care testing is often compromised by human error and improper storage. The most common cause for inaccurate test results is improper handling and storage. Improper handling can lead to the sample being contaminated or degraded, resulting in false negatives. Improper storage can lead to false positives, as well as a decrease in sensitivity and specificity. To ensure that patients receive the highest quality test results possible, it is important to know when point-of-care tests are inappropriate for use and what alternatives are available. POCT rapidity and accuracy can be improved by increasing specificity and sensitivity. The goal is to provide accurate results for patient care with the right sensitivity and specificity.

5.3 CONCLUSION

Clinical POCT tests have emerged as a lifesaving tool for doctors and nurses, as they allow for swift diagnosis and patient care. This is especially true for hospitals without their own clinical laboratories, which can now benefit from the testing capabilities that were previously unavailable to them. POCT tests are becoming an essential part of patient care in general, as they provide clinicians with a more comprehensive view of a patient's health than simply relying on traditional diagnostic tests. As POCT tests become more prevalent, hospitals must ensure that they have the right infrastructure in place to support their use. This includes ensuring that all the necessary equipment is available and that staff are properly trained in how to use it. In addition, hospitals should make sure that their policies regarding the use of POCT

tests are clear to both patients and staff. Finally, hospitals should keep track of the results of their POCT tests to ensure that they are effectively using this technology. However, as POCT tests are often created and implemented in hospitals without input from clinicians, the full potential of this practice is hindered by negative perceptions among some clinicians. In summary, POCT may have the potential to improve outcomes and reduce costs in certain settings, but it faces significant challenges that need to be addressed in order to realize its full potential. Perceptions among some clinician are negative, due in part to the lack of input from them. These challenges need to be addressed in order to realize the full potential of POCT.

Although POC tests have many potential benefits, such as providing accurate assessments of students' abilities, issues of distrust in their accuracy, limitations in their characteristics and testimonies regarding a lack of training on how to use them inhibit their full potential. The study found that there are often confrontational development processes and disparities in user experience. Respondents feel that they should be involved in purchasing decisions of POCT and there should be adequate programs in place to train them to use POCT more affectively. There are many benefits to POCT, but some clinicians are concerned that the results may not be as reliable as clinical laboratory tests. This may be due to a lack of quality assurance, control, and documentation of the test results. As a result, clinicians may avoid performing POCT altogether in order to ensure accuracy. To reap the greatest benefit from POC tests, stakeholders should include end-users in the development and implementation process. This will allow for a more comprehensive understanding of how users actually use the product or service, and can help to ensure that the tests are most effective. The findings of the study suggest that clinicians may benefit from incorporating POCT into their practices. However, more research is needed to

determine the specific processes and systems that need to be in place to make POCT more accessible and acceptable. Additionally, it is important to consider the potential risks and benefits of POCT in different clinical settings and patient populations. Future research should also include a larger population and in other provinces since provinces face different challenges. More research is needed to explore the impact of policy changes on the quality assurance and availability of POCT as well as the role that SANAS and SAPHRA can play in ensuring all POCT manufactured both in South Africa and internationally meet relevant ISO standards.

5.4 RECOMMENDATIONS FOR IMPLEMENTING A POCT PROGRAMME

Based on the study findings, we recommend that here must be a FSDoH POCT guide to support the challenges identified in the study results. POCT is a tool to improve the quality of health care and should be a part of larger health promotion, disease prevention and management programmes. POC testing should be as simple and convenient as possible, with a focus on the patient's experience rather than the rigidity of a test-centric approach. POCT should take into account the patient's comfort level, their health history and risk factors. Tests should be tailored to the individual patient and allow for modifications as needed. POCT should also be cost-effective, with consideration for cost savings for both the patient and the health care provider and should be conducted in a timely manner so that results are available quickly to provide treatment options for the patient.

POCT can be used to screen the general population, both in rural and urban areas, to identify risk factors and early warning signs of disease and can enable the early detection of life-threatening diseases and allow the early initiation of treatment.

Training on the use of POCT must be formalized and included in the skill development plans of health facilities in the FSDoH. This should include quality assurance and accuracy measures of POCT. Education on the proper use of POCT should be provided to all health care personnel who will be using the devices. This training should also include a review of standard operating procedures, calibration, and quality assurance, recording of results in patient files and periodic competency assessments and recertification. A quality control and assurance monitoring system should also be established to ensure accuracy of results and quickly identify deviations. These may include external laboratory testing and proficiency testing.

Training should include practical exercises in the use of the POCT device, such as setting up the device, running tests, interpreting results, and troubleshooting. Training should also include the use of safety equipment and protocols for handling hazardous materials or disposing of biohazardous waste. Additionally, staff should be trained on the proper storage and maintenance of POCT devices.

It is important to ensure that all healthcare personnel understand the limitations of POCT. Clinicians should be aware of the accuracy, reliability and limitations of POCT and know when to confirm a POCT result with the clinical laboratory. They should be familiar with the regulations, guidelines, and policies related to POCT in order to ensure compliance with applicable laws and regulations. By understanding the cost-effective use of POCT and adhering to the regulations, guidelines, and policies

regarding POCT, clinicians can help to ensure that quality care is provided to patients in a safe and effective manner.

Where possible results must be stored electronically to be accessed by other health facilities instead of just being in the patient's file where the test was performed. Some POCT tests that are used to diagnose tests in priority programmes must be loaded online for epidemiology purposes.

Managing a POCT programme can be a full-time position, or some tasks shifting to a phlebotomist must be considered. A dedicated POCT person is necessary to ensure that all clinicians are trained, POCT consumables are available, quality assurance is done on all POCT at regular intervals, and the programme is running smoothly.

When considering POCT, it is important to consider not only the cost of the test but also the time it takes professionals to perform the test. By doing a cost analysis and looking at the different options available, facility managers can make the best decision for their facilities.

5.5 FUTURE RESEARCH STUDIES TO BE CONDUCTED

With the rapid advances and adoption of POCT, it is important to continue to explore the costs and benefits of this technology. Thus, future research should not only explore the costs and benefits of POC testing but also identify ways to reduce the costs while maintaining the benefits for patients and healthcare providers. A cost analysis should be conducted to look at the cost of POCT holistically, which includes the time it takes professionals to perform the tests themselves. This should include

identifying best practices for POCT testing to optimize patient outcomes and reduce costs associated with shorter lengths of stays in hospitals and opportunity costs of patients not having to return for follow-up visits to obtain test results when in most cases, this is not necessary. Another area of future research should focus on the feasibility of using more POCT technology in primary care settings. This would allow clinicians to test for a variety of conditions and illnesses without having to refer patients out for testing. Lastly, there is a need for studies to assess the uptake of POCT between facilities where a POCT training program was implemented and facilities where no POCT training program was implemented to determine the effectiveness of such programs. Such studies could help to improve the understanding of POCT and help to improve the delivery of POCT training programs.

POCT should be incorporated into provincial clinical governance frameworks. Clinical governance is an important quality framework that includes risk management, clinical and cost-effectiveness, and patient outcomes. Provincial health departments are responsible for ensuring the effective implementation of POCT clinical governance. Laboratories must be involved in developing and implementing a comprehensive risk management strategy to ensure quality care for patients.

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Appendix 1 - University of Fort Hare Ethics Approval

University of Fort Hare
Together in Excellence

HEALTH RESEARCH ETHICS COMMITTEE

P.O Box 1054
East London 5200
Tel: +27 (0) 43 704 7368
E-mail: dgoon@ufh.ac.za

ETHICAL CLEARANCE CERTIFICATE
REC-100118-054

Certificate Reference Number:	**Ref # 2020=10=10=WatkinsE**
Project title:	**Clinicians' knowledge and perceptions and of Point of Care Testing in selected hospitals in the Free state, South Africa**
Nature of Project	Masters of Public Health
Principal Researcher:	Watkins E
Student Number:	201928122
Supervisors:	Dr KE Oladimeji

On behalf of the University of Fort Hare Health Research Ethics Committee (HREC), I hereby give ethical approval in respect of the undertakings contained in the above-mentioned project and research instruments(s). Should any other instruments be used, these require separate authorization. The Researcher may therefore commence with the research as from the date of this certificate, using the reference number indicated above.

Please note that the HREC must be informed immediately of

- Any material change in the conditions or undertakings mentioned in the document
- Any material breaches of ethical undertakings or events that impact upon the ethical conduct of the research

The Principal Researcher must report to the HREC in the prescribed format, where applicable, annually, and at the end of the project, in respect of ethical compliance.

University of Fort Hare
Together in Excellence

HEALTH RESEARCH ETHICS COMMITTEE

P.O Box 1054
East London 5200
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E-mail: dgoon@ufh.ac.za

The HREC retains the right to

- Withdraw or amend this Ethical Clearance Certificate if
  - Any unethical principles or practices are revealed or suspected
  - relevant information has been withheld or misrepresented
  - regulatory changes of whatsoever nature so require
  - the conditions contained in the Certificate have not been adhered to

- Request access to any information or data at any time during the course or after completion of the project.
- In addition to the need to comply with the highest level of ethical conduct principal investigators must report back annually as an evaluation and monitoring mechanism on the progress being made by the research. Such a report must be sent to HREC monitoring@ufh.ac.za.

The Ethics Committee wishes you well in your research endeavours.

Yours sincerely

Professor DT Goon
Chairperson: HREC
14 October 2020

Appendix 2 - FSDOH Research Approval

health
Department of Health
FREE STATE PROVINCE

06 November 2020

Mr E Watkins
Dept. of Management Laboratory Services
UFH

Dear Mr. E Watkins

Subject: Clinicians knowledge and perceptions and of Point of Care Testing in selected hospitals in the Free State, South Africa.

- Please ensure that you read the whole document. Permission is hereby granted for the above – mentioned research on the following conditions:
- Participation in the study must be voluntary
- A written consent by each participant must be obtained.
- Serious Adverse events to be reported to the Free State department of health and/ or termination of the study
- Ascertain that your data collection exercise neither interferes with the day to day running of **Tokollo, Katleho, Nala, Thusanong, Botshabelo, Dr JS Moroka, Mantsopa, National, Itemoheng, Phekolong, Dismant, Stoffel Coetzee & Albert Nzula** nor the performance of duties by the respondents or health care workers.
- Confidentiality of information will be ensured and please do not obtain information regarding the identity of the participants.
- **Research results and a complete report should be made available to the Free State Department of Health on completion of the study (a hard copy plus a soft copy).**
- Progress report must be presented not later than one year after approval of the project to the Ethics Committee of the University of the Fort Hare and to Free State Department of Health.
- Any amendments, extension or other modifications to the protocol or investigators must be submitted to the Ethics Committee of the University of the Fort Hare and to Free State Department of Health.
- **Conditions stated in your Ethical Approval letter should be adhered to and a final copy of the Ethics Clearance Certificate should be submitted to** scbeclats@fshealth.gov.za / makenamr@fshealth.gov.za **before you commence with the study**
- No financial liability will be placed on the Free State Department of Health
- **Please discuss your study with Institution Manager on commencement for logistical arrangements see 2nd page for contact details.**
- Department of Health to be fully indemnified from any harm that participants and staff experiences in the study
- Researchers will be required to enter in to a formal agreement with the Free State department of health regulating and formalizing the research relationship (document will follow)
- **As part of feedback you will be required to present your study findings/results at the Free State Provincial health research day**

Trust you find the above in order.

Kind Regards

Dr D Motau
HEAD: HEALTH
Date: 6/11/2020

Head : Health
PO Box 227, Bloemfotein, 9300
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Appendix 3 – Participant information Sheet and Consent form

Point of Care Testing (POCT) Study

TITLE OF THE STUDY

"Knowledge and perceptions on point of care testing (POCT) by clinicians in selected hospitals implementing POCT in the Free state, South Africa"

PRINCIPAL INVESTIGATOR

Edgar Jeffrey Watkins

Free State Department of Health

Cnr Harvey & Charles Street

051 408 1610 / 20

082 819 1044

watkinse@fshealth.gov.za

watkinseddy@gmail.com

You are invited to participate in a survey approved by the Free State Department of Health and Fort Hare University concerning Point of Care Testing in the Free State Department of Health. The survey will take around 20 minutes to complete. Your responses will be collated with other respondents and used to provide answers to the research questions of the study.

You are being asked to take part in a research study. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information. If you have questions at any time about this study, or you experience adverse effects as the result of participating in this study, you may contact the researcher whose contact information is provided above.

RESEARCH OBJECTIVES

- To evaluate the current POCT practices of clinicians.
- To explore how the knowledge and perceptions of clinicians influence the use of POCT.

WHAT IS POCT?

Point of Care Testing (POCT) is the testing of the patient specimen at the patient bed-site or near the patient in the consultation rooms instead of sending it to a clinical laboratory. These include tests like Glucose / Hemoglobin / Pregnancy / HIV / RPR / Urine Dipstix / Blood gases which are performed by clinicians.

CONFIDENTIALITY

Your responses to this survey will be anonymous. Every effort will be made by the researcher to preserve your confidentiality including the following:

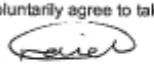
- Assigning numbers for participants that will be used on all research notes and documents
- Keeping notes and any other identifying participant information in a locked file cabinet in the personal possession of the researcher.

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy f this consent form. I voluntarily agree to take part in this study.

Participant's signature: 

Date:

25/11/2020

Contact details to confirm ethics approval or raise ethical concerns
University of Fort Hare South Africa
50 Church Street
East London
Central Business District
Eastern Cape
South Africa
+27 43 704 7093

Name of the hospital	Dimont
Name of the participant	Nicole Naidoo
Contact details – in case errors are detected in completion of the questionnaire – names and contact will not be shared	0834147445
Date of completion of the questionnaire	25/11/2020

Instructions

1. If you choose to complete the questionnaire online, you can download from a link that will be provided by the Head of Nursing or Clinical Manager.
2. You are requested to carefully read each question before registering yur response.
3. There are no right or wrong answers. I am interested in what you know and think. Complete the answers based on your own knowledge and understanding of point of care testing in the district hospital where you are currently working or recently worked.
4. All questions are important and carry weights that will be analysed.
5. Please read the definitions to understand the questions asked.
6. Where an questiona requires a tick, tick with an X
7. After completion of the manual questionnaire your are requested to put it into the sealed box in the office of the Chief Executive Officer. If you are completing the questionnaire online, you are requested to click the submit button.

Definitions

Point of Care Test – Also referred to as near-patient testing are diagnostic tests performed in the ward, clinic or in the presence of the patient. They are portable, provide quick test results, use smaller sample volume and can also be used for patient self-monitoring" (Miller Louise Kimberley, 2016).

Clinical laboratory tests / Traditional laboratory tests – "A clinical laboratory is a laboratory where tests are done on clinical specimens to get information about the health of a patient in order to confirm a diagnosis, treat, and prevent disease" (Michel, 2019).

Clinicians – A clinicians are health care professionals that may diagnose, treat and care for patients in a clinic, hospital, at home or in a private medical practice where they work directly with patients rather than in a laboratory or as a researcher (Wikipedia Contributors, 2019).

Turn-around-time (TAT) – Laboratory TAT is the time taken from requesting diagnostic tests to the point when the results become available to a clinician (Bhattarai & Manandhar, 2018). It is a sign of service satisfaction and is a key performance indicator for clinical laboratories. The shorter the TAT the better it is to allow the clinician to make a quick decision on what steps to follow in terms of diagnosis, screening or treatment monitoring.

POCT Selection - POCT selection is the process followed to identify which POCT devices or technologies are suitable to obtain a test result that will assist the clinician in making an informed scientific decision for patient management (Kosack, Page, Klatser, 2017). It includes defining the test purpose, identifying the cost of the tests as well as the time-based cost of clinicians or laypersons who will perform the tests, studying the market, determining the tests optimal diagnostic accuracy, determining the tests diagnostic accuracy in practice and monitoring the test when in everyday use. Mainly, POCT must improve the experience of both the patient and the clinician.

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Section A: Demographics and Professional Experience

1. Gender

Male	
Female	✓

2. Age Group

21 – 30	✓
31 – 40	
41 – 50	
51 – 60	
61 and above	

3. Date of birth – year/month/date

Year	1994
Month	April
Date	16

4. Profession

Professional nurse	
Doctor	✓
Clinical associate	

5. Persal Grade

Doctors		Nurses	
Medical Officer Grade 1	✓	Professional Nurse Grade 1	
Medical Officer Grade 2		Professional Nurse Grade 2	
Medical Officer Grade 3		Professional Nurse Grade 3	
Medical Specialist Grade 1		Operational Manager Grade 1	
Medical Specialist Grade 2		Operational Manager Grade 2	
		Clinical Programme Coordinator Grade 1	
		Clinical Programme Coordinator Grade 2	
Other – Please specify below:		Other – Please specify below:	

6. Work experience in years since qualifying in your profession

1 – 5	✓
6 – 10	
11 - 15	
16 – 20	
21 or more	

7. In which university were you trained? Type the name in the below.

UFS

8. In which country is this university? Type the name in the space below.

SA

9. How do you consider your hospital setting to be:

Urban	
Rural	✓
Semi-urban	
Semi-rural	

10. Which part of the hospital do you mostly work in mostly?

Casualties / Emregencies	
Out Patient Department	
Male Ward	✓
Female Ward	✓
Paediatrics	
Maternity	
Other – Please specify below:	

11. Is there a specific person allocated to manage POCT in your hospital?

Yes	
No	
Don't know	✓

Section Bi: POCT awareness

1. Are you familiar with point of care testing (POCT) like pregnancy and glucose tests, etc. which are performed by doctors and nurses instead of sending a specimen to a clinical Laboratory?

Yes	✓
No	

2. How do you access laboratory tests?

On-site	
Off-site	
On-site and POCT	
Off-site and POCT	✓
None	

3. How long do you wait on average for a U&E result?

Less tha 1 hour	
1 hour – 4 hours	
5 hours – 8 hours	
9 hours – 12 hours	
12 hours – 24 hours	✓
24 hours – 48 hours	
48 hours and longer	

4. How long do you wait on average for a FBC result?

Less tha 1 hour	

1 hour – 4 hours	
5 hours – 8 hours	
9 hours – 12 hours	
12 hours – 24 hours	✓
24 hours – 48 hours	
48 hours and longer	

5. How satisfied are you with the overall time of the clinical laboratory provider for tests that are also available as POCT?

Very dissatisfied	
Not satisfied	✓
Neutral	
Satisfied	
Very satisfied	

6. Do you think that POCT will improve the availability of test rsults?

No it will not at all	
Maybe it will	
Neutral	
Definitely	✓
Most definitely	

Section Bi: POCT awareness and practice

7. What are some of the POCT that you currently perform in your hospitals?

1	Arterial Blood Gases	
2	Blood Grouping	
3	Blood Lactate	
4	CarboxyHaemoglobin	
5	CD4	
6	Electrolytes	
7	Glucose	
8	Haemoglobin	
9	HbA1c	
10	HIV Rapid Test	✓
11	International Normalised Ratio (INR)	
12	Ionised Calcium	
13	Malaria Test	
14	MethHaemoglobin	
15	Pregnancy Test	✓
16	Rapid Syphilis Test (RPR)	✓
17	Rhesus Factor	✓
18	TB Mantoux Test or Tuberculin Test (TST)	
19	Thromboelastography (TE)	
20	Thromboelastometry (ROTEM)	

21	Troponin T and D-Dimer Qualitative Analysis	
22	Urine Test Strip or Dipstick	✓
Other, please specify below		
1		
2		
3		
4		
5		

8. How often do you use these tests?

		Daily	More than once / day	Weekly	Monthly	Once / year or less
1	Arterial Blood Gases					
2	Blood Grouping					
3	Blood Lactate					
4	CarboxyHaemoglobin					
5	CD4					
6	Electrolytes					
7	Glucose					
8	Haemoglobin					
9	HbA1c					
10	HIV Rapid Test		✓			
11	International Normalised Ratio (INR)					
12	Ionised Calcium					
13	Malaria Test					
14	MethHaemoglobin					
15	Pregnancy Test			✓		
16	Rapid Syphilis Test (RPR)			✓		
17	Rhesus Factor			✓		
18	TB Mantoux Test or Tuberculin Test (TST)					
19	Thromboelastography (TE)					
20	Thromboelastometry (ROTEM)					
21	Troponin T and D-Dimer Qualitative Analysis					
22	Urine Test Strip or Dipstick		✓			
Other, please specify below						
1						
2						
3						
4						

5						

9. Have you been trained on the use of any of the POCT?

Yes	✓
No	

10. If you could add more POCT in your hospital, can you list them below? Add in the space below.

1	Arterial blood gas
2	Hb machine
3	
4	
5	
6	
7	
8	
9	
10	

11. If you perform more POCT as a clinician, you will have less time to spent on patient care. Is this a concern to you?

Yes	
No	✓

12. Are you prepared to perform more POCT yourself (this mean not requesting somebody to perform the test)?

Yes	✓
No	

13. POCT results are not available online like is the case with clinical laboratory results. Does this post a major problem?

Yes	
No	✓

Section Bii: Reasons for performing of POCT

1. Which conditions do you consider that point-of-care tests will help them with diagnosis?

1	Arterial Blood Gases	✓
2	Blood Grouping	
3	Blood Lactate	
4	CarboxyHaemoglobin	
5	CD4	
6	Electrolytes	✓
7	Glucose	
8	Haemoglobin	✓
9	HbA1c	
10	HIV Rapid Test	✓
11	International Normalised Ratio (INR)	
12	Ionised Calcium	

13	Malaria Test	
14	MethHaemoglobin	
15	Pregnancy Test	
16	Rapid Syphilis Test (RPR)	
17	Rhesus Factor	
18	TB Mantoux Test or Tuberculin Test (TST)	
19	Thromboelastography (TE)	
20	Thromboelastometry (ROTEM)	
21	Troponin T and D-Dimer Qualitative Analysis	
22	Urine Test Strip or Dipstick	✓
Other, please specify below		
1		
2		
3		
4		
5		
6	I do not believe POCT will assist me in making diagnosis	

2. Which conditions do you consider that point-of-care tests will help to reduce referrals?

1	Arterial Blood Gases	✓
2	Blood Grouping	
3	Blood Lactate	
4	CarboxyHaemoglobin	
5	CD4	
6	Electrolytes	✓
7	Glucose	
8	Haemoglobin	✓
9	HbA1c	
10	HIV Rapid Test	
11	International Normalised Ratio (INR)	
12	Ionised Calcium	
13	Malaria Test	
14	MethHaemoglobin	
15	Pregnancy Test	
16	Rapid Syphilis Test (RPR)	
17	Rhesus Factor	
18	TB Mantoux Test or Tuberculin Test (TST)	
19	Thromboelastography (TE)	
20	Thromboelastometry (ROTEM)	
21	Troponin T and D-Dimer Qualitative Analysis	
22	Urine Test Strip or Dipstick	✓
Other, please specify below		

1		
2		
3		
4		
5		
6	I do not believe POCT will assist me in reducing referrals.	

3. Which conditions do you consider that point-of-care tests will help to monitor?

1	Arterial Blood Gases	✓
2	Blood Grouping	
3	Blood Lactate	
4	CarboxyHaemoglobin	
5	CD4	
6	Electrolytes	✓
7	Glucose	
8	Haemoglobin	✓
9	HbA1c	
10	HIV Rapid Test	✓
11	International Normalised Ratio (INR)	
12	Ionised Calcium	
13	Malaria Test	
14	MethHaemoglobin	
15	Pregnancy Test	✓
16	Rapid Syphilis Test (RPR)	✓
17	Rhesus Factor	✓
18	TB Mantoux Test or Tuberculin Test (TST)	
19	Thromboelastography (TE)	
20	Thromboelastometry (ROTEM)	
21	Troponin T and D-Dimer Qualitative Analysis	✓
22	Urine Test Strip or Dipstick	✓
Other, please specify below		
23		
24		
25		
26		
27		
28	I do not believe POCT will assist me in monitoring conditions.	

4. There is limited access to a clinical laboratory?

Strongly disagree	
Disagree	
Neutral	
Agree	✓

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Strongly agree	✓

5. There is an absence of accessible diagnostic laboratory services and POC will increase access to testing and patient care

Strongly disagree	
Disagree	
Neutral	
Agree	
Strongly agree	✓

6. I can use POCT to support in acute or life threatening emergencies?

Strongly disagree	
Disagree	
Neutral	
Agree	
Strongly agree	✓

7. By using POCT patient management can be changed in a single visit and ensure better patient outcomes and decision-making?

Strongly disagree	
Disagree	
Neutral	
Agree	✓
Strongly agree	

8. By using POCT my hospital can improve clinical pathways?

Strongly disagree	
Disagree	
Neutral	
Agree	✓
Strongly agree	

Section Biii: Accuracy: POCT compared with the clinical laboratory

1. Are you aware of the concepts of quality assurance (QA) and quality control (QC)?

Yes	✓
No	

2. Are you aware of the concepts of a tests specificity and sensitivity?

Yes	✓
No	

3. Are you satisfied that the accuracy of results from POCT are sufficient to be used in your hospital?
   a. (Yes)
   b. No

A. Involvement in selecting POCT

1. Have you ever been involved in the selection on a POCT device in a hospital?

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Yes	
No	✓

2. Do you think that clinicians should be involved in POCT device selection in their hospitals?

Yes	✓
No	

Section Biv: POCT Implementation

1. How can the implementation of POCT be improved in hospitals? Please complete your input in the space below in relation to the headings provided. If you have no comment, please write NC.

1	Training	Training is needed
2	Access to tests strips	Provides a challenge currently
3	Availability	Availability is a problem
4	Part of management oversight and planning	NC
5	Cost	Benefits outweigh the cost
6	Accuracy & quality	NC
7	Simplicity	NC
8	Storage	In casualty for emergency's or in the ward

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9	Waste disposal	NC
10	Connectivity to retrieve data	Difficulty accessing results due to poor network
11	Recording of test results	NC
12	Regulations	NC
13	National Department of Health policy / guides / framework	Should be placed around hospital
14	Dedicated POCT staff	needed
15	Allocation or appointment of a laboratory services and POCT coordinator.	great idea
Other, please specify		
16		
17		
18		
19		
20		

Thank you for completing the questionnaire.

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Appendix 4 – Proof of English Language Editor Review

ACKNOWLEDGMENT FOR PROOFREADING OF MY DISSERTATION

ACKNOWLEDGMENT

I want to extend a special word of gratitude to Freelancer Faizan Akbar (Proofreader and Editor on Fiverr), who helped me with my document by providing proofreading and editing services and reviewing the entire document within the given timeframe.

Remarks by Faizan Akbar
'The author has already completed his dissertation; I'm just offering my proofreading services as a second set of eyes to help him reduce errors in his document.' Thank you for your trust, and best wishes for the future'.

Thanks again for his support

Topic:
CLINICIANS KNOWLEDGE AND PERCEPTIONS OF POINT OF CARE TESTING (POCT) IN SELECTED HOSPITALS IMPLEMENTING POCT IN THE FREE STATE, SOUTH AFRICA

Date of Project: 12 August 2022

Service: Proofreading and Editing
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