Healthcare professionals' experiences in private practice of point-of-care testing for diabetic patients in Gauteng

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1. A research report submitted to the Faculty of Commerce, Law, and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration.

Johannesburg, 2021

ABSTRACT

This research reports experiences from healthcare professionals (HCPs) on point-of-care (POC) testing, for diabetic patients in private practice, at primary healthcare level in Gauteng, South Africa.

While there are many benefits to POC testing in an emergency setting, it might not provide the same benefits at a primary care level. Studies have produced mixed results over many years in terms of cost-effectiveness and health outcomes in a primary care setting. Despite mixed conclusions as to whether POC testing is beneficial at a primary care level, some practitioners still utilise POC devices. POC testing at a primary care level has many potential benefits.

This research reports insights through a qualitative study based on a phenomenological research design, from healthcare professionals (HCPs) that are currently using or have used POC devices in their private practice. The study was conducted using semi-structured interviews.

The research highlighted the need for new business models, which may further emphasize the benefits of POC. The main themes uncovered were improved patient outcomes, reduced decision time, compliance, HCP satisfaction and practice efficiency. The research concluded that HCPs were experiencing various benefits from using POC testing. Moreover, it uncovered some benefits that were not highlighted in literature review, such as the reduced risk of contracting COVID-19 and the role of POC in a care-coordinated model.

While POC testing has been in existence for many years, much more research needs to be done in private practice in Gauteng.

DECLARATION

I Sumesh Ghirdari declare that this research report is my own work except as indicated in the reference and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.

Sumesh Ghirdari

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Signed at Randburg

On the 28 day of April 2021

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Patrick Zhuwao, for his support and guidance throughout the research process. His guidance enabled me to focus on my research opportunity and write this report. He has truly made this an excellent learning experience.

I would like to extend my appreciation to all the participants, without whom this research would not have been possible; to the healthcare professionals that took time out of their day during a pandemic to participate in my research. For this, I am extremely grateful.

Furthermore, I would like to thank KardioGroup. KardioGroup assisted with identifying possible participants. Without them, my research would have required the tedious process of searching for participants that met my target group specifications.

Finally, I would like to thank my family, who have supported me throughout my MBA. Their support lightened the load for me and enabled me to focus on my academic work.

TABLE OF CONTENTS

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

GP	General Practitioner
HCP	Healthcare Professional
POC	Point-of-Care
EHR	Electronic Health Record
HbA1c	Glycated haemoglobin
HIV/AIDS	Human Immunodeficiency Virus / Acquired Immune Deficiency Syndrome
PMB	Prescribed Minimum Benefit

CHAPTER 1. INTRODUCTION

1.1 Purpose of the study

This research reports experiences from healthcare professionals (HCPs) on point-of-care (POC) testing, for diabetic patients in private practice, at primary healthcare level in Gauteng, South Africa. The purpose was to identify if practitioners were experiencing the theoretical benefits of POC and if KardioGroup's business model was successful. Although the research initially aimed to target general practitioners (GPs) only, all HCPs meeting the specific criteria were targeted due to COVID-19 challenges mentioned later. The research was based on a phenomenological design.

1.2 Background and context of the study

POC or 'bedside' testing has been in existence for just under fifty years (John & Price, 2014). Initial bedside testing started with urine analysis, which was conducted near the patient (Price, 2001). Over the years, technology has made huge advances to allow various bedside tests to be done (Price & Hicks, 1999 as cited in Price, 2001). The objective was and still is, to aid in faster clinical decision-making while reducing healthcare costs (Price, 2001).

POC devices allow for a wide range of tests to be done without sophisticated laboratory equipment (Price, 2001). While there are various types of POC devices, POC devices in respect of this research refer to blood analysers. The devices are portable and can be taken to the bedside of the patient. POC devices offer various benefits including but not limited to, quicker decision-making, improved adherence to medication regimens, reduced readmission rates, reduced length of stay at a hospital, reduced use of inappropriate drugs, and improved quality of life (Price, 2001). The assumption is that by offering these benefits, the healthcare system will experience a long-term economic benefit.

The company, KardioGroup, is one of two companies with exclusive rights to

sell the Afinion AS100 Analyser in South Africa, in the private market. This blood analyser has the ability to test quantitative determinations of HbA1c, Lipid Panel, ACR, and CRP (News Medical Life Science, 2020). These tests are all important tests for metabolic diseases such as diabetes. KardioGroup had experienced stagnant sales of POC devices. Practitioners were not purchasing the devices, which begged the question whether they were experiencing the benefits of POC devices as stated in the literature.

1.2.1 General private practice setting

Private practice is defined as healthcare provided through ‘for profit’ hospitals and by self-employed practitioners (Basu et al., 2012). Primary healthcare is defined as “the provision of integrated, accessible healthcare services by clinicians who are accountable for addressing a large majority of personal health care needs, developing a sustained partnership with patients, and practicing in the context of family and community” (Starfield et al., 2005, p. 458). In the majority of general private practices at a primary care level around South Africa, the usual process is to book an appointment with a doctor for consultation. The doctor then assesses the patient and decides if blood tests are necessary for further assessment. If this is the case, the patient obtains a blood form and must then go to a phlebotomist, which may or may not be situated inside the practice. The blood is drawn from the patient and then sent to the laboratory for testing. The patient then returns after a few days so that the doctor might analyse the results and give feedback to the patient (Engel et al., 2018). The pathway is displayed in Figure 1

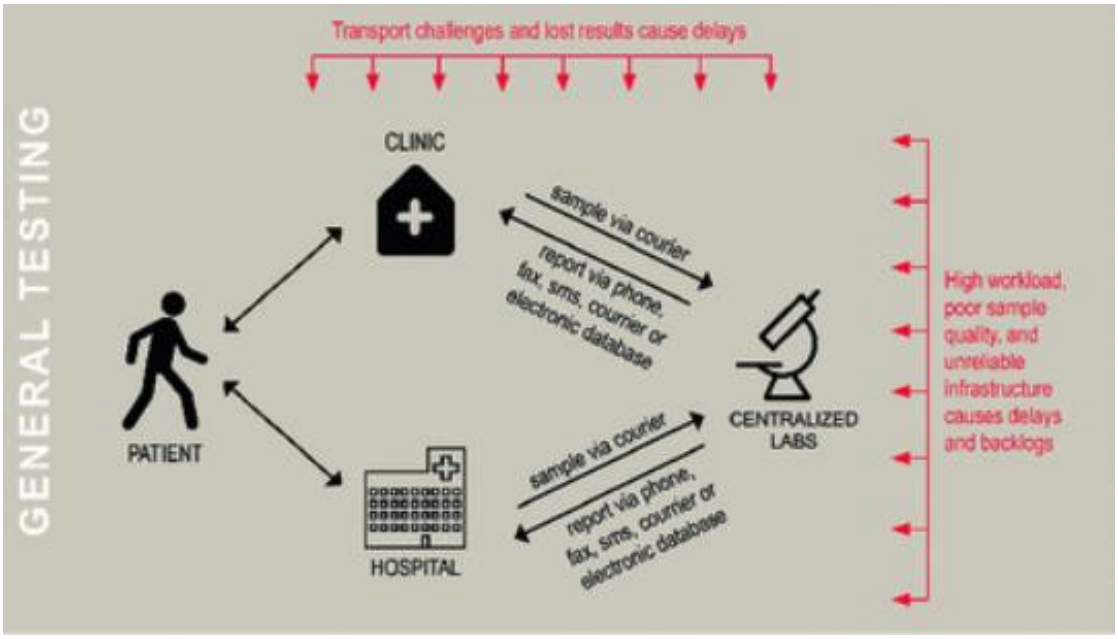

Figure 1: General pathology testing process (Adapted from Engel et al., 2018)

This process is the same for public and private care facilities. This standard process can lead to delays in treatment initiation, retesting due to poor samples, loss of results and strain on HCPs (Engel et al., 2018).

1.2.2 POC testing in a private practice setting

POC devices are portable diagnostic and monitoring devices that can be used at the bedside of the patient (Price & John, 2004 as cited in Sohn et al., 2016). POC testing allows practitioners to obtain various blood results within minutes (Abbott, 2020). Patients no longer need to leave the practice and return at a later stage for results and management. Almost immediate results allow the practitioner to make management decisions during the first consultation.

1.2.3 An introduction to formative evaluation

POC testing devices have shown their effectiveness and improved patient outcomes in many studies done in primary care settings (Motta et al., 2017; Pillay et al., 2019; Rust et al., 2008). The research done in South Africa is focused on the public sector; however; one study included private practice as

part of a broader scope of research (Engel et al., 2015). POC devices were initially developed for acute settings; however, over time many have begun noticing the potential benefits in primary care settings (Price et al., 2018).

1.3 Research conceptualisation

1.3.1 The research opportunity statement

Although research has produced mixed results regarding the use of POC testing at a primary care level, there is an increasing number of practitioners implementing these devices according to market research (Market Data Forecast, 2020).

POC testing offers a range of benefits for diabetes patients in a primary care setting, including improved patient outcomes, cost saving, increased practice efficiency, and improved patient and practitioner satisfaction (Larsson et al., 2015; Patzer et al., 2018; Schnell et al., 2016). However, these benefits are not yet confirmed in a private practice setting in Gauteng. Furthermore, over the years, various studies have produced mixed results regarding cost benefits and chronic patient outcomes (Gialamas et al., 2010; Khunti et al., 2006; Laurence et al., 2010; Pillay et al., 2019). The question remains if HCPs in Gauteng are in fact, experiencing the theoretical benefits of POC testing at a primary healthcare level.

The increased prevalence of chronic diseases increases the burden of disease on South Africa's healthcare system. It is estimated that by the year 2030, the cost of all type 2 diabetes cases in the public sector will amount to R35.1 billion (Erzse et al., 2019). An increased prevalence means more resources will need to be directed towards diabetes. The increased cost of private healthcare in South Africa coupled with the increased prevalence of diabetes indicates that change is required for a sustainable healthcare system. Overall health costs increased by 4.3 per cent in 2019, which is higher than inflation (StatsSA, 2019a). If POC testing is able to reduce long-term costs, this has the potential to reduce the disease burden on the healthcare system.

Despite mixed conclusions as to whether POC testing is beneficial at a primary care level, a few practitioners still utilise the device, what are the reasons? Are they experiencing the various benefits offered by POC testing? Or, do they have other reasons for using POC testing? This research focused on HCP experiences while using POC testing at a primary care level.

1.3.2 The research purpose (aims and objectives) statement

The aim of this research was to gather HCPs' experiences regarding POC testing at a primary care level in private practice in Gauteng. This was done using an explorative qualitative study, underpinned by a phenomenological design. Furthermore, the research aimed to gather insights as to the reasons why practitioners have implemented POC testing in their practices. These objectives were accomplished through semi-structured interviews with practitioners that use, or have previously used, POC testing in their practices.

1.3.3 The research questions

- *Question 1*: What beliefs do HCPs have regarding POC testing at a primary care level?
- *Question 2:* What benefits, other than therapeutic, are HCPs experiencing from utilising POC testing in their practice?
- *Question 3*: What are HCPs' opinions on the current reimbursement model for POC testing?
- *Question 4*: What are some of the factors that influenced HCPs to implement POC testing?
- *Question 5*: What do HCPs believe the barriers of entry are for POC testing in the private healthcare sector?

Question five was incorporated into the study after the approval of the research proposal. This was based on the direction of the first interview, in which the participant mentioned why they believed POC testing was less extensive in the

private healthcare sector. This could have been an important topic to include in this research.

1.4 Significance of the research study

The study produced results that would benefit various stakeholders in the healthcare industry such as patients, HCPs, POC device companies, medical aids, and public health officials.

By identifying why practitioners were implementing POC testing in their practices, insights were gained regarding their views of POC testing. One of the potential benefits of POC testing is reduced pathology costs (Laurence et al., 2010). HCPs mentioned that the pathology costs for POC testing were cheaper, compared to traditional laboratory testing. Participants went on to mention that patients were satisfied with the cost saving of POC testing. Patients saved on logistics, time, leave days, and consultation costs. The cost savings experienced by patients and funders has indicated that POC testing can reduce healthcare costs. Funders and government embracing POC testing would experience reduced pathology costs. Remodelling the healthcare system to have POC testing implemented on a large scale might result in exponential savings.

Investigating reasons for healthcare practitioners' use of POC testing provided POC device companies with insights on how to revise their strategy to ensure increased implementation. Participants mentioned that lack of awareness and financial risk were major deterrents to implementing POC testing at a primary care level. POC device companies could benefit from increased marketing and awareness campaigns. Furthermore, revising the business model to reduce financial risk to the HCP may entice practitioners to implement POC testing.

In line with business models, KardioGroup specifically, would benefit from this study as it has brought to light its problematic business model. HCPs highlighted the ethical dilemma they faced when using POC devices supplied by KardioGroup. To break-even, a certain number of tests need to be performed. This might influence practitioners to test unnecessarily in order to reduce

losses. KardioGroup would potentially benefit from a platform-based business model; allowing HCPs to use the software at no charge, would create an ecosystem of HCPs that would be very valuable to other companies. By offering advertising space on their platform to subsidise the cost of POC device use, KardioGroup would reduce the financial risk to HCPs and eliminate the ethical dilemma of excessive testing.

This study highlighted the benefits of POC testing that were not uncovered during literature review. First, the effect of POC testing on patient compliance; POC devices enabled patients to have pathology testing done during the first consultation; thereby reducing the need to travel to a laboratory for traditional testing. This improved the compliance of patients going for pathology testing and in turn, improved their clinical outcomes. Previously, patients would go home and not bother to go for pathology testing.

Second, the study highlighted the role of POC testing in a care-coordinated model. Multidisciplinary practices were able to coordinate referrals to necessary specialists immediately with pathology results. This reduced the risk of the patients defaulting on referrals and thereby improved their clinical outcomes.

Third, the study indicated that POC testing has the potential to reduce the spread of highly infectious diseases such as COVID-19. By reducing crowding in waiting rooms due to an improved practice workflow, patients were at a reduced risk of contracting COVID-19.

An important insight uncovered was the satisfaction HCPs expressed for the KardioPro software. The software includes electronic health records (EHR), which improves accuracy of patient data (Grand View Research, 2020). EHR make it easy for any practitioner to obtain a comprehensive overview of the patient and reduces duplicated tests. A comprehensive patient record might also assist with research, insurance claims, and malpractice lawsuits (Bali et al., 2011). This is important for KardioGroup to know, as software is complementary to POC testing devices. Using the software to attract customers to the holistic diabetes solution might increase sales of their system.

1.5 Delimitations and assumptions of the research study

The research was conducted in the Gauteng province of South Africa. KardioGroup, being one of two distributors of the Alere Afinion device in South Africa, agreed to assist with the research in terms of providing a list of potential participants. KardioGroup stated that the majority of their clients using Alere Afinion devices are based in Gauteng, hence the focus of this study.

This study focused on diabetes only. Any other chronic or acute medical condition was not included. Diabetes is a major contributor of morbidity and mortality in South Africa due to increased urbanisation (Pheiffer et al., 2018). Research into various methods of reducing the burden of diabetes in South Africa will aid the healthcare system.

The study was restricted to private practice practitioners; those performing general consultations at a primary care level were considered. Much of the existing research on POC testing in South Africa has focused on the public health sector; there is limited research in the private health sector.

The research was conducted in practices utilising the Alere Afinion AS100 Analyser. This analyser provides various results that are important for metabolic diseases such as diabetes (News Medical Life Science, 2020).

1.6 Preface to the research report

To this end, the report has six chapters. Following this introductory chapter, Chapter 2 provides a literature review covering the research opportunity: Although research has produced mixed results regarding cost benefits and improved outcomes for POC testing at a primary care level, some HCPs still utilise the device. What are the potential reasons for HCPs still implementing POC testing?

Chapter 2 examines the research problem, the high cost of healthcare in the private sector of Gauteng, and the ability of POC testing to reduce this burden.

The literature review also covers the research gap in the private healthcare system of Gauteng.

Finally, Chapter 2 covers the qualitative attributes key to this study and the framework used to interpret the results. The attributes vital to this study were the five major lines of enquiry namely: i) what beliefs do HCPs have regarding POC testing at a primary care level? ii) What benefits, other than therapeutic, are HCPs experiencing from utilising POC testing in their practice? iii) What are HCPs' opinions on the current reimbursement model for POC testing? iv) What are some of the factors that influenced HCPs to implement POC testing? v) What do HCPs believe are the barriers of entry for POC testing in the private healthcare sector?

The framework used to interpret research findings was based on previous research. The results obtained from this research were compared with those found in the literature review.

Chapter 3 discusses the research strategy, design, procedures, reliability, and validity measures as well as limitations. The study was based on an interpretivist strategy in order to gather insight on experiences from HCPs using POC devices. The study followed a phenomenological design, which described the phenomenon of POC testing at a primary care level.

The procedures cover the instrument used, target population and sampling, ethical considerations and research information processing and analysis. The research instrument used was a semi-structured interview. The target population was HCPs in Gauteng in primary care practice that had used POC testing for a minimum of six months. The sample was chosen purposefully in order to gather data needed for the study. The information was processed using thematic analysis in order to uncover common themes, which described the phenomenon.

Reliability and validity was achieved through conformability, which was achieved by achieving credibility through strong relationships, transferability

through thick descriptions from participants, and dependability through a logical and well-documented research process.

Research weaknesses and limitations are also covered by providing a detailed description of the various limitations experienced during the research process.

Chapter 4 presents the results. The results are detailed in two sections, namely i) themes from research questions, and ii) practices and participants. Each theme is described in detail and responses from each practice and participant listed.

Chapter 5 interprets the findings. The research indicated many potential benefits to POC testing in a primary care practice, such as reduced pathology costs, patient and HCP satisfaction, improved practice workflow, increased compliance, and reduction of infectious disease spread. The results also indicated that HCPs do believe POC testing improves patient outcomes. The research showed that HCPs were not experiencing any financial gain and were worried about the financial risk.

Chapter 6 summarises and concludes the research. While previous studies have produced mixed results on POC testing, in terms of cost reduction and improved outcomes, this research indicated a potential cost benefit. Furthermore, HCPs believed POC testing improved chronic patient outcomes. The research also concluded that HCPs and patients experienced many benefits from POC testing at a primary care level. There were some barriers to entry that might hinder widespread adoption of POC testing. The data has shown that KardioGroup may benefit from a different business model, resulting in increased sales.

CHAPTER 2. LITERATURE REVIEW

2.1 Research problem analysis

The burden of disease continues to plague the South African healthcare system (World Health Organization, 2018). Infectious and non-communicable disease both contribute to mortality with HIV/AIDS being the number one cause of death followed by ischemic heart disease (Institute for Health Metrics and Evaluation, 2020). Between 2009 and 2019, diabetes had an increased death rate of 11.8 per cent (Institute for Health Metrics and Evaluation, 2020). The prevalence of chronic illnesses in patients who have medical aid have increased between the years 2011 and 2016 with diabetes mellitus increasing by 35 per cent (Cairncross, 2018). It is estimated that by 2035, sub-Saharan Africa will have the highest increase of diabetes prevalence in the world (Erasmus, 2015).

According to Section 27, a human rights organisation, South Africa spent 4.2 per cent of GDP on private healthcare in 2017 (DPME, 2017 as cited in Section 27, 2019). This is exceptionally high considering that only 17 in 100 people have medical aid. Public health spend on the other hand, was only 4.4 per cent of GDP in 2017.

The burden of disease is not aided by South Africa's slow adoption of technology (The Global Entrepreneurship Network South Africa, 2017). Furthermore, health professionals in South Africa are significantly behind with electronic health record adoption (The Future Health Index, 2019). Health technologies offer an opportunity to leverage digital health to address challenges and improve the experience for both patient and practitioner (The Future Health Index, 2019). Furthermore, innovations in the health sector has the potential to significantly reduce healthcare costs (Singhal & Carlton, 2019). There are many factors that affect the adoption of POC testing at a primary care level, such as infrastructure, funding or reimbursement, policies, regulations, quality control, work-flow, training, supply chain, awareness, and more (Pai et al., 2012). Adoption becomes more difficult in South Africa as the population

generally has a low rate of adoption for technology (The Global Entrepreneurship Network South Africa, 2017).

South Africa has an estimated population of just over 57 million people (StatsSA, 2019b; World Bank, 2020). The healthcare system in South Africa can be divided into two categories, private and public (Mahlathi & Dlamini, 2015). Every citizen has access to both private and public healthcare services; however, private facilities are dependent on the individual's ability to pay (Mahlathi & Dlamini, 2015). All public services are funded by the government, while private healthcare is paid for by medical schemes and individuals. Medical schemes are non-profit organisations regulated by the Council for Medical Schemes (Discovery, 2020). The schemes offer medical aid, a form of insurance that individuals contributes towards on a monthly basis (Discovery, 2020). In return for these contributions, the insurance covers medical expenses the member may incur (Discovery, 2020).

There are various elements that contribute to the high cost of private healthcare, such as high medical inflation, the lack of competition, profit focused services, an aging population with an increased prevalence of chronic illnesses, high out-of-pocket expenses, and high medical aid contributions (Berger, 2007; Chowles, 2016a, 2016b). Overall health costs increased by 4.3 per cent in 2019, which is higher than inflation (StatsSA, 2019a).

The increased prevalence of chronic diseases places increased strain on the healthcare system (PricewaterhouseCoopers, 2021). Chronic patients cost 17 times more to manage than the average users of the healthcare system (Hwang, 2015 as cited in Bresnick, 2015). Moreover, chronic illnesses have various complications, each with their own costs to treat (Pearl & Madvig, 2020). It is estimated that by the year 2030, the cost of all type 2 diabetes cases in the public sector will amount to R35.1 billion (Erzse et al., 2019). Of this cost, an estimated 51 per cent is attributable to management of the disease and 49 per cent attributable to complications (Erzse et al., 2019). Rapid urbanisation contributes to the prevalence of non-communicable chronic illnesses as well (Allender et al., 2010). Individuals residing in a more developed areas have

increased risk factors for developing non-communicable chronic illnesses (Allender et al., 2010, 2011). Increasing prevalence of chronic illnesses will mean that more funds and resources will need to be allocated for these illnesses (Hwang, 2015 as cited in Bresnick, 2015).

Out-of-pocket payments also contribute to the high cost of private healthcare (Businesstech, 2016). In 2015, members paid R3.2 billion out of their own pocket for private healthcare (Council for Medical Schemes, 2015). This excludes monthly contributions to the scheme (Council for Medical Schemes, 2015). Out-of-pocket costs include any service or product not covered as a prescribed minimum benefit (PMB) such as medicines and special investigations (Council for Medical Schemes, 2015). Some pathology costs can therefore be out-of-pocket payments. This expense is increased by excessive pathology testing. Studies indicate that approximately 82 per cent of physicians order more tests and procedures than are medically necessary (Chowles, 2016a). Various organisations have developed guidelines for the management of diabetes, including treatment and frequency of testing (International Diabetes Federation, 2020); however, each patient is different and it is at the practitioner's discretion to decide what treatment and management patients require(Medical Defence Union, 2010).

The burden of disease and the predicted increase in cost of healthcare indicates that there needs to be a change (Erasmus, 2015). This is where POC testing comes in. POC testing aims to reduce healthcare costs, improve patient outcomes, and has the possibility of strengthening the healthcare system (Erasmus, 2015). The market is growing at a rate of seven to eight per cent annually and more accurate and comprehensive devices are continuously being developed (Erasmus, 2015).

Some of the benefits of POC devices include portability, ease of use, small sample volume, reduced clinic visits, improved adherence to treatment, and the potential to improve clinical outcomes (Erasmus, 2015; Price, 2001). The advantages of POC testing are extensive; however, the concept also has disadvantages, such as incorrect handling of the device, inadequate

calibrations, quality controls, insufficient documentation, and possible lack of cost-effectiveness (Müller et al., 1999). Many studies have been done on the reliability and accuracy of POC testing, which have resulted in mixed findings (Okorodudu, 2011). Research has also indicated that 90 per cent of the errors in POC testing are associated with the pre-analytical and post-analytical phases (Bonini, 2002 as cited in Okorodudu, 2011). Pre-analytical errors result from sampling and inserting the sample into the device (Okorodudu, 2011). The majority of these errors can be minimised through rigorous training and ensuring standard operating procedures are in place. Post-analytical errors result from incorrect result recording (Okorodudu, 2011).. Results are now sent to a cloud and recorded electronically to reduce errors (Valcke, 2020). Studies have also indicated that POC testing is accurate and reliable (Juliano & Wason, 2017; Schwartz et al., 2009). Furthermore, there are currently no regulations or guidelines for POC testing in South Africa (Jalavu et al., 2020). The American Association for Clinical Chemistry has however developed an extensive guidance document for the implementation and management of POC testing in various settings (Nichols et al., 2020). The document takes into consideration various aspects of POC testing and provides guidance to ensure quality and reliable test results (Nichols et al., 2020).

The integration of POC testing into a practice requires a workflow change as well as training for staff members who will be doing the testing (Nichols et al., 2020). Patients can now have certain blood test results within minutes, without having to leave the practice (Price, 2001). Each practice workflow will be different and physicians will have to decide which process works for them. Patzer et al., (2018) concluded that integration of POC testing into three medical practices in Germany improved workflow as well as increased staff and patient satisfaction. Does this indicate that POC testing has the potential to improve practice workflow and perhaps allow practitioners to consult with more patients? Does changing a practice workflow require behavioural changes? A study in New Zealand found that performance incentives is one of the best methods of influencing behaviour (Wells et al., 2017). This suggests that POC testing might have unanticipated costs.

The current reimbursement model used in South African private care is a medical aid and patient reimbursement model (McIntyre, 2010). Standard laboratory testing is done with accredited service providers (Engel et al., 2018). The test is paid for from Medical Aid Savings or as an out-of-pocket expense (Discovery Health, 2020). Evidence seems to indicate that POC testing is slightly different in terms of reimbursement. Physicians purchase testing cartridges from device companies. When the HCP performs the blood test in the rooms, it is charged out as a procedure, that the patient pays for it out of their own pocket or medical aid savings. Each POC testing procedure has a specific test code and stipulated reimbursement amount, which is paid according to medical aid procedure. This amount is usually higher than the amount the HCP pays for the test cartridges, resulting in a miniscule profit for the HPC, and as tests are cheaper than the standard laboratory testing the patient saves as well (KardioGroup, 2017).

KardioGroup's business model is such that they provide the testing devices as well as the software for a monthly subscription premium. Further revenue is generated from the sale of testing cartridges (KardioGroup, 2017). A business model canvas of KardioGroup can be seen in Appendix C. There are various definitions of a business model. Osterwalder et al., (2005, p17) defines a business model as a conceptual tool that contains a set of elements and their relationships and allows expressing the business logic of a specific firm. It is a description of the value a company offers to one or several segments of customers and of the architecture of the firm and its network of partners for creating, marketing, and delivering this value and relationship capital, to generate profitable and sustainable revenue streams. Teece, (2010, p173) describes a business model as a conceptual rather than financial model of a business. A business model makes assumptions about customers, revenue, costs, user needs and competitors- it describes the business logic needed to make a profit (Teece, 2010). Demil & Lecocq, (2010) define the business model concept as the articulation between different areas of a firms activity designed to produce value for customers.

2.2 Research knowledge gap analysis

Although theoretically POC testing should have an economic benefit on the healthcare system, some early studies have indicated that POC testing is more expensive than standard laboratory testing; albeit insignificant results (Grieve et al., 1999). Since this publication (Grieve et al., 1999), there has been a tremendous amount of development in technology used for bedside testing, thereby possibly reducing the cost of POC testing. However, results remain mixed regarding POC testing (Gialamas et al., 2010; Khunti et al., 2006; Laurence et al., 2010; Pillay et al., 2019). Some later studies have found that POC testing costs were lower compared to standard laboratory testing; however, these results were also insignificant (Khunti et al., 2006; Laurence et al., 2010; Pillay et al., 2019). Goldstein et al. (2019) recently conducted a clinical trial in an emergency department setting wherein she concluded that in certain combinations, POC testing is more cost effective than standard laboratory testing. She went on to conclude that upfront POC testing has the potential to save not only money, but time as well.

John and Price (2013) indicated that POC testing might be more costly initially due to the loss of economies of scale. While a laboratory has hundreds of thousands of tests being performed daily, a POC device is limited to the number of patients in a practice (John & Price, 2013). This results in costly tests as each test is expensed separately. John and Price (2013) went on to mention that a cost saving was realised by the patient due to reduced clinical visits. Studies to assess the economic benefits provide conflicting results due to different reimbursement models, care pathways, and the financial flows between all stakeholders (John & Price, 2013).

One of the advantages of POC testing is possible improved patient outcomes resulting from faster decision-making (Erasmus, 2015). The benefit can be experienced in various settings depending on the outcomes measured (Price, 2001). One study found little evidence to support POC testing in a primary healthcare setting (Hobbs et al, 1997 as cited in Price, 2001). Instead, the benefit of improved patient outcomes were realised in self-testing, emergency, and operating theatre environments (Price, 2001). Price (2001) concluded that improved patient outcomes are not observed in a primary care environment as patients do not often present with acute conditions, making it difficult to observe the benefit. However, chronic disease monitoring, for example diabetes, may improve adherence to treatment and reduce long-term complications in a primary care facility (Price, 2001).

Improving primary care management of chronic illnesses potentially improves outcomes and reduces costs (Phillips, 2003 as cited in Reynolds et al., 2018). Bubner et al. (2009) found that POC testing produces the same effectiveness as standard laboratory testing for most tests, indicating that POC testing may have no effect on patient outcomes for chronic conditions. On the other hand, various studies have concluded that POC testing at a primary care level did improve patient outcomes (Motta et al., 2017; Pillay et al., 2019; Rust et al., 2008). The conflicting results suggest that outcomes are dependent on various factors such as practice setting, workflow, acceptability, proficiency of operators, and more. The results also suggest that more research is needed to determine if POC testing improves chronic patient outcomes.

While there is conflicting evidence regarding POC testing at a primary care level, it is important to note that all studies were conducted in a public health setting- there is yet to be evidence to conclude that patient outcomes are improved in a private practice setting.

International studies have indicated that practitioners believe POC testing will be beneficial in their practice and would improve patient care (Patzer et al., 2018; Varzgaliene et al., 2017). The implementation of POC testing in any setting requires a process change (Nichols et al., 2020). For example, previously, where a patient would need to take a blood test and return to the practice a few days later for the result, they would now be able to obtain the result within minutes (Engel et al., 2018). This process change may be difficult to implement as healthcare workers see POC devices as being additional work (Wells et al., 2017). Moreover, the change in processes may require additional staff, which will result in increased costs. Studies indicate that implementing POC testing is complex and that a process of change management must be implemented to maximise success of POC testing (Pai et al., 2012).

Not much research is focused on gaining a better understanding of POC testing on diabetes patients in the private practice setting of Gauteng. KardioPro indicates that the minuscule profit on testing might sound like a win for the doctor; however, the effort to perform the tests and the practice flow changes may nullify the profit (KardioGroup, 2017). This research aimed to gather insights from practitioners to gain an understanding of their POC testing experience.

Although POC offers a range of potential benefits for HCPs, sales at KardioGroup have been minimal. This raises the question of whether KardioGroup's business model is successful. The study aimed to investigate HCPs' experience with KardioGroup and if they believed the business model worked.

2.3 Qualitative attributes key to the research

This research gathered insights from HCPs' experience with POC testing in a private practice setting. The research aimed to identify if HCPs that use, or have previously used, POC devices, believe that POC testing improves chronic patient outcomes. This involved gathering insights about the various aspects of POC testing and the impact on patient outcomes. Khunti et al. (2006) stated that POC testing alone does not lead to improved outcomes and that an optimised patient management program, which integrates rapid testing, is needed.

The second line of inquiry in this study was to identify what benefits, other than therapeutic, practitioners were experiencing from utilising POC testing in their practices. HCPs could experience time saving, practice flow improvements, and an increase in patient and staff satisfaction (Patzer et al., 2018). Evidence suggests that POC testing in Gauteng is potentially cheaper than standard laboratory testing; however, many factors could affect this cost (KardioGroup, 2017). Many of the pre-analytical errors mentioned by Okorodudu (2011) have the possibility of affecting the expenses related to POC testing. Practice flow changes, hiring of new staff, and various infrastructure costs, such as an internet connection, have an impact on the cost of POC testing implementation and management (Pai et al., 2012). Apart from the benefits identified in public practice, are private HCPs experiencing benefits that are yet to be identified?

This research also aimed to identify whether practitioners were satisfied with the current reimbursement model of POC testing. Some medical aids only pay for services if certain service providers are used (Council for Medical Schemes, 2015). Services and products reimbursed by a scheme depends on the plan and scheme (Bonitas, 2021; Medical-Aid, 2016; Momentum, 2021). Although POC testing is registered as a procedure that can be reimbursed, practitioners may experience difficulty when claiming reimbursement (KardioGroup, 2017). This research gathered insights regarding the ease of reimbursement and any possible issues experienced when claiming.

Research has indicated that POC testing implementation at a primary care level can have mixed outcomes (Beilby et al., 2009; Gialamas et al., 2010; Khunti et al., 2006; Laurence et al., 2010; Pillay et al., 2019). Are patients experiencing improved outcomes? Are patients and practitioners experiencing a financial benefit? With mixed results, the exact reasons for practitioners deciding to implement POC testing are unclear. The research intended to identify the various factors practitioners consider before implementing POC testing.

2.4 Framework for interpreting research findings

Implementing POC testing at a primary care level has the potential to improve patient outcomes (Price et al., 2018). POC testing at a primary care level can significantly improve glycaemic control in diabetic patients, leading to improved clinical outcomes (Larsson et al., 2015; Pillay et al., 2019; Schnell et al., 2016). Therapeutic benefits of POC testing can be measured in terms of improved clinical outcomes, such as improved adherence to treatment and reduced complications (Price, 2001).

POC testing has the potential to save the healthcare practitioners' money and time (Crocker et al., 2014). POC testing resulted in a 21 per cent reduction in tests ordered, an 89 per cent reduction in follow-up calls and letters, and a 61 per cent decrease in patient visits (Crocker et al., 2014). Cost saving from improved practice efficiency amounted to US$24.64 per patient (Crocker et al., 2014). This suggests that HCPs may be experiencing additional benefits of POC testing, rather than improved patient outcomes alone.

While companies historically thrived on economies of scale to grow, this is no longer the case (Jacobides et al., 2019). Many of the companies that thrive today are platform-based, shifting production from inside the firm to outside (Jacobides et al., 2019). This suggests that KardioGroup may thrive from shifting their business model to something more platform-based.

Previous studies have also indicated that HbA1c POC testing implementation in primary care practices resulted in improved practice workflow, and increased satisfaction of physicians and staff (Patzer et al., 2018).

A study conducted in the United Kingdom, Australia, Belgium, Netherlands, and the United States has shown that GPs would like to use more POC testing (Howick et al., 2014 as cited in Schols et al., 2018). Doctors did however, indicate their concerns regarding over-reliance on tests, accuracy, and the use of tests without proper medical indication (Jones et al., 2013 as cited in Schols et al., 2018). This suggests that practitioners do see the value in POC testing although they still have concerns.

Having test results readily available is something many practitioners desire; however, the ability to interpret various results may be a problem (Howick et al., 2014 as cited in Howick et al., 2017). One study found that GPs missed myocardial infarctions due to misinterpretation of the POC test result (Nilsson et al., 2014 as cited in Howick et al., 2017). This suggests that practitioners might not experience improved patient outcomes because of incorrect result interpretation.

Some barriers linked to POC testing in a primary care setting include the impact on clinical decision-making, patient experience, and cost-related issues (Price et al., 2018). One of the major barriers identified in Europe, is absence of funding and reimbursement models, indicating that reimbursement is an area of concern (Price et al., 2018).

Certain PMBs cover a specific number of tests depending on the chronic condition (Diabetic South Africans, 2017). For diabetes, medical aids must cover pathology testing every three to six months (Diabetic South Africans, 2017). Practitioners can perform POC testing and claim reimbursement from the medical aid, should the patient be on medical aid (KeyHealth Medical Scheme, n.d.).

KardioGroup’s business model was analyzed against the business model canvas (Osterwalder & Pigneur, 2010). The business model canvas is a matrix used to detail various aspects of the business and how it will generate revenue while providing value to customers.

2.5 Summary and conclusion

2.5.1 Summary of literature reviewed

During the literature review, one qualitative study that included private practice as part of a broader study was found (Engel et al., 2015). Much of the literature focused on public clinics at primary care level (Laurence et al., 2010; Motta et al., 2017; Pillay et al., 2019; Rust et al., 2008). Some studies indicated that POC testing at a primary care level improved chronic patient outcomes (Motta et al., 2017; Pillay et al., 2019; Rust et al., 2008). However, some studies concluded that POC testing did not improve patient outcomes for chronic diseases (Bubner et al., 2009; Stevens et al., 2017). A few studies found POC testing to be more cost-effective than standard laboratory testing; however, these results were statistically insignificant (Khunti et al., 2006; Laurence et al., 2010; Pillay et al., 2019). One study done in an emergency setting did however conclude that POC testing was significantly more cost-effective than laboratory testing for certain tests (Goldstein et al., 2019). One study found that POC testing was more expensive than standard laboratory testing (Simeon et al., 2019). POC testing has many advantages however there are disadvantages as well (Okorodudu, 2011). Can these disadvantages be overcome through rigorous training and education?

While studies have produced inconclusive results over the years, POC testing at a primary care level has the potential to reduce the disease burden on Gauteng significantly. Research focused primarily on the public healthcare system. Conducting research in the private healthcare sector might provide valuable insights as to how doctors perceive POC testing.

2.5.2 Proposed research strategy, design, procedure, and methods arising from the literature reviewed

Much of the literature reviewed evaluated POC testing at a primary care level in public healthcare (Gialamas et al., 2010; Laurence et al., 2010; Pillay et al., 2019; Rust et al., 2008). There has been limited research done in the private healthcare setting of Gauteng. Many of the barriers or issues experienced using POC testing at a public primary care level may be adaptable to the private sector; however, there may be various topics not recognised in private practice. Qualitative research provides insights into personal experiences and understanding of HCPs' point of view (Austin & Sutton, 2014). This method of research enabled insight into POC testing in the private sector. Following an interpretivist strategy enabled the development of an in-depth understanding of POC testing in a private healthcare setting. Interviewing practitioners allowed gathering of unrestricted data. A thematic analysis uncovered common problems experienced and possible root causes (Nowell et al., 2017).

CHAPTER 3. RESEARCH METHODOLOGY

This chapter identifies and describes the research approach, design, as well as procedure and methods employed in this research to collect, process, and analyse empirical evidence. Broadly, the chapter has three objectives; namely, to identify and describe the research strategy (Section 3.1), the research design (Section 3.2), as well as the procedure and methods (Section 3.3). It also describes the reliability and validity measures (Section 3.4) that this research applied to make it credible as well as the technical and administrative limitations of the choices made (Section 3.5).

3.1 Research strategy

Research paradigms can be classified into three philosophical categories: positivism, interpretivism, and critical postmodernism (Gephart, 1999 as cited in Thomas, 2010). Positivists believe knowledge is objective and quantifiable. Knowledge is obtained through observation and experiment (Thomas, 2010). Studies based on a positivist paradigm, focus on uncovering the truth and presenting it by empirical means (Henning et al., 2004 as cited in Thomas, 2010).

Interpretivists believe that reality consists of people's subjective experiences of the external world (Thomas, 2010). Interpretivists develop constructs based on in-depth analysis of phenomena (Thomas, 2010). Key data collection methods used in interpretivist research are the questionnaire and interviews (Aspers, 2004 as cited in Thomas, 2010).

Critical postmodernism is a combination of critical theory and postmodernism (Gephart, 1999 as cited in Thomas, 2010). Critical theory aims to critique the norm and seeks to bring about political, cultural and social change to eliminate domination and alienation (Thomas, 2010). Postmodernism seeks to remove power structures by opening up opportunities for the previously disadvantaged (Gephart, 1999 as cited in Thomas, 2010).

Research strategy moves the philosophical assumptions into research design and data collection (Myers, 2009 as cited in Thomas, 2010). There are three research methodologies namely, (i) qualitative, (ii) quantitative and (iii) mixed-methods (Creswell, 2014).

For this research, an interpretivist philosophy was followed. The interpretivist paradigm is based on observation and interpretation. Data on certain events is collected meaning made through inferences, patterns and matching information (Aikenhead, 1997 as cited in Thomas, 2010). The interpretivist seeks to understand the world through subjective experiences of individuals (Thomas, 2010). This research intended to understand the experiences of HCPs as they utilise POC testing. An interpretivist approach enabled the gathering of subjective experiences of HCPs as they use POC in primary care. Understanding their experiences provided valuable insights into how POC testing works in private practice. The data collected further assisted in identifying problems as well as benefits experienced by practitioners and patients.

Research conducted by Engel, et al. (2015) studied how various tests are done using POC testing in various settings in South Africa. The aim of Engel's study was to determine if POC testing was successfully implemented. Engel et al. (2015) concluded that no previous studies have been conducted surrounding POC testing and the perspectives of the various stakeholders. Their aim was to gather insights on the testing process in various settings for a list of diseases (Engel et al., 2015). Utilising a qualitative methodology enabled Engel, et al. (2015) to gain an in-depth understanding of the POC testing process for various diseases in South Africa. Following a qualitative approach provided this study with a similar advantage – the ability to gain an in-depth understanding of POC testing in private primary practice.

3.2 Research design

Research design provides a framework for the collection and analysis of data. It provides a blueprint of data that will be collected, measured, and analysed

(Bryman, 2012). The research design is based on the research problem. Beginning research with a design that has already been decided on puts the research at risk of being weak and unconvincing (Barbara, 2006 as cited in Claybaugh, 2020).There are four major qualitative research designs: phenomenology, ethnography, grounded theory, and case study (Astalin, 2013).

Phenomenology aims to describe experiences from the perspective of the individual (Lester, 1999). This design aims to describe, rather than explain, experiences (Lester, 1999). Data obtained using this design is not generalisable (Grossoehme, 2014). Phenomenology can be applied to single cases or deliberately selected samples (Lester, 1999).Various methods can be used to conduct phenomenological research including interviews, conversations, participant observation, action research, focus meetings, and analysis of personal texts (Lester, 1999). Analysis of data can be conducted using a theme identification method (Lester, 1999). This study used phenomenology to gain an enhanced understanding of the use of POC devices in private practice at a primary healthcare level.

A phenomenological design was used to describe POC testing in private practice. The aim was to describe what HCPs are experiencing with POC testing, rather than explain their experiences. The goal was to identify the phenomenon of POC testing in private practice at a primary care level. The study also made use of a deliberately selected sample. This ensured that the participants being interviewed met specific criteria. Participants were selected deliberately based on their use of POC testing in their primary practice. The Alere device specifically, was selected based on its capabilities to provide tests for metabolic illnesses such as diabetes. Furthermore, KardioGroup was approached to assist with sampling, as it is one of two distributors of the Alere device in South Africa for the private market. Having worked at KardioGroup enhanced the likelihood of obtaining a list of participants that met the specified criteria.

Austad (2015) used a phenomenological design to gain in-depth understanding on GPs' experiences using multiple clinical guidelines. By utilising this design,

first-person experience on a particular phenomenon was gathered. The advantage that this research expected to achieve was to provide enough information to prompt future studies on POC testing in private practice.

3.3 Research data gathering procedure and methods

This section documents the procedure and methods employed in this research to collect, collate, process, and analyse empirical evidence. It begins with the data and information collection instruments (Section 3.3.1), the target population and sampling of respondents (Section 3.3.2), and the ethical considerations during the research process (Section 3.3.3). It follows with data and information collection process and storage (Section 3.3.4), data and information processing and analysis (Section 3.3.5), as well as the background description of the respondents who provided empirical evidence for this research study (Section 3.3.6).

3.3.1 Research data and information collection instrument

A research instrument is the tool that is used to collect data. This is also known as a fact-finding strategy. When selecting an instrument, a critical assessment of the instrument must take place to ensure it will capture the data needed (Annum, 2017). There are many instruments that can be used to collect data including questionnaire, interview, observation, and reading (Annum, 2017).

This research made use of the interview instrument. An interview is an “active interaction between two or more people leading to a negotiated contextually based result” (Silverman, 1997, p. 98). For this instrument, the interviewer needs to possess special skills to build a good relationship with the respondent to ensure highly detailed responses (Coventry University, 2020). This instrument was selected to allow for flexibility to gather as many insights as possible.

There are various types of interviews, including personal, unstructured, focused, clinical, telephonic, stress, behavioural-based and pre-requisites, and elementary doctrines of cross-examining (Buriro et al., 2017). Another type of interview is the semi-structured interview (Cohen & Crabtree, 2006). This research used a semi-structured interview to improve the chances of answering the research questions as well as to gain additional insights. A semi-structured interview is a guide for the interviewer, which is used to ensure specific topics are covered but also allows for topics to stray (Cohen & Crabtree, 2006). The semi-structured interview will allow for flexibility of data collected but also ensure pertinent topics are covered.

Engel et al. (2015) utilised a semi-structured interview in their research. The aim of this research was to identify barriers, which restrict successful POC testing. Engel et al. (2015) used this method to obtain a rich understanding of the process of POC testing and to gain perspective from various stakeholders. The rich data gathered from this method of data capturing allowed the necessary detail for POC testing to be successful. This research aimed to gather insights on POC testing in private practice, which allowed the identification of barriers and requirements to ensure successful POC testing.

This research asked questions that probed responses from participants that would address the research objectives. The research instrument can be seen in Appendix A.

3.3.2 Research target population

A target population or research population, is the entire set of units on which data will be used to make inferences (Lavrakas, 2008). The population must be specifically defined to note eligible units for the study. Geographic and temporal characteristics must be outlined as well as the type of units being used (Lavrakas, 2008). For this research, the target population was identified by the following criteria:

- HCP in private practice at primary care level within the Gauteng area; and

- Utilised the Alere Afinion™ AS100 Analyzer for a minimum of six months.

The target population criteria were based on the availability of participants. KardioGroup stated that the majority of Alere users are based in Gauteng. Participants using the Alere device were selected based on the functionality of the machine. The machine is designed for metabolic illnesses such as diabetes (News Medical Life Science, 2020). Furthermore, participants were selected based on their period of use. Six months was enough time for an HCP to experience POC testing. Initially, the study intended to focus on GPs only. However, due to limited responses and COVID-19 challenges, the scope was broadened to all HCPs that used the Alere device for a minimum of six months. This population would provide a more holistic description of POC testing in practices.

In South Africa, Engel et al. (2015) interviewed clinicians in private practice as part of a broader study. In this study, they focused on POC testing in various settings to understand the tests performed, and the various processes of testing. Private practice clinicians were included to understand the extent of POC testing done in this setting. For this study, the population of private practice HCPs at a primary care level in Johannesburg was selected to gain a better understanding of POC testing in private practice.

3.3.3 Sampling or selecting respondents from the target population

Research rarely captures data from an entire population. A sample is chosen to represent the population and this is based on several factors. There are two types of sampling namely probability sampling and non-probability sampling (McCombes, 2019). Non-probability sampling is used in qualitative research. Non- probability sampling is a selection based on ease of data collection (McCombes, 2019). There are four types of non-probability sampling which include convenience sampling, voluntary response sampling, purposive sampling, and snowball sampling (McCombes, 2019).

This research used purposive sampling. Purposive sampling involves the use of judgement to select a sample that would be the most beneficial for the research (McCombes, 2019). This method was selected to capture insights from specific participants. Initially the research intended to have five participants. However, due to challenges with COVID-19, the number of participants was increased to eight. After the first two interviews, it was ascertained that due to COVID-19, HCPs were pressed for time and therefore giving very short responses. These responses did not paint the vivid picture of POC testing that was anticipated. The number of interviews was increased to boost the chance of gaining a deeper understanding of POC testing at a primary care level. The sample was selected based on information provided by KardioGroup; not many participants had used the Alere device for a minimum of six months and therefore, only eight participants were selected based on usage and location. Participants who exhibited high usage of the device were selected in order to gather extensive insights to their experience with POC testing. Eight participants from four separate practices participated in this research. One practice was situated in a lower socioeconomic area, while the other three were in affluent locations. Three practices were contracted to medical schemes, which enabled patients to pay cash for services or for the practice to claim reimbursement from schemes. One practice had a cash payment policy, whereby patients pay cash and claim it back from medical schemes in their own capacity. All four practices had varying numbers of diabetic patients.

One study utilised purposive sampling to ensure they selected practitioners that would provide the data they needed (Schot et al., 2017). The aim of the study was to explore perceptions of practitioners regarding the addition of POC testing for children. Using this method, they were able to select the appropriate respondents. This research used purposive sampling in order to select the appropriate sample group.

3.3.4 Ethical considerations when collecting research data

Research ethics governs the standards for research. Ethics protects the rights, welfare, and dignity of participants. Therefore, all research involving humans

needs to be reviewed by an ethics committee to ensure standards are being upheld. Ethics review focuses on the principles of beneficence, justice, and autonomy (World Health Organization, n.d.).

This study was not funded by KardioGroup; however, all participants in the study were identified by KardioGroup, as it was one of two companies with the rights to distribute the Alere Afinion device in the private healthcare sector in South Africa. The company therefore has a database of practitioners using the device. KardioGroup obtained consent from practitioners before providing the list of practitioners that currently use the Alere blood analyser.

Respondents were not deceived in any way. No respondents were harmed (physically or developmentally) during this study, nor were respondents driven to a point where they lost self-esteem. There was no physical interaction with the respondents, only verbal interaction. Questions focused only on POC testing. A consent form was signed by respondents, which gave permission for interviewing and recording. The respondents were made aware that they could revoke consent at any time should they wish to do so. Respondents had the opportunity to read the consent form and confirm if they understand the form. All data captured was kept secure and no personal information regarding the respondents was made available to any party. All respondents were assigned a code, which kept their identity confidential during reporting.

The Wits Business School Ethics Committee issued the Ethics Clearance Certificate, attached at Appendix B.

3.3.5 Research data and information collection process

Data collection is the process of gathering information using a systematic method in order to answer research questions (Responsible Conduct of Research, n.d.). Accurate data collection is vital to maintain the integrity of research. Improper data collection can lead to misleading results, distorted findings, and the inability to answer the research question (Responsible Conduct of Research, n.d.). There are four main data collection methods, which

include observation, interview, focus group sessions, and documents or questionnaires (Jha, 2017).

The data collection method chosen for this study was the semi-structured interview method. This method was chosen as it allows flexible data to be captured, while addressing research questions. All interviews were recorded on a mobile device. The data was then transcribed using YouTube's transcription capabilities. Any post-interview comments were documented. All data was stored on a laptop accessible only to the researcher to ensure safety and security. Data was collected via in-person, digital, and telephonic interviews. Before conducting any interviews, a list of expected responses was made to increase trustworthiness. All interviews were recorded with the exception of one interview, due to technical difficulties. The COVID-19 pandemic created a few challenges during the research. Initially, only GPs were to be included; however, the pandemic resulted in many GPs being inundated with work. After a few weeks of attempting to contact potential participants with no response, the sample selection was broadened to include any HCP that had used or was currently using the Alere POC device. Furthermore, due to fear of the coronavirus, many participants opted for a digital or telephonic interaction. This posed some challenges due to a break in the connection and poor signal; however, all necessary responses were captured.

Schot et al. (2017) used the interview method to collect data for their research. This method allows for open-ended questions, which can lead to detailed responses. Schot et al. (2017) wanted to gain detailed insights on the perceptions of GPs and wanted flexibility to allow for unplanned new data to be captured. The interview method also allows the exploration of emerging themes revealed during the interview. The benefit of this data collection method is the flexibility to explore emerging themes.

3.4 Research data and information processing and analysis

Qualitative research has numerous methods of data interpretation. The most popular methods include content analysis, thematic analysis, textual analysis,

and discourse analysis (Bhandari, 2020). Content analysis describes and categorises common words and phrases. Textual analysis examines the content and structure of text. Discourse analysis examines communication and the effects of language. Thematic analysis identifies themes and patterns from the data. Qualitative research intends to generate theory based on human experience, otherwise known as grounded theory (Nowell et al., 2017). This research gathered insights from private HCPs regarding POC testing at a primary care level. In doing so, the research identified common benefits and problems experienced by HCPs when using POC testing. Data was processed using a thematic analysis in order to uncover common experiences between participants.

Thematic analysis can be broken down into steps that include data familiarisation, initial code generation, identifying themes, reviewing themes, naming themes and producing a report (Braun & Clarke, 2006). After conducting all interviews, the audio was transcribed using YouTube to generate an initial transcription, which was edited by listening to the interview recordings. Interviews were transcribed verbatim and relevant post-interview comments, which were made after stopping the recording were documented.

3.4.1 Data familiarisation

Before reviewing the data, all preconceptions and personal beliefs regarding what the data may conclude, must be noted. This increases the credibility of the research. The entire data set must be read at least once before any coding can commence (Braun & Clarke, 2006). During the first reading, notes can be made about possible coding and possible themes. It is vital that the researcher immerse themselves in the data to understand the breadth and depth of the data (Braun & Clarke, 2006).

Before analysing the transcriptions, all personal beliefs regarding POC testing were noted. These preconceptions were as follows:

- Participants were unable to experience financial gain;
- POC testing resulted in improved diabetic outcomes;

- Patients were happy with POC testing;
- Practices were more efficient;
- HCPs experienced difficulty with reimbursement from medical aids;
- Patients thought the tests were expensive;
- Patients loved the electronic reports;
- Wasted cartridges or test errors resulted in further loss for the participant;
- HCPs implemented POC testing as they desired financial gain;
- HCPs desired practice efficiency; and
- HCPs did not implement POC testing for patient benefit.

3.4.2 Coding

Coding is a process of reflection and interaction regarding the data (Savage, 2000 as cited in Nowell et al., 2017). Research transitions from unstructured data into developing ideas (Morse and Richards, 2002 as cited in Nowell et al., 2017). This task should be undertaken in a systematic way to ensure equal attention is given to each section of data. Codes should have explicit boundaries to ensure they are not interchangeable or redundant (Attride-Stirling, 2001 as cited in Nowell et al., 2017). Codes refer to “the most basic segment, or element, of the raw data or information that can be assessed in a meaningful way regarding the phenomenon” (Boyatzis, 1998, as cited in Braun & Clarke, 2006, p. 63). Codes are different from themes in that themes are a broader analysis of the data. Each extract of data should be coded based on what insights are sought. This initial ‘code book’ can then be used as a guide. The data captured can continuously be reviewed and codes allocated (Braun & Clarke, 2006).

Each research question was addressed separately and codes were generated for each question. The coding book, together with generated themes, are discussed in section 4.1. For the coding process, the initial step was to read all transcripts and highlight various responses to questions. Second, similar

answers were grouped together on an Excel spreadsheet. Codes were then generated based on similar responses.

3.4.3 Identifying themes

At this stage, the codes are grouped into themes. The data is analysed with a broad view and themes and their relationship between codes and other themes are identified (Braun & Clarke, 2006).

Once coding was completed and reviewed, the various codes were placed into themes. Themes were generated upon analysis of similar codes. The themes generated in this study are displayed in section 4.1.

3.4.4 Reviewing themes

Each initial theme is reviewed to evaluate if it captures each code of data. If the themes do not adequately capture the codes then the themes should be revised. Once the themes are satisfactory, a review of the raw data is needed to assess if the themes capture what is represented in the raw data. This stage begins to draw relationships or a thematic map, between themes (Braun & Clarke, 2006).

The themes and codes were revised to ensure there was no redundancy. The codes and themes were compared with transcripts to ensure the researcher captures the data correctly.

3.4.5 Defining and naming themes

The themes are defined and redefined; continuously reviewing themes to ensure they are not too broad and that the themes are coherent with the codes and data. The themes are named at this stage (Braun & Clarke, 2006).

Themes were named based on a central topic of discussion. For example, if there were codes all mentioning something about KardioPro, then those would be grouped into a theme titled KardioPro. The themes were reviewed and compared to the data once again.

3.4.6 Producing the report

The report needs to be a narrative on the story being told by the data. This is not a simple paraphrasing exercise, but should note that which is interesting and important about the findings. Vivid examples from the data should be included here to capture the essence of the theme. The report should be concise, non-repetitive, logical, and interesting (Braun & Clarke, 2006).

Once the thematic analysis had been complete, the report was written. General responses were mentioned and interesting points emphasised.

3.5 Research strengths: Reliability and validity measures applied

Reliability and validity indicate how well a method or instrument measures something. Reliability is the consistency of measure while validity is the accuracy of measure (Middleton, 2019). Reliability means that the same results can be obtained if the exact same experiment is done again. Validity in essence, evaluates if the test or method measures what it is intended to measure (Chiang et al., 2015). Reliability and validity strengthens the results from research. It assures readers that the work is of a high standard and that the research can be used to build or conclude theories.

In qualitative research, reliability and validity are measured by the trustworthiness of the research. Trustworthiness is categorised into credibility, transferability, dependability and confirmability (Lincoln & Guba, 1985 as cited in Nowell et al., 2017).

Credibility is the appropriateness of the respondents' views and the researcher's interpretation of them. Credibility in this study was strengthened through strong relationships and data collection triangulation. The researcher had a strong relationship with all participants, as KardioGroup was their support provider when they implemented POC testing. Strong relationships increase honest answers from participants, as they trust the researcher. Furthermore, data was collected from various HCPs from the same practice. There were four

practices in total with eight participants. Gathering data from different professionals in the same practice increased the credibility of the answers.

Transferability is the generalisability of the results. Researchers cannot know the extent of transferability and must therefore provide detailed descriptions in order for other researchers to judge transferability (Lincoln & Guba, 1985 as cited in Nowell et al., 2017). During the interview process participants were encouraged to provide extensively detailed descriptions of their experiences with POC testing. Some participants gave elaborate answers while others responded with concise answers. The practitioners responding with concise answers were pressed for time due to the COVID-19 pandemic. They indicated that they could only spare a few minutes for the interview, as they needed to consult with patients as well as assist in hospitals. This might have reduced transferability.

Dependability relates to the research process. To improve dependability the researcher can ensure the research process is logical, traceable, and clearly documented (Tobin & Begley, 2004 as cited in Nowell et al., 2017). This can be done by ensuring an audit trail is available and that readers are able to follow the decision process clearly. Providing rationale for methods and decisions ensures readers follow the logical process or train of thought of the researcher (Koch, 1994 as cited in Nowell et al., 2017). This research followed a logical, semi-structured interview process with a well-documented thematic analysis (Nowell et al., 2017). Target population criteria were sent to KardioGroup, which was used to identify potential participants. Consent forms were sent to all eligible participants notifying them of the research, and KardioGroup provided a list of participants consented to their contact details being furnished. The participants were then contacted and consent and research information documents sent. Once participants agreed to participate, interviews were scheduled either telephonically or in person. Interviews were recorded on a mobile device and then transcribed. Upon completion of transcription, a thematic analysis was performed and the results presented in this report.

Conformability is ensuring that interpretations and conclusions are derived from the data, with the researcher providing a process of how conclusions were drawn (Tobin & Begley, 2004 as cited in Nowell et al., 2017). Conformability is established once credibility, transferability, and dependability is achieved (Guba & Lincoln, 1989 as cited in Nowell et al., 2017). By addressing credibility, transferability, and dependability, this study achieved conformability.

Trustworthiness can be strengthened through the following actions: (i) accounting for personal bias, (ii) meticulous record keeping, (iii) establishing a comparison case, (iv) thick and rich verbatim responses, (v) demonstrating clarity of thought process, (vi) engaging with other researchers, (vii) respondent validation, and (viii) data triangulation (Noble & Smith, 2015). Once the interviews had been conducted, the researcher documented any personal bias. This included responses expected from the data. As much information as possible, with rationale for various decisions, was documented. The decision to extend the research to all HCPs instead of just GPs was documented and discussed with the research supervisor. The decision and rationale to include a new research question was also documented. With four practices participating, case comparison was possible and conducted during analysis of data. All interviews were transcribed verbatim using YouTube's software. The accuracy of the transcription was reviewed by simultaneously listening to interviews and reading the transcripts. All errors were corrected in this process. Although it was initially intended to have respondents validate their transcripts, this was not possible due to COVID-19 challenges.

Schot et al. (2017) conducted case comparisons, provided thick verbatim descriptions of responses, and validated responses. This ensured trustworthiness of the research. By ensuring this study conducted these activities, the trustworthiness of the research was strengthened.

3.6 Research weaknesses: Technical and administrative limitations

The main limitation of a qualitative study is the inability of findings to be generalised (Atieno, 2009). Qualitative studies are conducted in specific settings, which influence behaviour, character, and responses. Thematic analysis is considered a weaker form of data analysis due to the lack of literature. Other methods such as ethnography and grounded theory have substantial literature to verify these methods. The flexibility of thematic analysis may also invite inconsistency and incoherent themes (Nowell et al., 2017). Using a semi-structured interview method may result in salient topics being inadvertently omitted (Johnson & Christensen, 2010). Interviews are also time consuming and require the interviewer to possess soft skills (Jha, 2017). Non-probability sampling has a higher risk of sampling bias and results cannot be used to make inference for a population (McCombes, 2019). Trustworthiness of the research may be limited due to the inability to engage with other researchers and the inability of data triangulation (Noble & Smith, 2015).

Conducting this qualitative research was a tedious process. Keeping meticulous documentation took time and discipline. One of the most challenging processes was transcribing the interviews. Although YouTube had been used to do the first draft of transcribing, reviewing and ensuring accuracy of the transcription took hours. Due to many of the interviews being telephonic, the recordings were not of the highest quality. This resulted in YouTube missing much of the information. Furthermore, ensuring all the ‘uhm’ and ‘uh’ phrases were captured, to ensure a verbatim transcript, was an incredibly tedious task.

Arranging interviews with GPs posed a challenge due to the COVID-19 pandemic, as doctors were inundated with work. In order to ensure the completion of this research, the target population was broadened to HCPs. This enabled the inclusion of nurses, phlebotomists, and specialists. The broad target population made it easier to arrange interviews; however, these were not perfect. All participants agreed to participate in the research due to the strong relationships with them; however, they made it clear that time was of the

essence. The strained healthcare system due to the pandemic resulted in all HCPs working tirelessly to save lives. Due to these time constraints, some participants gave very brief answers, rather than thick descriptions. Although they did answer the research questions, they did not detail their experience. Technical difficulties were also present during the interviews. One interview in particular was not recorded due to the microphone failing. Telephonic interviews also had some breaks in communications and the quality of the audio was not excellent. This increased the difficulty of transcription.

The interview questions, being semi-structured, allowed for some leniency in responses from participants. However, using the interview guide might have inadvertently omitted some topics that might have provided valuable insights. Furthermore, selecting ‘high-usage’ participants might have resulted in some topics being overlooked by ‘low-usage’ HCPs.

CHAPTER 4. PRESENTATION OF RESEARCH RESULTS

4.1 Introduction

This chapter presents the data captured during the research process. The sections in this chapter are description of practices and participants (Section 4.1) and themes (Sections). Sections 4.1 describes each participant and practice. Practices are primary care medical practices that consult with diabetic patients. Participants are HCPs working in medical practices. Section 4.2 identifies and lists the themes uncovered during the data coding process. This was based on the thematic data analysis method

The data is presented according to themes identified during the coding process. It is presented in this way to assist with data analysis in Chapter 5. Identifying themes aids in describing and analysing the data. Listing the responses from practices and participants assists with identifying common themes from participants in one practice.

4.1.1 Description of practices and participants

Practice 1 had one participant who was interviewed. The practice comprised a GP with a variety of patients, including diabetic patients who were assessed and managed. This practice is located in an affluent area of Gauteng. The practice had utilised the POC device for two years and then stopped when the contract expired. The interview was conducted in person and recorded.

Practice 2 had one participant that was interviewed. The participant was a specialist physician specialising in pre-anaesthetic medicine. The practice assesses patients before undergoing anaesthesia. Although this is the primary focus of the practice, they do see diabetic patients as well. The practice was situated in a middle class area of Gauteng. The interview was conducted through the Microsoft Teams platform; however, due to technical difficulties, the interview could not be recorded. All notes documented were transcribed.

Practice 3 included three participants. Participant 3 is a GP and Participants 5 and 6 are both clinical associates. Participant 3 owned the practice and Participants 5 and 6 worked for Participant 3. The practice was a multidisciplinary practice situated in a low socioeconomic area of Gauteng. The practice saw a variety of patients, including those who sought services from a diabetic nurse educator and podiatrist. All three interviews were conducted separately through WhatsApp calls. All three interviews were recorded.

Practice 4 included Participants 4, 7 and 8. Participant 8 was a cardiologist and owner of the practice. The practice was a multidisciplinary practice that only accepted payment in cash from patients. Participant 7 currently works in Practice 4 as a phlebotomist, performing POC testing. Participant 4 was a clinical associate that previously worked in Practice 4. The practice, situated in an affluent area of Gauteng, managed a variety of patients. All three interviews were conducted in person and recorded

4.1.2 Themes from research questions

In order to generate themes, a coding analysis was conducted. Figure 2 represents the coding process. Similar codes were grouped together and colour coordinated. Participants from the same practice were colour coordinated, for a visual representation of participants from the same practice.

Codes	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Participant 6	Participant 7	Participant 8
Improved diabetic outcomes								
Improved diabetic outcomes	X		X	X	X	X	X	
POC allows for better patient outcomes			X					
Unsure if POC improves chronic patient outcomes								X
Outcomes measured with various factors								X
POC does not directly affect pt outcomes								X
Management of the diabetic patient affects outcomes								X
Time saving				X				X
Quick results				X			X	X
Sending bloods to lab is time consuming for patients				X				
Instant results beneficial during pandemic				X				
POC assists with diagnosis							X	
Improved clinical decisions								X
Adjust treatment immediately				X			X	
POC allows for immediate pt management decisions								X
Patient management does not necessarily change with POC								X
POC may be more beneficial in rural areas								X
Some patients don't go to lab for tests			X					
Some patients don't return for follow-up consult			X					
Non-compliance resulted in poor patient management and outcomes			X					
No need for follow up consult				X				
Reduces defaulting complications				X				
Reduced consults beneficial for DM pts during pandemic				X				
Constant reminder of risk results in improved outcomes					X			
Lifestyle modification important					X			
POC provides the routine blood tests for diabetics				X				
Patients believe that only medicine is needed					X			
Patient satisfaction					X			
Patients unsure if they're diabetic						X		
Able to generate CV risk with KardioPro software				X				
KardioPro system allows for various tests to be done other than POC				X				
ABI is a great addition to KardioPro				X				
Easy to understand reports					X			
Additional benefits								
Immediate decision making	X		X	X				
Alter treatment immediately	X		X		X			X
Quick results		X	X	X	X		X	X
Immediate treatment decisions				X			X	
Instant understanding of patient condition		X						
Same day diagnosis		X						
Same day treatment initiation		X						
Time saving							X	
Not time consuming					X			
Normal lab testing takes longer				X				
Alter patient management immediately								X
Same day decision making								X
KardioPro software is great	X	X			X			
Comprehensive reports		X						
Reports allow for better treatment decisions		X						
EHR assist with diagnosis		X						
Device can be challenging to use					X			
Device is temperature sensitive					X			
Connectivity an issue		X			X			
KardioPro assessment provide CVD risk					X	X		
POC assists with patient risk profile						X		
Simple reports help patients understand condition						X		
Electronic results help patients understand their condition						X		
Alere a very good device					X			
Don't know patient risk profile						X		
POC makes work easier					X			
More time spent with patient			X					
Quick results reduces lab process complications				X		X		
Increased patient numbers							X	
Lab quality results		X						X
Saves time					X			X
Device suitable for primary practice		X						
Very beneficial at primary care clinics		X						
Great device for DM patients		X						
Advocate for POC				X			X	
Loves POC device	X							
POC easy to use				X		X		
POC allows for contextual discussion								

Training is simple				X			
POC very useful tool					X		
Effective tool for monitoring diabetic patients				X		X	
POC allows for better patient management		X					
POC changes patient management				X			
POC has all necessary tests for diabetics			X				
Over time device becomes easier to use				X			
Advanced technology attracts patients				X			
No complaints from patients		X	X			X	
Patients unhappy with extra tests		X					
Patients don't like being bled twice		X					
Patient satisfaction	X	X		X	X	X		X
Immediate results beneficial for patients			X				
No follow-up consult required for blood results		X			X			X
Patient experiences cost saving			X					X
Convenience for patients			X					
Patients save on time			X					
Patients save money on transport			X					
Patients save on sick leave			X					X
Large savings for patient if one had to quantify it			X					
Patient save money on second consult								X
Patient, doctor satisfaction				X				
Assisted patients with understanding their condition				X				
Patients attracted to number of tests that can be done with KardioPro					X			
Patients attracted to the KardioPro assessment					X			
Patients love same day results					X			
Patients like POC						X		
Patients curious about POC						X		
Patients buy POC equipment						X		
Improve patient service								X
Contextual consult with patient								X
POC made process simpler for patients			X					
Patients are keen to get tested						X		
Practice provided better service				X				
Many doctors stop using POC after 2 years contract expires			X					
Large group practices would make huge savings		X						
No financial gain		X	X					
Enabled private practices to earn additional income				X				
Financial gain	X			X	X	X		X
Reimbursement affects profit			X					
Experiences financial loss			X					
Happy to just break even			X					
Numerous tests needed to be done to sustain POC			X					
Expired cartridges results in loss			X					
Roughly 20 patients needed to break even				X				
Initial issue with expiring cartridges				X				
Difficult to meet patient target and not test inappropriately				X				
Patients needed to understand POC first				X				
POC required patient trust				X				
Marketing improved patient understanding				X				
Patient consent needed				X				
Tests are expensive					X			
Financial gain and expenses cancel out					X			
Practice breaks even					X			
POC tests cheaper than lab tests						X		X
Unsure of financial gain							X	
High patient turnover required	X							
Purchase cartridges before doing test								X
Number of patients determine profit								X
Certain number of patients needed to cover costs	X							
Medical aid limits reimbursement	X							
Difficult to meet patient targets	X							
POC is occasional	X							
Only use it only high profile patients due to cost					X			
Device pricey					X			
Cost-effective device	X	X						
POC may result in savings due to reduced long term complications			X					
Improved patient workflow	X				X		X	X
Improved practice efficiency		X	X	X	X	X		X
Practice efficiency depends on skill of operator							X	
Enables division of tasks					X			
Smoother practice workflow			X				X	
Able to split tasks for efficient practice			X					
POC changed the way he practiced			X					
Change in patient consultation process			X					
POC assist with allied disciplines			X					

Immediate results allows for quick referrals			X			X		
POC beneficial in a multidisciplinary practice			X					
Chronic patients managed differently						X		
Allows for care coordination model								X
POC prevents unnecessary referrals						X		
POC reduces covid risk						X		
Chronic patients seen quicker						X		
Patients not coming into the practice	X							
Pandemic has resulted in lower test volumes			X					
Reimbursement Model								
Happy with reimbursement model	X							
No issues with reimbursement	X	X						
Initial queries from medical aids		X			X			
Reimbursement model can be improved			X					
Unclear guidelines from funders			X					
Bigger schemes have influence on industry			X					
Numerous rejections from medical aids			X					
POC is new for GP practices			X					
Medical aids concerned about abuse of testing			X					
Schemes happier to reimburse on a capitation model			X					
Scheme reluctant to pay on a fee for service model			X					
Schemes may be willing to pay going forward			X					
Bigger schemes have POC cap			X					
Low cost practice setting			X					
Rely fully on medical aid reimbursement			X					
Schemes only pay for some tests			X			X		
Not all medical aids pay for POC					X	X		
Higher plans usually pay					X			
Lower plans don't pay out					X			
POC is done on patients with higher plans					X			
Funders look at outcomes in terms of costs saved								X
Reimbursement not outcomes based								X
Doctors paid to deliver service								X
Doctors not paid to drive improved outcomes								X
Difficult to measure outcomes								X
No complaints regarding payment from patients	X		X	X		X		
Patients happy with cheaper blood tests			X					
Patients pay cash and claim back							X	
Costly for patient to pay cash						X		
No reimbursement issues				X			X	X
Some cash patients can afford it					X			
Patients who can afford it don't mind paying					X			
Difficult to break even			X					
Capitation model may offer financial gain			X					
Practice covers shortfall						X		
Practice covers minor tests						X		
Some POC cheaper than others		X						
Difficult to tell if Alere specifically results in profit			X					
Patient condition determines cost of investigations								X
Rural practices may have difficulty with reimbursement								X
Affluent areas have no reimbursement issues								X
Practice is in rural area					X			
Factors of implementation								
Perform tests by herself	X							
Desired technologically advance practice		X		X		X		
Desired electronic patient reports		X						
KardioPro provides great reports		X	X					
POC part of a bigger solution			X					
Electronic reports help with trend analysis		X						
Implemented POC because of KardioPro			X					
Technology and service big factors for patients				X				
EHR was not as good as it is now			X					
Would not use POC without software (EHR)			X					
KardioPro viewed as Diabetic management solution			X					
Other electronic solutions not suitable for primary practice			X					
KardioPro is simpler and designed for GP practices			X					
Simple reports that the patient could understand			X					
Practice initially established for pre-anaesthetic patients		X						
POC testing is easy			X		X			
Financial gain not a factor for POC implementation								X
Low cost for tests make it ideal for start-up		X						
Financial gain	X			X				
Desired to cut costs for patient		X						

Cheaper tests for quality healthcare		x						
POC previously not reimbursed			x					
Reimbursement model has changed			x					
POC assisted with sustainability and growth				x				
Alter patient treatment immediately		x		x				
Immediate initiation of treatment				x				
POC assist with defaulting complications					x			
Great for initial assessments					x			
Improved patient workflow	x			x				
Increased practice efficiency		x		x				
Quicker results means quicker diagnosis							x	
Immediate results rounded up consultation				x				
Follow-up consult unnecessary				x				
Assess patient immediately					x			
Contextual discussion was most important								x
POC implemented to attract patients					x			
POC aided in trust of profession				x				
Implemented POC for clinical outcome			x					
Practice wanted to improve patient health						x		
Dr wanted to understand chronic illnesses better							x	
Barriers of entry								
Belief that results inferior to lab		x						
Distrust of results	x	x		x				
Collaboration with lab will improve trust				x				
Lack of awareness		x			x	x		
POC makes practice efficient					x			
Old school doctors don't understand POC				x				
Better marketing needed for POC				x		x		
Doctors don't know benefits of POC						x		
Trinity satisfaction						x		
Fancy devices					x			
Comfortable using labs	x							
Doctors use labs due to habit		x				x		
Doctors resistant to change		x				x		
Doctors may use POC if implemented by practice manager		x						
Mindset is an issue affecting adoption				x				
Cost is a barrier for POC								x
Capital layout a problem		x						
Financial benefits for patients		x						
Doctors want financial gain		x						
Purchasing of cartridges before test		x						
No guarantee on ROI		x						
Shelf life of cartridges may result in loss		x						
POC is expensive initially			x					
Test errors result in loss				x				
Profitability takes time to be realised				x				
Number of patients is very important								x
Primary care practitioners are income challenged and not willing to invest								x
Placement model has minimum utilization clause								x
Placement model may result in inappropriate testing			x					x
Financial vs clinical decision conflict								x
Practices don't want additional expenses						x		
Sending patient to lab means no risk for doctor			x					
POC means doctor takes on all risk for testing			x					
POC needs to improve test cartridges				x				
POC companies must allow for test errors				x				
Reluctant to implement POC due to potential wasted cartridges				x				
Labs use POC devices				x				
Extensive implementation will take time		x						
Adoption of POC largely depends on funders			x					
Capitation model will result in increased POC adoption			x					
Funders concerned with verification of results			x					
Labs can produce same day results			x					
Immediate results not necessary as patients not urgent			x					
Skilled labour needed to run POC tests				x				
Chronic patient difficult to manage						x		
Value-based medicine		x						
POC would work well in specific practices		x						
POC works well in rural practices			x					
Big schemes rolling out their own POC may change the industry			x					
Some doctors won't use POC at all			x					
POC the best thing for private practice				x				
Believes POC will be in all doctors parctices							x	

Figure 2: Coding book

4.2 Improved patient outcomes

The first line of questioning was asked with the intention of revealing what HCPs believed about POC testing at a primary care level. More specifically, did they believe that POC testing improved diabetic patient outcomes? If so, what caused them to believe this?

This line of enquiry produced five main themes. The themes in order of importance for this research were improved patient outcomes, reduced decision time, compliance, patient understanding, and KardioPro (software).

4.2.1 Improved patient outcomes

The first theme, improved patient outcomes, appeared in seven interviews from three different practices. Between the participants, the theme was mentioned eleven times in total. This theme consisted of statements mentioning anything regarding the outcomes of patients.

Participant 1 gave very brief responses to the research questions as they were in a hurry to start consulting with patients. They indicated that they did believe POC testing improved patient outcomes; however, failed to elaborate on reasons for this belief. Participants 3, 4, 5, 6, 7 and 8 all agreed that POC testing improved patient outcomes. Participant 8 specifically mentioned that POC testing did not directly improve patient outcomes; however, POC testing enabled a practitioner to make quicker decisions, which might improve outcomes

Participant 2 indicated that they did not believe POC testing improved chronic patient outcomes. Their practice focused on current conditions of the patient rather than improved chronic outcomes.

4.2.2 Reduced decision time

The second theme, reduced decision time, appeared in three interviews from two different practices. Between these three participants, the theme was mentioned thirteen times in total. This theme consisted of all comments related to saving time, immediate decisions, and quick results.

The ability to make immediate decisions based on accurate pathology results

allowed better management a patient. Sending patients to the laboratory for testing was time-consuming and POC solved this problem by making results available within minutes without the need to travel to a lab. POC testing also assisted with immediate patient diagnosis, resulting in improved clinical decisions.

4.2.3 Compliance

The third theme, compliance, appeared in three interviews. All responses in the compliance theme emerged from one practice, specifically the practice located in a lower socioeconomic area. The theme was mentioned ten times in total. This theme related to comments based on patient compliance that may result in improved outcomes.

POC testing allowed for better outcomes due to improved compliance. Patients received their pathology results on the same day, reducing the risk of them not having regular blood work done. Participant 3 stated:

> *…there was a non-compliance in patients coming back and so in terms of management you know we weren't getting the management and as a result we weren't getting the outcomes.*

Participants noted that a follow-up consultation to discuss pathology was not necessary, thereby reducing the risk of patients not returning to discuss treatment options. Participant 8 added to the theme of compliance stating that POC testing might be beneficial in lower socioeconomic areas. Patients in these areas do not have the funds or time to travel constantly to see a doctor. Same-day results might improve compliance and therefore, patient outcomes

4.2.4 Patient understanding

The fourth theme, patient understanding, appeared in two interviews from two different practices. The theme was mentioned three times in total. This theme related to comments explaining that improved patient understanding resulted in improved patient outcomes.

Same day results increased patient satisfaction as it allowed HCPs to have

contextual discussions with the patient. This improved the patient understanding of their condition, which might result in improved outcomes. Participant 6 stated:

> *… if they have a constant reminder um, of their risk and what they need to do um, having explained it to them in a way that they understand then it has a way better outcome.*

Participants indicated that some patients did not know if they were diabetic. While these patients might have previously been diagnosed, some forget or fail to understand the implications of being diabetic. POC testing allowed patients to confirm their diagnosis immediately.

4.2.5 KardioPro

The final theme, KardioPro, appeared in two interviews from a single practice. The theme was mentioned four times in total. The KardioPro theme included any response that indicated the software, which is used with the Alere device, possibly resulted in improved patient outcomes.

KardioPro calculated a cardiovascular risk for patients, which enabled practitioners to treat patients accordingly. Moreover, the additional tests that can be performed with KardioPro, such as the ankle-brachial index, provided them with the opportunity to do extensive assessments on patients.

4.3 Additional benefits

This line of questioning was asked to determine if healthcare practitioners were experiencing any additional benefits, other than improved patient outcomes.

Responses generated seven major themes. The themes in order of importance were financial benefit, healthcare practitioner satisfaction, patient satisfaction, coordinated care, reduced decision time, practice efficiency, and COVID-19.

4.3.1 Financial benefit

The financial benefit theme appeared in all eight interviews. All four practices contributed to the theme. The theme was mentioned 40 times in total. This theme contained any comments regarding financial benefit.

Although it is possible to make a profit on POC testing due to the revenue from test cartridges, it was challenging to do so. Participants mentioned that a high number of patients needed to test in order for the practice to cover costs. They also mentioned POC testing is seasonal which meant there were good and bad financial months. Participant 1 responded:

> *Sometimes, because it's very seasonal as well, whether the patients come in or not.*

They went on to say:

> *…medical aids also just give you X amount of tests that they pay per year that also puts a limit on how many times you can actually um get paid for the test.*

Practices usually experienced a financial loss- most months, they are happy just to break even.

Only one practice experienced financial gain from POC testing. Participant 4 indicated that they experienced initial financial difficulty as test cartridges were expiring and patients did not understand POC testing. However, after some extensive marketing, patients understood POC testing and trusted the results.

One practice indicated that they did not make any financial gain from POC testing as they billed the patient at the cost of the cartridges. The financial viability could therefore not be evaluated.

4.3.2 HCP satisfaction

Healthcare practitioner satisfaction was the most notable theme under this question. The theme appeared in all eight interviews involving all four practices. This theme was mentioned 45 times in total, highlighting how satisfied healthcare practitioners were with POC testing. This theme included comments highlighting practitioner satisfaction with POC devices and KardioPro software.

Participants specifically mentioned how KardioPro provided a risk profile for patients, which enhanced their management. The quick electronic results

allowed for contextual discussions with patients, thus enhancing patient understanding. The KardioPro reports and the electronic health record assisted with patient diagnosis as well.

Participant 4 mentioned that POC testing reduced possible complications with traditional laboratory testing. When sending a patient for pathology testing, the laboratory might come back to them with possible reasons for being unable to conduct pathology testing. Participants stated that POC testing was easy to use and the Alere device was adequate for diabetic patient pathology testing. The device provides lab-quality results within minute which practitioner enjoyed. Participant 7 specifically highlighted that POC testing had resulted in increased patient numbers in their practice.

4.3.3 Patient satisfaction

Patient satisfaction was mentioned in all eight interviews. The theme was mentioned 37 times in total with responses coming from all four practices. The theme encompassed participant comments relating to patient satisfaction.

Participants mentioned that patients were satisfied with POC testing, as they did not have to wait for pathology results. This resulted in patients saving on time, money, travel, and sick leave. Providing same-day results to patients improved their satisfaction as there was no need to return for a follow-up consultation. POC testing allowed for a contextual discussion with patients, which patients appreciated. Moreover, patients could have an electronic copy of their results with simple interpretations, which they can review at home.

Participant 2 indicated that patients were satisfied with POC testing if there was no need to bleed the patient twice. If POC testing indicated the patient was in need of further pathology investigation, the doctor would need to draw blood again from the patient to send to the laboratory. Patients did not enjoy being pricked twice; however, they were happy with the cost saving POC testing provided them

Participant 7 stated that patients were curious about POC testing and liked the concept. Some patients, who were practicing doctors, went as far as to purchase POC devices after experiencing the testing.

4.3.4 Coordinated care

The coordinated care theme appeared in three interviews from two practices. The theme was mentioned seven times in total. The theme included comments indicating that POC testing was beneficial for a multidisciplinary practice.

POC testing enabled quick and appropriate referrals to various in-house specialists. Participant 6 indicated that chronic patients could be managed differently compared to acute patients as a result of this. Participant 8 stated that same day results enabled them to refer patients to the in-house dietitian for immediate assessment. Participant 3 stated:

…having the POC [test results] also allows us to set up the um allied disciplines that we use you know so the diabetic nurse educator, the dietitian, the podiatrist

4.3.5 Reduced decision time

Reduced decision time was mentioned in seven interviews from all four practices. The theme was mentioned 23 times in total. This theme included any responses relating to time saved.

Participants highlighted the ability to make immediate decisions as well as alter treatment immediately as benefits of POC testing. Quick results enabled them to get an immediate understanding of a patient's current condition and make same day treatment decisions.

4.3.6 Practice efficiency

Practice efficiency was mentioned in all eight interviews and included all four practices. The theme was mentioned 17 times in total. This theme included comments related to improved practice efficiency.

Participants confirmed that POC testing resulted in improved patient workflow. POC testing enabled them to increase time spent with patients and the contextual discussion allowed for improved patient management.

Participant 3 highlighted that POC testing enabled the division of tasks, improving practice workflow. POC testing has also changed the way they practice in terms of patient workflow.

Participant 7 mentioned that practice efficiency was determined by the skill of the POC device operator. An experienced operator would be able to conduct testing faster, compared to an inexperienced operator.

4.3.7 COVID-19

COVID-19 was mentioned in three interviews from two practices. The theme was mentioned four times in total. The theme included any comments relating to COVID-19.

Participants 3 and 6 both added to the COVID-19 theme. Participant 3 indicated that COVID-19 had resulted in reduced patient testing, which contributed to financial loss. Participant 6 highlighted that because chronic patients can be managed more efficiently, they would spend less time in the waiting area, thereby reducing the possibility of contracting COVID-19.

4.4 Reimbursement

This line of questioning was asked to determine if healthcare practitioners experienced any problems with reimbursement.

Four major themes emerged from responses. The themes, in order of importance were schemes, cash patients, financial, and socioeconomic.

4.4.1 Schemes

The schemes theme appeared in six interviews and included all four practices. The theme was mentioned 29 times in total. This theme encompassed comments regarding medical scheme reimbursement.

Some participants were happy with the current reimbursement model while other expressed their dissatisfaction. Participant 1 indicated that they were happy with the reimbursement model as they were contracted to medical schemes which made reimbursement easier.

Participants indicated that the guidelines from funders in terms of POC testing were unclear, which resulted in numerous rejections from schemes. They also indicated that POC testing is something new for GP practices, and that medical aids were concerned about excessive testing.

Participant 3 mentioned that medical aids are happier to pay for POC testing as part of a capitation model rather than a fee-for-service model.

Participant 8 stated that funders assessed improved outcomes in terms of costs saved. Although POC testing may improve patient outcomes; it is difficult to attribute this improvement solely to POC testing. Therefore, if it cannot be proved that POC testing improves outcomes, the scheme would continue to pay for traditional laboratory testing only. Participant 8 stated:

> *…all doctors are paid the same amount of money to deliver a service … we are not necessarily reimbursed uh … or spending more time or driving outcomes.*

4.4.2 Cash patients

The cash patients theme appeared in seven interviews from three different practices. The theme was mentioned 12 times in total. All comments relating to cash accepting practices were captured under this theme.

All participants indicated that patients were happy to cover the costs, as the tests were cheaper than standard laboratory testing. Some patients found it costly; however, they would save money and return to the practice when they could afford to pay.

4.4.3 Financial

The financial theme appeared in four interviews from three practices. The theme was mentioned seven times in total. The theme included any comments relating to the impact of reimbursement on the financial sustainability of POC testing.

Reimbursement had a large impact on financial outcomes for practices as many were not being reimbursed for tests. This results in the patient or practice having to cover the pathology costs.

Participant 6 highlighted that due to the location of the practice, they relied heavily on reimbursement from medical aids. They indicated that medical aids paid for certain tests depending on the scheme and plan type. In the event of a shortfall, patients who were unable to pay had the shortfall covered by the practice. This contributed to financial loss. The practice however, formulated a guide indicating which schemes and plan types covered various testing and used this to reduce financial loss.

Participant 2 indicated that there were cheaper POC devices in the market, compared to the Alere; however, they may not be validated. They also mentioned that it was difficult to conclude that the Alere device specifically resulted in profit.

Participant 8 contributed to the financial theme stating that POC testing could not be the only consideration terms of cost. A patient's condition would determine the various investigations required for assessment. As investigations were added, the cost of treatment increased. Therefore, reimbursement challenges with patients who have several ailments might be experienced

4.4.4 Socioeconomic

The socioeconomic theme appeared in two interviews from two different practices. The theme was mentioned three times in total. Comments relating to how practice location and socioeconomic status affect reimbursement were captured in this theme.

Practices in lower socioeconomic areas might have reimbursement challenges. Areas of higher socioeconomic status are unlikely to experience any reimbursement issues.

4.5 Factors of implementation

This line of questioning was asked to identify what expectations HCPs had when implementing POC testing in their practice. Six major themes emerged under this question. In order of importance, the themes were financial, improved patient outcomes, practice efficiency, patient satisfaction, reduced decision time, and KardioPro.

4.5.1 Financial

The financial theme appeared in five interviews from all four practices. The theme was mentioned nine times in total. This theme relates to any comments mentioning finance as an implementation factor.

Being the owner of the practice, Participant 3 considered the financial

implications. They indicated that they had considered POC testing a few years back but because it was not being reimbursed, they decided against it. The reimbursement model has recently changed to accommodate reimbursement for POC testing.

Some participants stated that financial gain was not a factor they considered for POC testing implementation. Participant 4 contradicted this by stating financial gain was a major factor. They went on to state that POC testing assisted the practice with sustainability and growth.

4.5.2 Improved patient outcomes

The improved patient outcomes theme was mentioned in three interviews from two different practices. The theme was mentioned three times in total. Any mention of implementing POC testing to improve patient health was captured in this theme.

Practices wanted to improve the health of their patients. Participant 7 stated that the doctor wanted to understand and manage chronic patients better. The idea was that POC testing might assist with this goal.

4.5.3 Practice efficiency

The practice efficiency theme was mentioned in four interviews from three practices. The theme was mentioned five times in total. The theme included any comments regarding practice efficiency and improved workflows.

Participants indicated that they wanted to improve practice efficiency and reduce waiting times. Being able to bleed 1 patient while consulting with another improved workflow.

4.5.4 Patient satisfaction

Patient satisfaction was mentioned in three interviews from two practices. The theme was mentioned six times in total. The theme included comments relating to HCPs considering the patient when implementing POC testing.

Some practices aimed to reduce costs for patients, while still providing them with quality healthcare. This was a major factor for POC implementation.

Participant 5 indicated that patient satisfaction was important, and would reduce

defaulting patients. POC testing was also effective for initial patient assessments, to obtain a comprehensive understanding of their condition.

4.5.5 Reduced decision time

The reduced decision time theme appeared in three interviews from three different practices. The theme was mentioned five times in total. The theme included comments relating to time saved due to POC testing.

Being in a pre- anaesthetic clinic, Participant 2 needed quick results in order to understand the patient's current condition, which POC testing offered

Participant 5 indicated that POC testing was implemented to attract patients as well. The ability to assess patients immediately was important for implementation.

The ability to alter patient treatment immediately, and initiate treatment were factors practices considered for implementation.

4.5.6 KardioPro

KardioPro was mentioned in six interviews from participants in all four practices. The theme had a total of 20 mentions. Any comments relating to KardioPro or POC testing in general were captured under this theme.

Practice 2 and 4 implemented POC testing, as they desired a technologically advanced practice. The KardioPro system provided this advanced feeling as the system has many capabilities including EHR software, trend analysis, and treatment guidelines. Participant 3 stated:

> *… if Alere was just a stand-alone machine, I wouldn't have taken it.*

State-of-the-art technology also attracts more patients to the practice as patient want to be treated using the best technology. Participant 4 stated:

> *… patients want to go to a place that is technologically advanced.*

Participant 3 stated that they would not have implemented POC testing if it were a standalone device. KardioPro was a diabetic patient management solution and this software is what convinced them to implement the devices. Participant 3 indicated that although there is other EHR software available, none was GP

focused.

4.6 Barriers of entry

This line of questioning was asked to identify what barriers HCPs believed were preventing widespread adoption of POC testing at a primary care level.
Five major themes appeared in this line of questioning. In order of importance, the themes were financial risk, lack of awareness, environment, habit, and distrust.

4.6.1 Financial risk

Financial risk appeared in five interviews from three different practices. The theme was mentioned 22 times in total. All comments relating to the financial risk of POC testing were captured under this theme.

Participants believed the major contributor to barriers of entry were financial implications. Although POC testing enabled patients to save money, doctors want to experience a financial benefit as they are performing the testing. Practices had to pay a monthly subscription and purchase test cartridges before testing. Doctors outlay significant amounts of money and there is no guarantee on the return on investment. Participant 3 said:

> *I have to upfront prepay for the cartridges, monitor stock control, then bill the medical aid and hope I get paid.*

When comparing this to traditional laboratory testing, doctors had no risk, as laboratories were responsible for ensuring they are paid for pathology testing. Moreover, wasted cartridges resulted in financial loss. New POC device operators risked wasting cartridges due to lack of experience. This deterred practitioners from implementing POC testing

Participant 8 expressed that the number of diabetic patients was important for POC testing, as this would influence financial gain. Therefore, smaller practices might not be able to use POC testing, as they did not have enough patients. In addition, POC devices were expensive to purchase. Primary care practitioners were income challenged and not willing to invest in POC testing facilities.

Device companies were testing a placement model where doctors did not need to pay for the device itself, they were only required to pay for the test cartridges. This model however, has a minimum usage clause, which creates an ethical dilemma for HCPs; did they perform pathology testing to cover costs or did they test based on a clinical need.

4.6.2 Lack of awareness

The lack of awareness theme was mentioned in four interviews with participants from three different practices. The theme was mentioned 10 times in total. All comments regarding poor awareness of POC devices were captured here.

Participants agreed that lack of awareness was a major barrier. They stated that practitioners were unaware of the benefits of POC testing and the positive changes it could make to their practice. They stated that better marketing was needed to educate doctors on POC testing. Older doctors might not understand POC testing and the benefits it could bring. Improved marketing is required to improve awareness. Participant 2 stated:

> *… doctors need to be more educated on POC [testing] as not many know about it.*

4.6.3 Environment

The environment theme appeared in five interviews from three different practices. The theme was mentioned a total of 16 times. The environment theme captured responses relating the healthcare environment as well as the practice environment.

The adoption of POC testing largely depends on funders. If schemes did not reimburse POC testing, doctors would not use the devices. Moreover, schemes were more willing to pay for POC testing as part of a capitation model as the move towards value-based medicine. Funders were also concerned about the validation of the results as not all POC devices produced laboratory quality results

Participant 4 stated that POC testing requires skill. If practices did not have the skilled labour to conduct these tests, they might shy away from implementation. While traditional laboratories have the reputation of trustworthy results, many

practitioners did not know that laboratories are also using POC devices for pathology testing. The laboratories, however, would not admit to this as they valued their market share. They added that POC testing was the best thing for private practices at a primary care level. Participant 7 echoed this stating that POC testing would soon be in all HCP practices.

Participant 2 believed that POC testing would work well in large group practices. They also mentioned that as the healthcare industry moves toward value-based medicine, POC testing would gain more traction.

4.6.4 Habit

The habit theme appeared in four interviews from all four practices. The theme had a total of seven mentions. The theme captured comments regarding healthcare practitioners' resistance to change.

Participants believed HCPs used traditional labs due to comfort and habit. Participant 6 stated that doctors have been trained to use traditional labs since medical school and were therefore accustomed to this method of pathology testing. They also added that doctors were resistant to change.

Participant 4 contributed to the habit theme, stating that doctors' mindsets might be a barrier, as they refused to change their way of thinking

4.6.5 Distrust

Distrust appeared in three interviews from three different practices. The theme was mentioned a total of five times. The theme encompassed comments related to the distrust of POC testing results.

Participants indicated that many HCPs do not trust POC results and believe they are inferior to traditional lab testing.

CHAPTER 5. DISCUSSION OF RESEARCH FINDINGS

5.1 Introduction

POC devices have been around for just under fifty years (John & Price, 2014). The technology was created to provide fast results, which would lead to quicker treatment decisions, resulting in improved patient outcomes (Price, 2001). The use of POC devices in a primary care setting has revealed that the devices might have additional benefits to improved patient outcomes, such as cost saving, increased practice efficiency, improved patient and practitioner satisfaction (Larsson et al., 2015; Patzer et al., 2018; Schnell et al., 2016). Theoretically, healthcare practitioners should be experiencing some of these benefits; however, was this the case in the private health sector of Gauteng?

Sections 5.2 to 5.6 discuss the findings in each line of questioning. Section 5.2 discusses themes found regarding improved patient outcomes. Section 5.3 discusses the themes found under additional benefits of POC testing. Section 5.4 discusses the data regarding reimbursement. Section 5.5 discusses the data regarding factors of implementation. Section 5.6 discusses the themes found under barriers of entry.

Section 5.7 discusses the methodological findings where the findings surrounding the research process are described.

5.2 Improved patient outcomes

Research results indicated that seven out of the eight participants believed POC testing improved diabetic patient outcomes. Participant 2 did not mention improved outcomes as their practice was established for pre-anaesthetic assessments only. Therefore, they only used the devices to determine the patients' current condition and had no interest in improved outcomes.

It was interesting to uncover the various reasons HCPs had for believing that POC testing improved patient outcomes. Reduced decision time improved patient outcomes was an expected outcome as it is well known that POC

provides pathology results within minutes. This was consistent with the literature, which stated that POC testing enables practitioners to make instant decisions, which results in improved patient outcomes. (Kost, 2006 as cited in Schnell et al., 2016).

Compliance was a major theme for one specific practice. The practice was located in a lower socioeconomic area and many of their patients are low-income earners. Due to limited finances, patients often did not make their way to laboratories for routine blood tests. Furthermore, patients that did go for the tests failed to return for a follow-up consultation to discuss the results and their implications. KardioPro generated simple electronic reports, with interpretations, which patients could understand. This was interesting to uncover, as compliance was not listed as a factor for improved patient outcomes in the literature review. This may however, be a new selling point for POC as many practitioners struggle to keep patients compliant. This could be added to KardioGroup's value proposition on the business model canvas which would increase their offering to customers.

During a post-data analysis literature review, there was evidence suggesting that POC testing within a community improved compliance (Till et al., 2003 and Nola et al., 2000 as cited in St John, 2010). In both studies, pharmacists took the initiative to improve patient outcomes through screening and testing. Gialamas et al., (2009) concluded that POC testing in a primary care facility is associated with the same or better medication adherence. They went on to conclude that having the test result readily available at consultation can facilitate important behaviours such as medication adherence (Gialamas et al., 2009). Improved medication adherence may reduce death rates, hospitalisation and the cost of healthcare (Kini & Ho, 2018).

There is however, limited research to indicate that POC testing at a primary care facility improved the compliance of patients following through with referrals to specialists. This might be an area for further research.

POC testing eliminated the need for a follow-up consultation as practitioners could discuss results with their patients during the first consultation.

This resulted in reduced complications due to defaulting patients. The digital reports could also be sent to the patients, which allowed patients to have a constant reminder of their condition. Having this constant reminder will encourage patients to make choices that would be beneficial for their health. This was also an unexpected outcome as the author did not consider the reports from the patients' view.

5.3 Additional benefits of POC testing

Many of the expected themes appeared in the responses such as: healthcare practitioner satisfaction, patient satisfaction, practice efficiency, and reduced decision time. The anticipated theme of financial benefit emerged. KardioGroup sold the testing cartridges to practitioners at a cost, which was less than the amount they could claim back from the medical schemes. This resulted in a marginal profit for practitioners, on each test.

The financial model of KardioPro is such that practices paid a monthly subscription to have the POC devices placed in their practiced and to have access to the KardioPro electronic health record software. Additionally, practitioners needed to pay upfront for each test cartridge before they could perform a test. In order to experience financial gain, a certain number of tests had to be performed to cover the cost of the cartridges as well as the monthly subscription fee.

Although participants indicated that they experienced a financial gain, they did make mention of the difficulty in doing so. Practitioners understood that there was a specific number of patients to be tested every month in order to cover costs; however, it would be unethical to test patients unnecessarily. Moreover, medical schemes regulated the number of tests they would reimburse.

These factors made it increasingly difficult for practitioners to experience financial gain. The ethical dilemma also highlighted the problem with KardioGroup's business model. One survey in the United Kingdom produced results indicating that practitioners at a primary care level were concerned about excessive testing with POC devices (Turner et al., 2016). This suggested that the ethical dilemma of excessive testing was a concern to many practitioners

who used POC testing at a primary care level. In order to address this dilemma, KardioGroup needs to develop a business model which relieves financial pressure from the HCPs. One possible way is to offer the software for free while charging a subscription for the devices. Another avenue could be to offer advertising space on the KardioPro platform. This would generate additional income which could be used to subsidize the cost of POC. This can be seen in the proposed business model canvas for KardioGroup in Appendix D

Participant 3 highlighted the importance of the business model with which POC devices are made available to practitioners, stating that most doctors stopped using the devices after the two-year contract expires. Some HCPs stopped using the device because the doctor never owned the devices, but continually paid a monthly subscription. This reaffirms the need for KardioGroup to develop a new business model with HCPs in mind. The current business model considers KardioGroup first, rather than their customers. This focus needs to shift so that HCPs are put first when developing a business model.

In a multidisciplinary practice, POC testing enabled a care-coordinated model. Patients were able to have a consultation with the doctor, and based on the blood results, the patient could be referred immediately if necessary. This reduced patients neglecting to see specialists, such as the dietitian or podiatrist, for further assessment. In theory, this should lead to improved patient outcomes. Furthermore, it enhanced patient satisfaction as they had the potential to have all necessary assessments done in one day, rather than make multiple appointments with various specialists.

In a post-data analysis literature review, it was found that POC testing related clinical decision support should be extended to various specialists that might treat patients with diabetes complications, such as retinopathy or nephropathy (O'Connor & Sperl-Hillen, 2019). This suggested that if POC testing was fully integrated into a care coordinated model, patient outcomes might be improved. This is significant as it highlights the need to change from a fee-for-service model to a care coordinated model. Healthcare business have the potential to benefit themselves as well as patients by integrating a care coordinated approach in their practices.

The recent COVID-19 pandemic highlighted the need for POC testing. Diabetic patients with type two diabetes are at increased risk of severe illness due to COVID-19 (CDC, 2020). POC testing and improved practice efficiency may result in less crowded waiting areas, reducing the risk of COVID-19 transmission (CDC, 2020). This suggested that POC testing might improve management of comorbidities during COVID-19.

5.4 Reimbursement

In the private healthcare sector of South Africa, there were two ways in which a doctor can be paid for their services: (i) medical aid reimbursement or (ii) patients pay cash. Participants indicated that medical schemes only paid for certain tests depending on the funder and plan type. Furthermore, POC testing was never considered something that would be done at a GP level. This resulted in no clear guidelines from medical aids to facilitate POC testing implementation.

One participant made mention of an increased willingness of medical aids to pay for POC when it was part of a capitation model. With such a model, doctors are paid a lump sum every year by the scheme, for each diabetic patient they have under their care. Any investigation that the patient needs is paid from this lump sum. Whatever funds the practitioner has left from the lump sum is theirs to keep at the end of the year. This incentivises the practitioner to strive toward improved patient outcomes (Canopy Health, 2017).

As medical schemes move toward value-based healthcare rather than a fee-for-service model, it seems that the capitation model will be an ideal way to improve patient outcomes as well as reimburse practitioners for POC testing. This also highlights the customer segment of managed care organizations on the business model canvas. While this has been a target customer for KardioGroup, they were unable to secure any contracts with managed care organizations (KardioGroup, 2017). This prompts the company to evaluate the reasons behind why they have not secured any contracts- this may have something to do with their business model.

Patients did not mind paying for the tests, as they were cheaper than traditional laboratory testing. Patients who were unable to afford to do the blood tests on the day saved money and returned. This indicated how satisfied patients were with POC testing. KardioGroup is heavily focused on higher socioeconomic areas as they believe this is where patients won't mind paying for these tests. However, the results indicate that even patients in lower socioeconomic areas did not have a problem paying for the pathology tests. This gives KardioGroup a new target market to focus on and possible increase sales.

5.5 Factors of implementation

Participants made mention of various factors regarding KardioPro including ease of use, simple reports, electronic health record, and KardioPro being part of a bigger solution. KardioPro software was geared towards diabetic patients. The software generates risk profiles, simple reports, and current treatment guidelines. It was evident that the software was a key implementation factor. Participant 3 even stated that if it were not for the software, they would have not purchase the solution. This emphasises how important the complementing KardioPro software is for customers.

Considering the revised Porter's five forces business model (Porter, 1979), which incorporates complementors as a sixth force (Kenton, 2020), the power of a complementary good or service can be noted. Complementors add value to existing products in the market; however, if customers perceive complementors as unattractive, it might slow growth (Corporate Finance Institute, 2021). KardioGroup has leveraged their complementor product of the software in order to sell POC devices. This was their strategy to penetrate the market and increase the likelihood of adoption.

Cheaper pathology tests were an implementation factor, whether it be for financial gain for the practitioner or cost reduction for the patient. This is a selling point which KardioGroup should maintain as customers and patients value the cost reduction.

POC testing was created to reduce decision time and therefore improve patient outcomes (Kost, 2006 as cited in Schnell et al., 2016). In contrast, this study saw only three of the eight participants implementing POC testing to reduce decision time. In a similar vein, only three participants implemented POC testing with the intention of improving patient outcomes. It appears that participants were interested in the technology of KardioPro itself, rather than the benefits it could provide for their patients. This is another review point for KardioGroup's marketing. The company believes that customers want to implement POC to improve patient outcomes however, less than half of the participants had this intention. The marketing department should shift their focus to what the customer is searching for from POC: advanced technology.

Comparing the factors of implementation and the benefits practitioners experienced, it is evident that HCPs experienced the benefits they expected to experience when implementing POC testing. This is important to note as company's need to manage customer expectations with reality. Too often customers expect various benefits which are not experienced.

5.6 Barriers of entry

Although an increasing number of primary practitioners were implementing POC testing such as the Alere, in their practices, the number of current practices are minimal according to KardioGroup. This study attempted to gain some insight into possible reasons for practitioners being slow to implement POC testing.

Five participants indicated that financial risk was a major deterrent. The business model of KardioPro results in the healthcare practitioner taking on all the risk. Practitioners signed a two-year contract with a monthly subscription fee. Practitioners ordered cartridges well in advance as these are imported. Moreover, the test cartridges have an expiry date. All these factors place all the risk on the doctor. When compared to traditional laboratory testing it was noted that the laboratory takes on all the risk. The practitioner sends the patient to the laboratory for testing and it is the responsibility of the laboratory to ensure they receive payment. This convinces practitioners to stick to traditional laboratory testing, as there is less of a burden.

KardioGroup might need to revise their business model and structure a model that takes into account practitioners financial risk concerns. This might result in increased market penetration and sales. Creating a partially platform-based business model may allow for the company to gain a competitive advantage that supports market penetration using complementors, as a sixth force, within the context of the revised Porter's Five Forces model (Porter, 1979). Platform-based businesses enable interactions between a large number of participants (Hermans, 2021). For example, it could connect buyers and sellers. The role of a platform-based business is to govern and facilitate interactions so that network effects can be unleashed (Hermans, 2021). Network effects are a key economic phenomenon (Hagiu & Yoffie, 2016). Network effects create multiple equilibrium market configurations, which are determined by participants' expectations (Hagiu & Yoffie, 2016). KardioGroup could still sell the POC devices but perhaps allow users to use the software for free, or on a freemium model. Allowing practitioners to use the software for free would create a community or ecosystem which leverages network effects to grow at incredible rates (Accenture South Africa, 2017). Practitioners who wish to upgrade to the premium version could take up a monthly subscription, which includes the POC devices.

Lack of awareness emerged as a theme despite POC testing being in existence for just under fifty years (John & Price, 2014). It was expected that healthcare practitioners would have extensive knowledge of these devices however, this is not the case. The lack of awareness provides KardioGroup with some insight into the reasoning behind their slow market penetration. KardioGroup might need to adjust their marketing strategy and aim to improve awareness and education on POC testing. Many new technologies fail due to lack of awareness. KardioGroup may benefit by running extensive awareness campaigns regarding POC as well as the KardioPro software. This could be added to their business model canvas under channels to target customers.

5.7 Methodological findings

There was a possibility that the research interviews were not conducted in a manner that elicited very descriptive responses. Interviews require soft skills, which the researcher might not have possessed due to lack of experience. After the first two interviews, it was noted that the questions provoked yes or no answers. Before the third interview, the approach was adjusted, making use of open-ended questions. This encouraged participants to be more descriptive.

The COVID-19 pandemic added challenges to the interview process as practitioners did not have time to have lengthy discussions. This resulted in some participants providing concise responses, without elaborating. It is possible that HCPs had more opinions regarding POC testing. Research conducted in a less pressured environment might elicit more elaborate responses.

5.8 Summary

Research on POC testing at a primary care level has produced mixed results concerning cost benefits and chronic patient outcomes (Gialamas et al., 2010; Khunti et al., 2006; Laurence et al., 2010; Pillay et al., 2019). The theoretical benefits were evaluated in private practice at a primary care level in Gauteng.

Despite conflicting research results, market research indicates that POC testing continues to grow in the Middle East and Africa, with an estimated compound annual growth rate of 9.42 per cent (Market Data Forecast, 2020). The aim of this research was to begin investigating POC testing in diabetic patients in the private healthcare sector of Gauteng as there has been limited research done in this area. The objective was to gather HCPs' insights on their experience with POC testing on diabetic patients, in their practices and analyse KardioGroup's business model.

The study made use of a qualitative research approach, based on a phenomenological design. The intention was to capture experiences of practitioners having used or currently using POC devices. Data was collected through semi-structured interviews. The data was transcribed and analysed through thematic analysis.

The study had the following initial research questions:

- *Question 1*: What beliefs do HCPs have regarding POC testing at a primary care level?
- *Question 2:* What benefits, other than therapeutic, are HCPs experiencing from utilising POC testing in their practice?
- *Question 3*: What are HCPs' opinions on the current reimbursement model for POC testing?
- *Question 4*: What are some of the factors that influenced HCPs to implement POC testing?

Although not in the proposal submission, it was decided to ask participants a fifth question:

- *Question 5*: What do HCPs believe the barriers of entry are for POC testing in the private healthcare sector?

After conducting the first interview, it was decided that it might be beneficial to gather information regarding barriers of entry, as it could enhance understanding of why POC testing is not yet widespread in South Africa.

This research indicated that practitioners were experiencing various combinations of benefits with some experiencing all the theoretical benefits and more including: reduced risk of COVID-19 exposure due to less crowded waiting areas, and the improvement of a care-coordinated model. Although POC devices were not designed with highly infectious diseases in mind, the data suggested that POC testing has the potential to reduce the spread of infectious diseases to some extent. By improving practice workflow, waiting

rooms would be less crowded. Reducing the number of people in a room may reduce the spread of COVID-19.

Multidisciplinary practices made mention of the positive contribution POC testing has made to their care coordination model. Rather than wait for pathology results to indicate which specialist a patient might need to see, practitioners can refer patients during the first consultation. In a multidisciplinary practice, this is enhanced, as there is the potential for patients to be seen by specialists on the same day as their initial consultation. This might reduce patients deferring specialist consultation and even deciding not to see the specialist. This increased compliance with management might further improve patient outcomes and reduce healthcare costs.

Practitioners took note of patients' levels of satisfaction with POC testing. Patients experienced reduced travelling costs, reduced leave taken, reduced pathology costs, and the convenience that POC testing offers. COVID-19 has highlighted new benefits for POC testing, as it improved practice workflows and reduced crowding in waiting areas. Some practices highlighted the benefit of POC testing in a multidisciplinary practice, enabling these practices to have an enhanced care coordinated model. The quick results enabled the doctor to have a contextual discussion with patients during the first consultation rather than scheduling a follow-up consultation to discuss pathology results.

The healthcare industry was heavily influenced by major medical schemes as they dictate what they will reimburse. Although initially, some practitioners experienced reimbursement issues, many have adapted and learned how to claim effectively from schemes. Participant 5 made mention of a system they have developed over time to determine which plans from various medical aids will reimburse for POC testing. As schemes move over to a value-based healthcare model, practitioners believe POC testing reimbursement will improve. One well-known scheme announced their intention to roll out their own POC devices. This might change the industry's perception towards POC testing. Distrust was one of the themes expressed in the interviewee responses. Major schemes launching their own devices might influence practitioner to trust POC test results.

Practices enjoyed the various benefits they expected to experience when initially implementing POC testing in their practices. It seems as though many overlooked the various benefits of POC testing and focused on the technology: KardioPro. The simple reports, ease of use, HER, and more were major factors for implementation.

Responses indicated expected barriers of entry as financial risk, the healthcare environment, habit, and distrust. The theme that emerged in contrast to much of the literature was lack of awareness. After just under fifty years, practitioners still claim not to know about POC blood analysers and their potential benefits.

Responses highlighted the need for KardioGroup to develop a new business model that would reduce financial risk for practitioners as well as improve sales and market penetration. A partially platform-based business model is proposed to create an ecosystem to which the technology can be introduced.

CHAPTER 6. CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

6.1 Conclusions

While POC testing has been in existence for quite some time, the low adoption rate in the South African private health sector raised the question why more doctors are not using POC devices. Interactions with doctors while working for KardioGroup, enabled the researcher to draw certain conclusions pertaining to the slow adoption rate. The conclusion expected was that doctors were not experiencing financial gain, were not satisfied with the KardioPro solution, were not experiencing the theoretical benefits, and had extensive reimbursement issues. However, this was not the case. All participants experienced various benefits of POC testing. Moreover, all participants expressed their satisfaction with KardioPro. Practitioners had initial issues with reimbursement, which was now resolved.

This study confirmed that POC testing does function in the private healthcare system of South Africa. Results indicated that HCPs do believe POC testing improves diabetic patients' outcomes. Participants also confirmed that they experienced additional benefits such as improved practice efficiency, increased patient satisfaction, and HCP fulfilment. While there was potential for HCPs to enjoy a financial gain from POC testing, the results indicated that this was practice dependant.

Factors such as number of patients, location, and medical schemes affected practices differently, affecting financial gain. A higher number of patients being tested would increase turnover and therefore profit. Patients in more affluent areas were also on higher medical aid plans, which offer more benefits and therefore reimburse POC testing. Furthermore, wealthier patients had no problem paying cash for services in the event that the medical aid declines reimbursement.

POC testing has the potential to significantly improve the healthcare system of South Africa and reduce the diabetes disease burden. POC testing has the potential to improve diabetic patient outcomes. This could result in long-term savings for the industry due to reduced diabetic complications. POC testing also has the potential to reduce pathology costs, as it was cheaper than standard laboratory testing. POC testing would serve the public healthcare sector of South Africa well as it has the potential to improve compliance, improve patient outcomes, and reduce costs. POC devices boasted a host of benefits on its own; however, coupled with KardioPro software, practitioners experienced additional benefits. KardioPro was designed to be a diabetes management solution. Trend analysis, simple reports, and user-friendly software revolutionises the primary practice. With extensive use of POC testing at a primary care level, the benefits could be endless for HCPs, patients, and the healthcare industry itself.

The study indicated that KardioGroup's business model is not effective as customers are not benefiting financially. The data also indicated that a business model that reduces financial risk on HCPs will aid in increased sales. KardioGroup will need to revise their business model in order to improve sales and possibly enhance the benefits of POC.

6.2 Limitations

This study was done with the assistance of KardioGroup, one of two distributors of the Alere Afinion POC device in South Africa. This indicated that there might be other HCPs using the Alere device in private practice. The research was limited to the list provided by KardioGroup, as the researcher had a relationship with this company. Gaining assistance from the other company that sells the devices, may have been difficult, as the researcher had no prior relationship with them.

The study was conducted in Gauteng only. A larger geographical sample might provide different views on POC testing.

The study interviewed participants who had used the device for a minimum of

six months. Practitioners who had utilised the device for a longer period might have different views on POC testing. Participant 3 had been using POC testing for roughly three years and suggested that a longer usage time is needed to evaluate POC testing.

The study was limited to semi-structured interviews due to the COVID-19 pandemic. The restriction of movement and physical interaction guided the approach to use only semi-structured interviews. A research approach that included observations might produce different outcomes.

6.3 Recommendations for POC testing

POC testing has the potential to transform primary care practice; however, various factors prevent widespread implementation.

The study indicated that medical schemes had not been supportive of POC testing in a primary care setting. Medical schemes should provide more guidance and support to practitioners implementing POC testing, as the uncertainty of reimbursement leaves doctors contemplating if POC testing is a viable option.

The research further indicated that there was a lack of awareness regarding POC testing at a primary care level. Device companies need to increase awareness on POC testing, which will improve understanding of POC testing and possible implementation. Furthermore, device companies might use the insight, that patients are attracted to technologically advanced practices, strategically. They might use this to focus on affluent practices and convince HCPs that they could see more patients if their practice is technologically advanced.

Finally, some respondents indicated that the business model KardioGroup offers, shifts all risk to the HCP. This leaves HCPs uneasy and with a load of responsibility to ensure POC testing is sustainable. A doctor-centred business model should be developed. HCPs mention financial risks as one of the major barriers of entry. A business model reducing risk for the HCP might increase adoption. Looking toward the future of businesses, a platform-based business

may serve KardioGroup well. Making use of such a business model leverages a network in order to create a valuable ecosystem. KardioGroup could sell the POC devices, but allow practitioners to use the software free of charge. Creating a platform on this software where practitioners can connect and share valuable insights on patient management might give KardioGroup a valuable ecosystem. A proposed new business model canvas can be seen in Appendix D. In the words of Marshall Van Alstyne, “It is easier to introduce technology to a community; than to introduce a community to technology” (Accenture South Africa, 2017, 30:09).

6.4 Suggestions for future research

This research was an exploratory study done to gather insights on POC testing in private practice. Although the research confirmed much of what the literature had stated, more research is needed on POC testing in the private healthcare sector of South Africa. This research was conducted in Gauteng only. A broader geographical sample might provide different results.

Novice researchers conducting qualitative studies might need to conduct pilot studies to test their instruments, and ensure that they capture the data needed. During this study, it was noted early on that some participants were providing ‘yes’ and ‘no’ answers, rather than describing their experience. This may have been in part due to the lack of experience in conducting interviews, and the structure of the questions posed to participants.

This research indicated that POC testing might be beneficial in pandemics that limit social interaction, such as COVID-19. Research focusing on COVID-19 and POC testing could be conducted to uncover the various benefits POC testing can offer during such a pandemic. Furthermore, due to the challenges that COVID-19 posed in this study, a study conducted in a less pressured environment may produce different results.

This research asked participants what they believed may be barriers of entry for POC testing in the private healthcare sector of South Africa. These responses came from HCPs currently using POC testing. It would be beneficial to investigate why HCPs are not implementing POC testing by gathering data from HCPs who do not use these devices. This will create a better understanding of the factors affecting implementation.

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APPENDIX A

Data collection instrument

5 Interview Topic Guide

Improved chronic patient outcomes

1. What beliefs do you have regarding POC testing at a primary care level?

Benefits other than therapeutic

2. What benefits, other than therapeutic are you experiencing from utilising POC testing?
    a. Prompts:
        i. Financial
        ii. Practice efficiency
        iii. Satisfaction

Reimbursement model

3. Are you happy with the current reimbursement model?
    a. Prompts:
        i. Problems with reimbursement
        ii. Resistance from medical aid
        iii. Patients refusing to pay

Factors that influenced HCPs to implement POC testing

4. What factors influenced you to implement POC testing in your practice?
    a. Prompts:
        i. Benefits of POC testing
        ii. Financial gain from POC testing
        iii. Improved practice workflow
        iv. Patient satisfaction

APPENDIX B

Ethics Clearance Certificate

Graduate School of Business Administration
University of the Witwatersrand, Johannesburg

Wits Business School Ethics Committee
Constituted under the University Human Research Ethics Committee (Non-Medical)

Ethics Clearance Certificate

Ethics protocol number: WBS/BA537137/493
This certificate is only valid with a legitimate ethics protocol number and signed by the Researcher (below).

This certificate is only valid if accompanied by formal permission from the relevant stakeholder(s).

Project title	Healthcare professionals' experiences in private practice of point-of-care testing for diabetic patients in Gauteng
Investigator / Researcher	Mr Sumesh Ghirdari
Nature of Project	MBA (Research Article)
Decision of the Committee	Approved, provided stakeholders and participants are guaranteed confidentiality.
Issue Date of Certificate	2021-03-24
Expiry date	Date of submission of the project report
Chairperson	Prof Anthony Stacey ☎ +27 11 717 3587 +27 82 880 4531 Anthony.Stacey@wits.ac.za

Declaration by Researcher

One copy must be signed by the Researcher and returned to the Chairperson of the Wits Business School Ethics Committee.

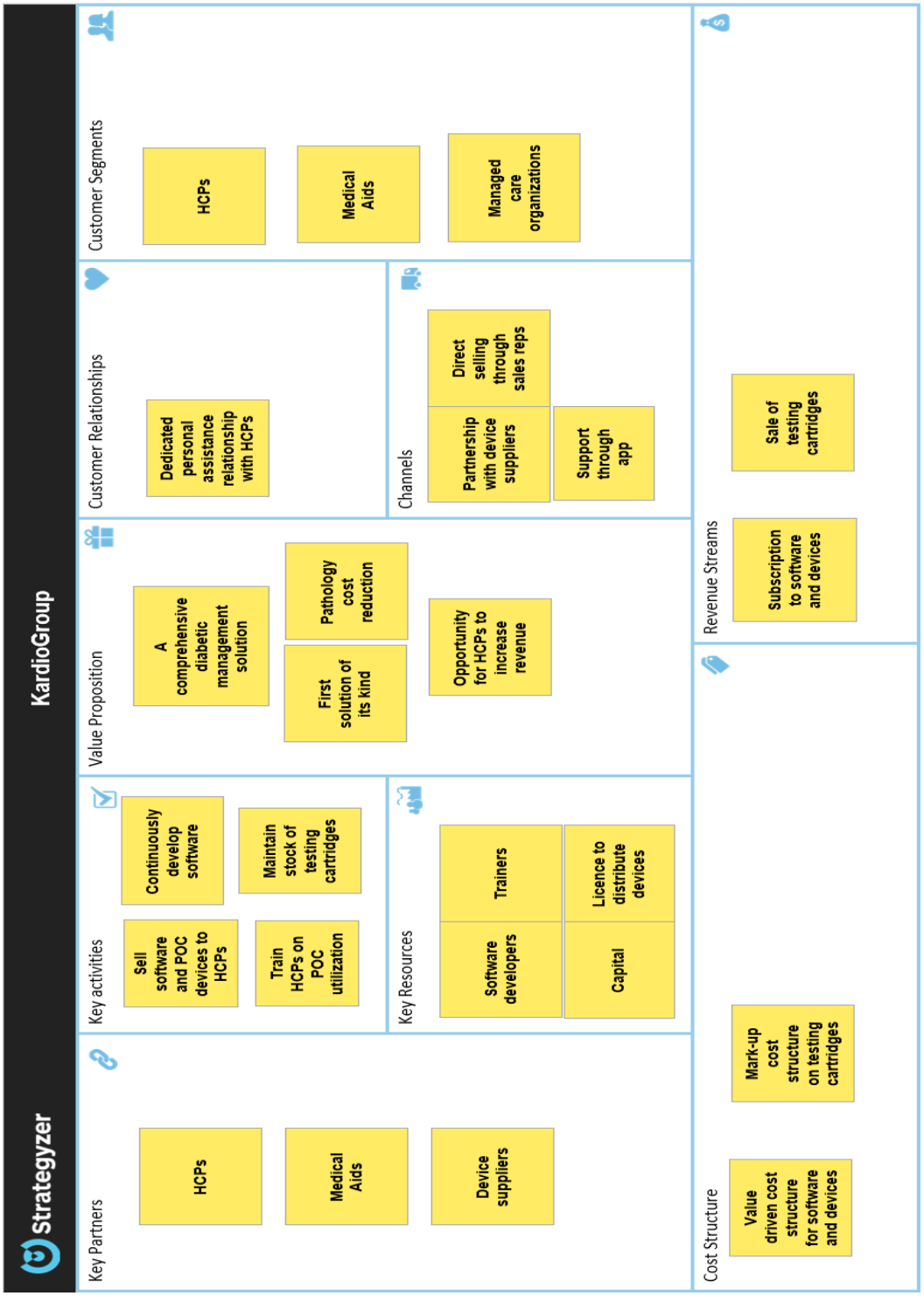
I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I undertake to resubmit the protocol to the Committee.

Sumesh Ghirdari
Signature

28 April 2021
Date:

APPENDIX C

KardioGroup's Business Model



APPENDIX D

KardioGroup's New Proposed Business Model