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Expanding and Enhancing Medical Testing Laboratories in rural areas of South Africa

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Expanding and Enhancing Medical Testing Laboratories in rural areas of South Africa.

Tshifhiwa Tshavhungwe

2432593

A business venture proposal project 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, 2024

Supervisor: Dr McEdward Murimbika

Ethics protocol number: WBS/BA2432593/135

DECLARATION

I, Tshifhiwa Tshavhungwe, hereby declare that this business venture report for the (MBA) in (Health- Medical Laboratory) submitted to the (Commerce, Law, and Management) at the University of Witwatersrand has not been submitted previously for any degree at this or another university. It is original in design and in execution, and all reference material contained therein has been duly acknowledged.

Student: **Tshifhiwa Tshavhungwe** **Date: 31 Mar 2024**

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I owe a debt of gratitude to my family, especially my kids for allowing me to steal their time for my studies, and for their unwavering support through my MBA journey, and my husband for his understanding.

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To God be the Glory- For: I can do All Things Through Christ Who Strengthens me (Phillipians 4:13, KJV).

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- ✓ **Executive Summary**
- ✓ **References**
- ✓ **Appendices**

Table of Contents

DECLARATION i
Acknowledgement: ii
DOCUMENT INFORMATION iii
Table of Contents iv
LIST OF TABLES AND FIGURES vi
Executive Summary: vii
1. Introduction: Current Medical Testing Laboratory Situation 1
1.1 Overview 1
1.2 Background 1
1.4 Context of the study 2
1.5 Business Opportunity 4
1.6 Justifications for the business venture 5
1.7 Scope of the Business Venture 5
1.8 Structure of the proposal 6
1. Business Literature Review 7
2.1 Introduction 7
2.2 Industry Overview 7
2.3 The Market and Opportunity 8
2.4 Identification of business opportunity gaps. 11
2.5 Relevant Theories and Models 15
2.6 Regulatory Environment 19
3. Methodology 22
3.0 Introduction 22
3.1 Research Approach 23
3.2 Research Paradigm 23
3.3 Research design 24
3.4 Population and Sampling 24
3.5 Data collection 26
3.6 Data Analysis Techniques 28
3.7 Ethical Considerations 29
Results Analysis and Interpretation 31
4.0. Introduction 31
4.1 Data screening 31
4.2. Sample Characteristics/ Demographic 32
4.3 Descriptive statistics 34

4.4 Validity 38
4.5 Reliability 40
4.6 Hypothesis testing 41
5. Business Venture Proposal 46
5.1 Executive Summary 46
5.2 Basic Business Information 49
5.3 Strategic Analysis 50
This business venture positioning statement is the dedication to bringing high-quality medical laboratory services to the heart of rural communities of Vhembe with the mission to ensure that the underserved community has access to timely and accurate medical diagnostic testing, for improved healthcare outcomes. 51
5.4 Market Analysis 51
5.5 Marketing Mix 53
The marketing mix outlines the strategies for product, price, place, and promotion: 53
5.6 Situational Analysis (environmental, industry, and competitor analysis) 57
5.6 Research and Development (R&D) 59
5.7 Management and Organisation 60
5.8 Business Financials 60
6. CONCLUSION 67
Appendices:..... 74
Appendix 1: Appendix 5: Survey Questionnaire form 74
Appendix 2: Questionnaire Results Spreadsheet 76
Appendix 3: Risk Analysis 77
Appendix 4: Projected Market related Year One Cost Estimates 79
Appendix 5: Sales Forecast 80
Appendix 6: Summary of Ratios 81
Appendix 7: Suppliers reagents costs catalogues 83
Appendix 8: Discovery Test price Spreadsheet 87
Appendix 9: Approval Letters 99
(Limpopo Department of Health, Vhembe District Department of Health, Elim, Donald Fraser, Louis Trichardt, Malamulele, Musina, Siloam and Tshilidzini. 99
Appendix 10: Ethics Documents 108

LIST OF TABLES AND FIGURES

Title	Number	Page No.
NHLS National Footprint	Figure 1	9
Research Variables	Figure 2	15
The Lean Startup Methodology	Figure 3	17
The WHO Health System Building blocks Frameworks	Figure 4	19
The Overall Research Strategy	Figure 5	28
Hospital Represented	Figure 6	32
Profession	Figure 7	33
Scree Plot	Figure 8	39
Histogram of regression residuals	Figure 9	43
Scatter plot of residuals	Figure 10	44
SWOT Analysis	Figure 11	56
Company Organogram	Figure 12	58
Notable Variables	Table 1	14
Years of laboratory usage experience	Table 2	33
Testing Accessibility-Descriptive Statistics	Table 3	34
Resource Accessibility-Descriptive Statistics	Table 4	35
Sample Referral-Descriptive Statistics	Table 5	36
Sample Transportation-Descriptive Statistics	Table 6	37
TAT- Descriptive Statistics	Table 7	37
KMO and Bartlett's Test	Table 8	38
Total Variance Explained	Table 9	39
Final Factor Composition	Table 10	40
Reliability of scale	Table 11	41
Descriptive statistics and Pearson's Correlation	Table 12	42
Regression Coefficients	Table 13	43
Model Summary	Table 14	44
ANOVA	Table 15	45
Hypotheses Summary	Table 16	45
PESTEL Analysis	Table 17	56

VRIO Analysis	Table 18	59
Income Statement	Table 19	63
Balance Sheet	Table 20	64

Executive Summary:

This venture aims to establish medical laboratories in underserved rural areas of Vhembe district in Limpopo, South Africa in order to address the critical need for enhanced healthcare services in rural areas of South Africa. With a population of 1,653,077, Vhembe has about eight private labs in semi-urban areas, along with public hospital laboratories. The venture proposal is driven by the recognition of significant challenges faced by rural communities, including limited access to diagnostic testing facilities and prolonged turnaround times for test results.

Limited access to laboratories impacts healthcare outcomes significantly (CDC, 2018). Healthcare laboratories aim to address this gap by providing advanced diagnostic services.

The proximity of our labs to rural communities improves Turnaround Time (TAT) significantly, a crucial performance indicator for laboratories (Cassim et al., 2020). Local laboratories minimise reliance on external facilities, reducing transportation costs and logistical challenges as well as the need for sample referral which in turn improves TAT. This improves healthcare accessibility and streamlines diagnostic services (Coetzee et al., 2022).

Vision

To establish and expand medical testing laboratories in rural areas to improve access, diagnostic capabilities, and healthcare outcomes for underserved populations.

Mission

To bridge the gap in healthcare services by providing timeous, convenient, accessible, affordable, and reliable diagnostic testing options in remote locations and communities.

Objectives

Expanding access by establishing modern medical testing laboratories in underserved rural areas and enhancing healthcare outcomes by ensuring quick turnaround times for accurate and timely diagnostic testing.

Current state of the business

The venture aims to establish medical laboratories in rural areas of Vhembe, South Africa to improve healthcare outcomes by providing timely and accurate diagnostic services, thus addressing the unmet demand for diagnostic testing services in these underserved regions.

Products and Services

The venture offers diagnostic testing services of high quality and affordable, including laboratory tests for various medical conditions.

Strategy and sources of sustainable competitive advantage

The venture's strategy revolves around leveraging its first-mover advantage in establishing medical laboratories in rural areas.

Customer acceptance

The venture anticipates strong customer acceptance due to the pressing need for improved healthcare services in rural areas.

Summary Financial Forecasts

The financial forecast includes projections for revenue growth over five years.

Projected revenues Year1	**R1 995 600**
Projected revenues Year2	**R2 676 000**
Projected revenues Year3	**R3 439 080**
Projected revenues Year4	**R4 234 320**
Projected revenues Year5	**R4 988 640**

Money required.

The venture seeks R1,000,000 to establish medical labs in Vhembe District within 18-24 months to expedite the setup process and capitalize on the market demand.

CHAPTER 1: PROBLEM DESCRIPTION

1. Introduction: Current Medical Testing Laboratory Situation

1.1 Overview

Diagnostic testing labs are essential for medical decisions, with 70% relying on test results (CDC, 2018). Yet, many South African rural areas lack quality labs, impacting health outcomes. Establishing labs in these areas could improve turnaround time (TAT), accuracy, disease surveillance, and care quality, leading to better health outcomes. In South Africa, quality healthcare is a constitutional right, and essential for all citizens, regardless of location or socio-economic status (SA Department of Health, 2021).

1.2 Background

According to CDC (2018), for disease prevention as well as timely effective disease diagnosis, treatment, and control, medical testing laboratory services are a key component of the health system. However, remote areas often lack laboratories, leading to samples being sent long distances, affecting turnaround time (TAT) and result integrity.

This can hinder timely treatment and contribute to underdiagnosis and misdiagnosis, impacting morbidity and mortality (Moran et al., 2019). Establishing more labs in rural areas improves access, TAT, patient care, and efficiency (Mabuza et al., 2020). This study also found that patients in rural areas had to travel long distances to access laboratory services, which led to delays in diagnosis and treatment.

Establishing more private medical laboratories in rural areas will also be in support of upcoming South Africa's National Health Insurance (NHI) program.

1.3 Purpose of the study

The main purpose and objective of this business venture proposal is to expand and improve medical testing labs in rural areas of Vhembe district in Limpopo, SA. The proposal aims to assess the feasibility of establishing innovative diagnostic labs in remote areas to enhance diagnostic services and healthcare outcomes, this is also aligned with the upcoming NHI program.

Using the Lean Start-up methodology, the plan focuses on establishing labs one at a time to analyse sustainability in remote areas. Lack of affordability is a key reason for fewer laboratories in these areas. The venture plan aims to seek venture capital from Angel investors and institutions like the Industrial Development Corporation of South Africa (IDC) to realize the plan.

1.4 Context of the study

Namahumi et al. (2021) highlight a surge in demand for laboratory testing services to manage both diseases over the past decade. This trend is evident in South Africa, where the NHLS laboratories in rural areas experience high work volumes from surrounding clinics and public hospitals, resulting in significant pressure and fatigue among staff due to staffing issues.

The South African government has since embarked on the establishment of the National Health Insurance (NHI) after publishing the Green Paper with NHI proposal in 2011 in alignment with Universal Health Coverage (UHC) as advocated by the World Health Organization (WHO) and the United Nations. UHC aims to improve healthcare accessibility without necessarily implying an increase in insurance coverage (World Health Organization, 2013).

The NHI rollout is phased by the SA government, with a total duration of 14 years, aiming for full functionality by 2026. Once implemented, the NHI will grant all South Africans access to affordable, high-quality healthcare services, regardless of their socio-economic status. Private practitioners and hospitals will be obliged to treat referred patients and claim compensation from the NHI, a strategy facilitated by risk pooling and

fund management (Department of Health, 2020). Consequently, the anticipated rise in healthcare accessibility may lead to increased demand for private medical laboratories, especially in underserved rural areas.

The benefits of establishing more clinical laboratories in rural areas include:

Improved access to diagnostic services: By having private laboratories locally, healthcare providers can easily order and receive test results, enhancing the quality and timeliness of patient care.

Enhanced patient care: Access to local medical testing enables quicker and more accurate diagnosis and treatment of infectious diseases, potentially leading to better outcomes for patients.

Increased efficiency: Local medical testing reduces the need to send samples to distant laboratories, saving time and resources for healthcare providers and patients. This results in shorter turnaround times for test results, improving patient care and potentially increasing survival rates.

Economic development: Establishing private laboratories creates jobs and stimulates economic activity, improving the overall quality of life in small towns and rural areas. These jobs include laboratory technicians, pathologists, phlebotomists, clerks, drivers/couriers, and cleaners, contributing to local employment and economic growth.

The NHLS, a public health laboratory service with facilities nationwide (NHLS intranet, 2024), primarily serves the rural population in Vhembe. Siloam, Elim, and Tshilidzini are examples of district, medium-sized, and regional NHLS laboratories, respectively. According to the Laboratory Specific Procedures documents (GPL 3974v11, GPL 3942v18, GPL 2523v16) and presentations from the Laboratory Manager's Management Review Meeting 2023, Siloam operates with six staff members and serves 16 clinics and 15 hospital wards, with a workload of approximately 17,000 tests per month. Elim operates with 10 staff members, serving 15 hospital wards and 32 clinics, with a monthly workload of approximately 20,000 tests. Tshilidzini Regional Laboratory, the largest, operates with 12 staff members, serving 38 clinics and 16 wards, with a monthly workload of approximately 30,000 tests.

These statistics indicate the need for more laboratories near healthcare clinics to streamline transport and referral logistics and improve turnaround time (TAT) and healthcare outcomes. Additionally, establishing these laboratories would create employment opportunities for skilled and non-skilled workers.

1.5 Business Opportunity

Limited access to medical testing laboratories in rural areas significantly impacts healthcare outcomes, as these facilities are crucial for diagnosis, treatment, and disease prevention (CDC, 2018). Vhembe district, with a population of 1,653,077 people, has only eight private laboratories, mainly located in semi-urban areas, leaving underserved regions without nearby facilities (Stats SA, 2022).

The rural nature of Vhembe poses challenges in accessing health services due to distance and time barriers (Vhembe Health District disease profile, 2015). Despite having six district hospitals, one regional hospital, and 116 clinics, rural residents still face limited access to laboratory services (Vhembe District Municipality profile, 2020).

Studies indicate that the lack of rural laboratory services leads to poor health outcomes and high mortality rates, with patients often traveling long distances for diagnostics (Mabuza et al., 2020). Timely medical treatment is hindered by unreliable diagnostics, contributing to underdiagnosis and increased morbidity and mortality (Moran et al., 2019).

The most crucial performance indicator for laboratories is Turnaround Time (TAT), as delays in results release lead to delayed diagnosis and treatment, impacting patient outcomes (Cassim et al., 2020). Insufficient rural laboratories exacerbate TAT delays, affecting disease monitoring and prevention efforts.

The gaps identified present opportunities for establishing and expanding rural laboratories:

Limited Access to Diagnostics: Rural areas lack medical labs, causing delays in treatment. More labs can improve access.

Improved Healthcare Outcomes: Remote labs can lead to better diagnoses and treatments, reducing morbidity and mortality.

Samples Referral and Turnaround Time: Rural labs can reduce transportation delays, ensuring faster results and treatment.

Increasing NHI Demand: NHI implementation will increase demand for rural labs, providing equal access to healthcare.

Establishing more medical laboratories in rural areas like Vhembe can improve access to diagnostics, enhance TAT, and reduce morbidity and mortality rates. This can ensure quality healthcare, lower healthcare costs, and create job opportunities.

1.6 Justifications for the business venture

Medical laboratory services are invaluable, analysing submitted patient samples, and undertaking medical tests to determine much-needed health care decisions.

Establishing more medical laboratories in rural areas improves healthcare accessibility and quality by reducing TAT for diagnostic testing. In South Africa, where quality healthcare is a constitutional right, limited access to medical facilities persists, hindering timely diagnoses and treatments.

By establishing local labs, patients and healthcare practitioners gain easy access to testing services, leading to more precise diagnoses and effective treatments, especially for infectious diseases. This also reduces the need for sample transportation and referral to distant labs, saving time and resources.

1.7 Scope of the Business Venture

This venture proposal aims to establish and expand medical testing laboratories in Vhembe rural areas to improve diagnostic capabilities and healthcare outcomes. Addressing the limited access to medical testing facilities in this underserved region is a priority, aiming to enhance healthcare services within the Vhembe district.

The strategy involves starting with a pilot laboratory project in one area, collaborating with local healthcare providers, and incorporating iterative improvements based on feedback. The revenue model will focus on service fees, partnerships, and potential collaborations with insurance schemes.

Overall, the goal is to establish sustainable medical testing laboratories in rural areas, ensuring better diagnostics and healthcare outcomes for underserved populations through quality results and quicker turnaround times.

1.8 Structure of the proposal

This research proposal focuses on the Vhembe district in Limpopo and involves detailed formal surveys distributed to public healthcare practitioners in Vhembe public hospitals. The data collected will determine the market perception and the need for more laboratories in rural areas.

Assumptions

This study assumes that the respondents:

- have experience working in remote areas and are familiar with the challenges,
- have knowledge and experience working with medical laboratories and understand the importance of diagnostic services for healthcare delivery,
- have access to the necessary technology and infrastructure to complete the survey questions.

Summary:

This proposal section outlines the status of medical testing labs in rural South Africa, with a focus on the Vhembe district. It underscores the significance of diagnostic facilities in healthcare decision-making and highlights challenges like limited access leading to prolonged turnaround times and compromised sample integrity. The proposal aims to explore establishing innovative diagnostic labs in Vhembe, using the Lean Start-up approach, and seeking venture capital. Through market analysis and assessing healthcare practitioners' needs, it aims to address gaps in lab services,

improve access, enhance healthcare outcomes, reduce costs, and create jobs. Ultimately, establishing labs in underserved areas could bridge healthcare disparities and improve overall population health.

CHAPTER 2:

1. Business Literature Review

2.1 Introduction

This chapter anchors the business proposal of establishing more medical testing laboratories in remote areas to improve diagnostics and quality healthcare. The discussion is on the inadequacy of medical diagnostic laboratories in small towns and rural areas, as well as on the importance of these laboratories in improving diagnosis and healthcare outcomes.

The literature review looked at previous studies done on how access to diagnostic (Including medical testing laboratories) is poor and inequitable in rural areas despite it being central to health care, and how improving this can promote timeous diagnosis and treatment resulting in improved healthcare outcomes by preventing or reducing morbidity and mortality.

Patient care quality improvement through better diagnostic testing presents an opportunity to boost efficiency, lower costs and reduce delays in preventative care, (Indwe Risk Services, 2022). This was evidenced by HIV testing success in the past and, with COVID testing recently.

2.2 Industry Overview

In South Africa, we have the National Health Laboratory Services (NHLS), the state-owned enterprise, that is in every government hospital to service the majority of the South African population. We also have private labs, with the big three (Ampath, Lancet

& Pathcare) mostly located in or next to Private Hospitals to service private clinicians and their patients. There are also a few other established private laboratories in and around busy towns that are also targeting private doctors and patients.

In Vhembe district of Limpopo province, we have LLM laboratory in Makhado (Louis Trichardt), and Capricon diagnostix medical laboratory in Thohoyandou; Lancet laboratory is in Malamulele, Musina, Louis Trichardt and Thohoyandou, while Ampath is in Louis Trichardt and Thohoyandou, and has only a depot in Musina for sample collection and referral.

All these laboratories use the same referral method, they do have drivers who use either scooters and mostly vehicles to fetch samples/ specimens from the surrounding clinics/ health facilities, doctors, or clinicians' rooms and deliver them to referral laboratories for analysis.

2.3 The Market and Opportunity

Specifically looking at the Vhembe region, there are a few private laboratories as compared to its population as indicated above, with all of them located in the same areas of busy small towns. This seems to be an indication of a need for the establishment of more private medical laboratories in this region to service and improve the healthcare outcomes of this underserved population.

Vhembe is a district situated in the Northern part of Limpopo Province and consists of four local municipalities, namely, Collins Chabane, Makhado, Musina, and Thulamela with eight hospitals situated across the district.

In terms of population size, Vhembe District has a total of 1 653 077 people, with 130 899 residing in Musina, 443 798 in Collins Chabane, 502 452 in Makhado, and 575 929 in Thulamela. Thulamela is the most populated municipality in the district, while Musina LM is the least. (Stats SA, 2022).

Regarding public health facilities, the district has a total number of six district hospitals, one regional hospital, and 116 clinics providing comprehensive health care services to communities. (Vhembe district municipality profile, 2020). SA government had divided

the rolling out of NHI into three phases, with five years allocated for the first and second phases, and four years for the last phase, adding up to a total of 14 years with NHI expected to be functional in 2026. The implementation of the National Health Insurance (NHI) in South Africa will mean that all South Africans irrespective of their socio-economic status but based on their health needs, will have access to private affordable quality personal health services. Private practitioners and private hospitals will be expected to attend and treat all referred or presenting sick patients and claims from the NHI which aims to achieve this through pooling of risks and funds (Department of Health, 2020). This will potentially increase the demand for more private medical laboratories in small towns and rural areas.

The below figure illustrates how big the SA population is and the pressure that the NHLS is dealing with currently as the only state laboratory due to the socio-economic issues which only result in the minority being able to afford private laboratory services. The NHLS is currently servicing close to 80% of the population, with the private laboratories servicing the remainder of the population. When NHI gets implemented, all health care workers, including private laboratories will be available to provide equal quality services to all needing it.

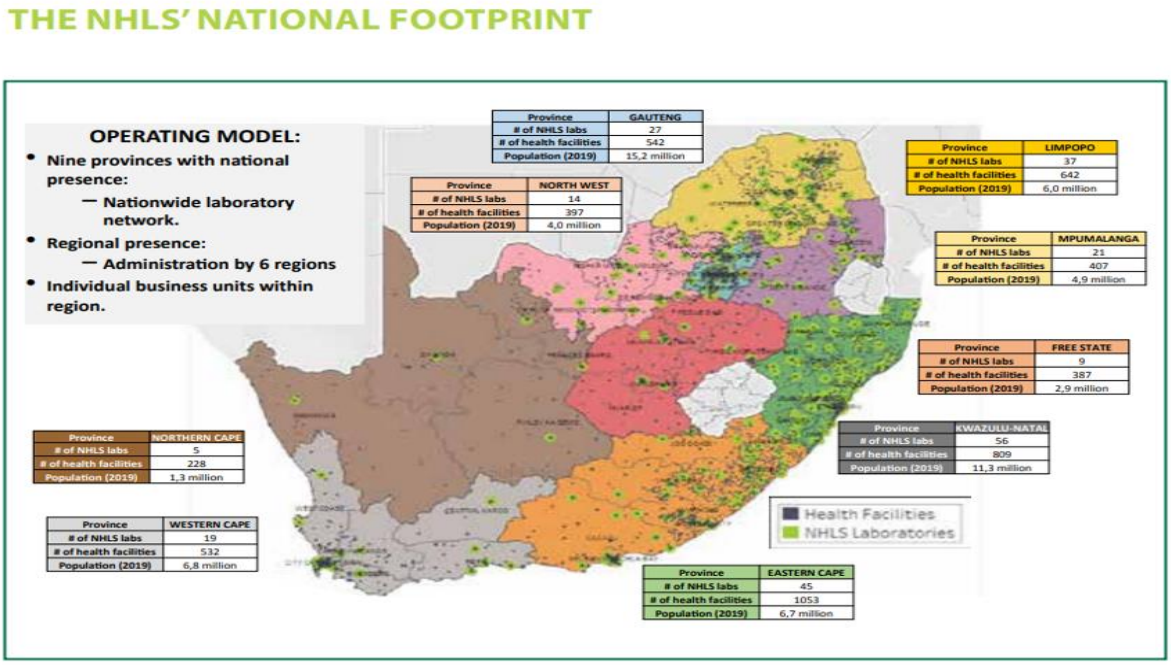


Figure 1: Retrieved from NHLS 2021/2022 Annual report.

Rural areas such as Vhembe district, often face challenges in accessing healthcare services due to geographical barriers and limited infrastructure which results in unmet healthcare needs.

The population in Vhembe District, as indicated by Stats SA, is substantial, yet only a few private laboratories are serving the area. This indicates a potential gap in healthcare services that could be addressed by establishing more laboratories.

The medical diagnostic services are being driven by the rising burden of chronic disease, with more than USD 35 Billion Laboratory market expected by 2029. This is because of the crucial role that laboratories play in the early detection of these chronic conditions, including management and monitoring thereof (Bonafide Research, 2024). This growth presents a lucrative opportunity for investment in medical laboratories, particularly in underserved rural areas where demand is high, and competition is relatively low.

From the literature review, it becomes evident that there is a significant business opportunity in establishing more medical testing laboratories in the rural areas of the Vhembe region.

While there is a clear market demand and potential for establishing more medical laboratories in rural areas like Vhembe, various challenges such as inadequate funding, lack or shortage of skilled personnel, inadequate laboratory infrastructure and resources, and logistical challenges (Mphatswe et al., 2018; Akintola, 2015; Lehmann et al., 2019), need to be addressed to fully tap into this opportunity and improve healthcare access and outcomes for underserved populations.

Studies have shown that the establishment of medical testing laboratories in rural areas can improve healthcare outcomes. For example, a study by Matsoso and Fryatt (2016) on the impact of diagnostic laboratories on the quality of healthcare in South Africa found that the establishment of diagnostic laboratories in rural areas led to improved healthcare.

2.4 Identification of business opportunity gaps.

Limited Access to Diagnostic Services:

Several studies have shown that healthcare inequalities in South Africa led to poor health outcomes, and high morbidity, and mortality rates (Barron et al., 2018; Keikelame et al., 2019).

A study by Mabuza et al. (2020) found that the lack of laboratory services in rural areas in South Africa led to poor health outcomes, including high mortality rates; and that patients in rural areas had to travel long distances to access laboratory services, which led to delays in diagnosis and treatment.

A study by Moosa and Reid (2016) on the state of health services in rural South Africa found that most rural areas lacked adequate healthcare facilities, resulting in limited access to health services.

A study by Moran et al. (2019) also indicated that timely medical treatment in resource-limited settings can be hindered by not having access to reliable diagnostics, this could result in under-diagnosis and misdiagnosis of diseases which contributes to morbidity and mortality and morbidity.

A study by De Jager et al. (2019) found that rural areas in South Africa had a limited number of medical testing laboratories, and the quality of services provided was suboptimal.

The literature review highlights the inadequate access to medical diagnostic laboratories in rural areas, leading to delays in diagnosis and treatment. There is an opportunity to address this gap by establishing more medical testing laboratories in rural areas to improve access to diagnostic services for the local population.

Improved Healthcare Outcomes:

Several studies have shown that the establishment of medical testing laboratories can improve healthcare outcomes, including timely diagnoses and effective treatment (Jegede et al., 2018; Madiba & Mokgatle, 2016).

A study by De Jager et al. (2019) also found that the lack of laboratory services in rural areas led to delays in diagnosis and treatment, which resulted in poor health outcomes.

A study by Matsoso and Fryatt (2016) on the impact of diagnostic laboratories on the quality of healthcare in South Africa found that the establishment of diagnostic laboratories in rural areas led to improved healthcare outcomes and reduced healthcare costs. Other studies by Blaauw et al. (2018); Lehmann et al. (2019); Mulaudzi et al. (2017) have shown that rural areas have limited access to healthcare services, including medical testing laboratories. This has resulted in delayed diagnoses and inadequate treatment, which can lead to adverse health outcomes.

The literature review suggests that the establishment of medical testing laboratories in remote areas can lead to improved healthcare outcomes, including timely diagnoses and effective treatment. There is an opportunity to capitalize on this by expanding or establishing more medical testing laboratories in rural areas to enhance healthcare outcomes and reduce morbidity and mortality rates.

Resource Accessibility: (including funding, infrastructure, personnel, equipment, and supplies).

Access to quality healthcare services in remote areas in South Africa is significantly affected by inadequate healthcare facilities and medical equipment. Studies have highlighted the shortage of healthcare facilities, limited medical equipment, and inadequate infrastructure as major obstacles to quality healthcare provision in these areas (Moosa & Reid, 2016; Smith & Burger, 2018).

Several challenges have been identified that may hinder the establishment of medical testing laboratories in small towns and rural areas in South Africa. These challenges include inadequate funding, lack or shortage of skilled personnel, inadequate laboratory infrastructure and resources, and logistical challenges (Mphatswe et al., 2018; Akintola, 2015; Lehmann et al., 2019). These studies have shown that addressing these challenges is crucial for the successful establishment of medical testing laboratories.

In addition, a study by Miot et al. (2017) found that the quality of medical equipment in rural areas of South Africa was often substandard, resulting in inaccurate diagnoses and treatment.

A study by Naidoo et al. (2021) found that the lack of funding for laboratory infrastructure and equipment was a significant barrier to the establishment of medical testing laboratories in rural areas in South Africa. The study also found that the lack of trained personnel and inadequate regulatory frameworks were additional challenges.

However, despite the numerous challenges, some studies have shown that the establishment of medical testing laboratories in rural areas can improve healthcare outcomes. For example, a study by Matsoso and Fryatt (2016) on the impact of diagnostic laboratories on the quality of healthcare in South Africa found that the establishment of diagnostic laboratories in rural areas led to improved healthcare outcomes and reduced healthcare costs.

There is an opportunity to address these challenges by providing the necessary resources and infrastructure support to enable the successful operation of medical testing laboratories in rural areas.

Samples Referral, Transportation, and Turn Around Time:

As indicated by Driessen et al. (2015), a source of laboratory test results delays is usually due to delays in the pre-analytical phase. This is usually due to delays in transportation logistics when samples are being referred from the collection to the testing laboratory.

TAT, which is the time from the sample registration in the laboratory to the release of results of that sample, is the most important performance indicator for a diagnostic testing laboratory service (Cassim et al., 2020). Shortened TAT will be the variable measured for closer access to diagnostics due to the establishment of laboratories in rural areas. These will in turn mean timeous diagnosis, prevention, and monitoring of disease. According to the study done by Coetzee et al. (2022), TAT of samples registered and tested at the same laboratory as seen when CD4 was being processed and tested at the same newly implemented Tswaragano laboratory, was shorter or quicker as compared to when the sample gets referred to another far laboratory for testing.

Delays in sample referral and transportation contribute to longer turnaround times for diagnostic test results. Establishing more medical testing laboratories in rural areas can

help reduce transportation delays and improve turnaround times, leading to faster diagnoses and timely treatment for patients.

Quality Management System and Accreditation:

One important thing to consider and implement as per WHO (2016) comprehensive health system framework for establishing medical testing laboratories is a Quality Management System that includes quality control and quality assurance procedures. This is to ensure accuracy and reliability of test results. Accreditation is linked to periodical audits, to stimulate improvement and maintenance of QMS, which leads to a high standard of health service delivery.

The literature review emphasizes the importance of implementing a quality management system and obtaining accreditation for medical testing laboratories. There is an opportunity to establish accredited laboratories in rural areas, ensuring the accuracy and reliability of test results and enhancing the quality of healthcare services provided.

The below Table 1 consist of notable variables as per prior research insights:

Type of Variable	Name of Variable	Reference
Independent	Diagnostic testing accessibility	CDC (2018). SA Department of Health (2021). Mabuza et al. (2020).
	Resource accessibility (including funding, infrastructure, skilled personnel, equipment, and supplies).	Mphatswe et al. (2018) Akintola A. (2015) Lehmann et al. (2019) Miot et al. (2017) Naidoo, et al. (2021) Smith & Burger (2018)
	Samples referral	Cassim et al. (2020) Coetzee et al. (2022) Driessen et al. (2015)

	Sample transportation	Cassim et al. (2020) Coetzee et al. (2022) Driessen et al. (2015);
Dependent	TAT	Cassim et al. (2020); Coetzee et al. (2022).

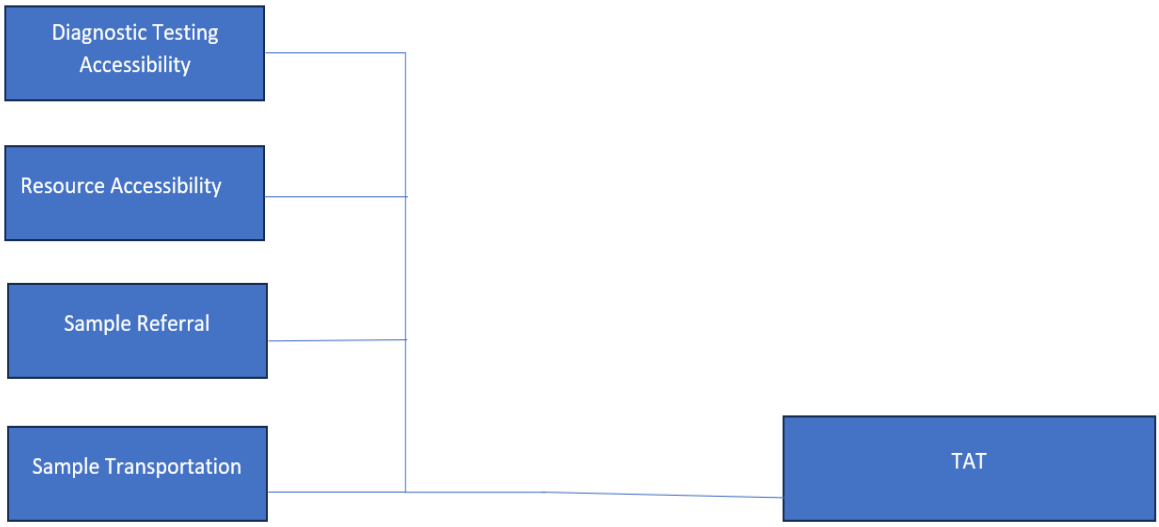


Figure 2: Research variables: Source- Researcher.

2.5 Relevant Theories and Models

2.5.1 Lean Start-up method:

To guide the final business venture proposal, and to validate the need for more medical testing laboratories in underserved areas, a lean start-up method will be utilised. This is the concept that around 2010, evolved into a methodology. It was developed by Steve Blank and Eric Ries who were Silicon Valley entrepreneurs, with early adopters including CTO Rob Fana and Sharethrough co-founder promoting it.

This methodology emphasizes the importance of prototyping, testing, or experimenting with new ideas, gathering feedback from customers, and iterating quickly to improve the product or service. It will be applied to test out this minimum viable product (MPV)

of new laboratories in remote areas by gathering feedback from potential customers such as healthcare workers.

As per Blank (2013), lean start-up founders begin with the search for a business model and not with a business plan. The emphasis is on experimentation rather than elaborate planning, customer feedback instead of intuition, and iterative design over the development of traditional up-front designs. They focus on execution only after a model that works is revealed after quick rounds of experimentation and feedback.

For instance, in a study by Sinha (2017), the author highlighted that the Lean Startup methodology is a novel approach to the management of healthcare delivery organisations. The study suggested that healthcare providers can use this methodology to identify customer pain points, test out potential solutions, and develop innovative approaches to improve healthcare delivery. Additionally, a Deloitte report (2019) demonstrated how the Lean Startup methodology can be used to enhance healthcare innovation. The report suggested that the methodology can be used to reduce the risk of innovation failure, increase the speed of innovation, and improve overall innovation outcomes.

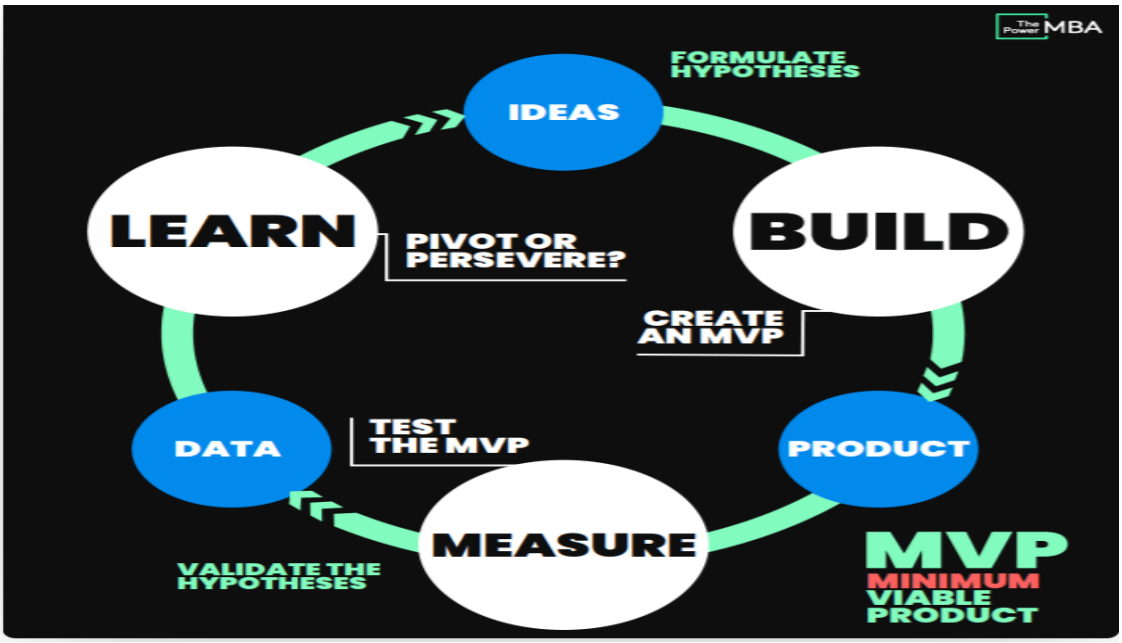


Figure 3: The Lean Startup Methodology Cycle: 4 Steps to Risk-Free Success; Source: The Power Business School.

For the strategic development of this proposal study, lean start-up will be applied through the Business Model Canvas, which as per Heidi et al. (2021), sets out the different building blocks for a new venture on a single page and contains nine key elements broken down into four categories: 1. Offering (value proposition), 2. Customer (customer segments, customer relationships, channels), 3. Financial sustainability (cost structure, revenue streams), and 4. Key drivers (key partners, key activities, key resources).

The nine building blocks of the BMC will be used to sketch the business proposal hypothesis. I will outline the value and the customer problem that the company is trying to solve; identify key partners, resources, and activities; determine how to get, keep, and grow customer relationships; segment customers and understand the most important ones; find out the right channels to reach our customers and determine the ones that are more effective and cost-efficient; determine the business most important costs, most expensive activities and resources; and also determine value that customers are willing to pay by looking at the current price tactics. This will be part of the final business proposal.

2.5.2 The health systems framework was found to be relevant to the study from the health industry as it considers the various components of the healthcare system, including infrastructure, personnel, and funding, and their impact on healthcare outcomes. Establishing medical laboratories in remote areas can be a challenging task, but it is an important step towards reducing health disparities and improving access to healthcare, as such a comprehensive health system framework for establishing such laboratories should consider the following (WHO, 2016):

Assess local healthcare needs, including prevalence of diseases and the types of medical tests required. This can be done either through interviews or surveys with healthcare providers and community members and through data analysis.

Identify available resources including equipment, funding, infrastructure, and personnel. This can be done through partnerships with government agencies, private sector entities, and non-profit organisations.

Establish laboratory infrastructure which includes building or renovating a facility ensuring that it meets the regulatory requirements for accuracy, quality, and safety, and for it to house the laboratory equipment and staff.

Train laboratory personnel on how to use and maintain equipment, and on standard laboratory procedures and safety protocols. This can be provided by service providers, experienced laboratory technicians, or through partnerships with technical schools and universities.

Establish a Quality Management System that includes quality control and quality assurance procedures, this is to ensure accuracy and reliability of test results. This includes calibrating and maintaining equipment regularly as per manufacturer's recommendations, running quality control material regularly as per the recommended frequency, enrolling and conducting proficiency testing, and implementing standard operating procedures (SOPs).

Ensure sustainability by developing a plan for ongoing funding, maintenance, and staffing. This may include partnerships with local healthcare providers, government agencies, or private partners, as well as engaging with local healthcare providers and the community to promote the laboratory's services.

As indicated by Jack and Lazarus (2014), it was in 2007 when the WHO proposed and published a health systems Building Blocks framework to promote a health system common understanding and strengthening factors. The proposed framework conceptualized the healthcare system as consisting of six building blocks, namely: service delivery; health workforce; information; medical products, vaccines, and technologies; financing; and leadership and governance, as well as four process elements: access, coverage, quality and safety, and four outcomes: improved health and health equity, responsiveness, social and financial risk protection and improved efficiency (Figure 1). It was also noted by Jack et al. (2014) that the WHO model is not the only health systems model, but that there are 41other health systems frameworks developed since 1972 that were identified by Hoffman and colleagues with the whole health system encompassed by nineteen of them, while focus of the remainder is either on how societal and health system interacts or on particular parts of the system.

Based on this literature, I am hypothesising that a business venture of establishing medical testing laboratory in rural areas of Vhembe district may be feasible and that the negative perception of building private labs in this area can be addressed if the health system components described above are considered and addressed as suggested.

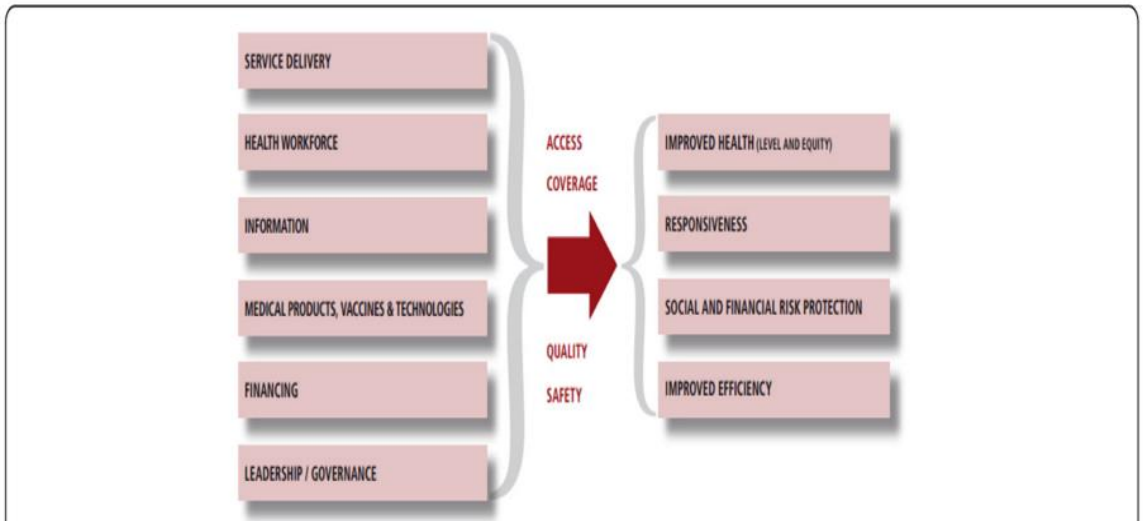


Figure 4: The WHO Health System Building Blocks Frameworks. Source: WHO, 2007

Other strategic conceptual frameworks such as PESTEL for Macro environmental analysis, Porter's Competitive Five Forces Framework for industry and sector analysis, were looked at for business feasibility and they are outlined in detail in Chapter 5.

2.6 Regulatory Environment

The South African healthcare sector is regulated by various Acts and regulations that establish the legal framework for the provision of healthcare services, including medical laboratory services. The first act is The National Health Act of 2003 which sets out the framework for the delivery of healthcare services and regulates the establishment, registration, and licensing of healthcare facilities; The second act is The Health Professions Act, of 1974, which regulates the practice of healthcare professions in South Africa. Any medical laboratory operating in South Africa must employ laboratory personnel who are registered with the Health Professions Council of South Africa (HPCSA), and the third act is The Occupational Health and Safety Act, 1993 sets out the

health and safety standards that employers must comply with to ensure the safety of their employees in the workplace.

These regulations aim to ensure quality, safety, and standardized practices. With the health industry being highly regulated, the perception of the regulatory environment in the rural healthcare sector is positively associated with the demand for private rural health laboratory services as this will ensure quality healthcare service delivery.

Hypotheses from the literature review.

Based on the literature review, it is evident that the establishment of medical diagnostic laboratories in remote areas is crucial for improved diagnostics and quality healthcare. This initiative can significantly enhance turnaround time (TAT) for laboratory test results, eliminating the need for individuals to travel long distances to access laboratory services and reducing the necessity for sample referrals to distant laboratories. Tests conducted locally can result in a quicker TAT, leading to improved healthcare outcomes.

Therefore, from the literature review, the following hypotheses are proposed:

- There is a need to establish more medical testing laboratories in the rural areas of the Vhembe district to improve accessibility to diagnostic services.
- The establishment of local laboratories will lead to a significant improvement in TAT for laboratory test results.
- Increasing accessibility to well-resourced laboratories will decrease the need for sample referral and transportation, consequently improving the efficiency of diagnostic services.
- The reduction in TAT is expected to facilitate timelier diagnosis and early disease treatment, thereby enhancing overall healthcare outcomes for the underserved population in these rural areas.

Healthcare workers from Vhembe public hospitals who utilise laboratories are the participants targeted to test these hypotheses by answering the formulated survey questionnaires.

Summary:

This chapter highlighted the market demand for more medical testing laboratories in rural areas such as Vhembe, presenting a feasible business opportunity. The market and opportunity analysis underscores the need for more private medical laboratories in underserved regions like Vhembe.

The population size of approximately 1.5 million is substantial with only a few private laboratories servicing it (three each in Thohoyandou and Louis Trichardt, one each in Malamulele and Musina), and this indicates a gap and a significant demand for healthcare services, including private diagnostic testing laboratories. Additionally, the impending implementation of the National Health Insurance (NHI) in South Africa presents an opportunity for increased demand for private healthcare services, potentially driving the need for more medical laboratories in rural areas.

To address this identified opportunity, the chapter also provided a comprehensive overview of the strategic framework and theoretical concepts and methods to guide the establishment of medical laboratories in remote areas of Vhembe district in Limpopo. The lean start-up method, along with the Business Model Canvas, was utilised to test the feasibility of the venture and gather feedback from potential customers. The health systems framework was also found to be relevant to this study as it emphasises the need to assess local healthcare needs, identify available resources, establish laboratory infrastructure, train personnel, implement quality management systems, and ensure sustainability.

By considering these strategic frameworks, theoretical concepts, and the regulatory environment, this proposal aims to address the challenges of establishing medical laboratories in remote areas and contribute to reducing health disparities and improving access to healthcare in the Vhembe district.

The previous studies indicated that shortened TAT achieved through closer access to diagnostic services in rural areas can lead to timely diagnosis, disease prevention, and monitoring, ultimately reducing mortality rates. Improved TAT also enhances patient experience by reducing waiting periods for test results, allowing for prompt initiation of treatment.

From the above previous studies, one can see that despite the challenges, the establishment of medical diagnostic laboratories in remote areas is crucial for improved diagnostics and quality healthcare as this can improve TAT significantly. There will be no need for people to travel far to access laboratory services and samples will not need to be referred to far away laboratories. Based on this, I am hypothesising that there is a need to establish more medical laboratories in Vhembe district and that the same benefits of improved and shortened TAT which could lead to a timeous diagnosis, early disease treatment, and diagnosis resulting in improved and quality diagnostic and health outcomes are possible.

Vhembe, being a rural district with limited healthcare accessibility, could greatly benefit from the establishment of medical laboratories to improve diagnostic capabilities and health outcomes.

CHAPTER 3:

3. Methodology

3.0 Introduction

This is the methodology overview chapter which includes sections on the research design, population and sampling, data collection, and data analysis method. The business venture proposal used a literature review and formal questionnaires to obtain data and information for the business venture study. A quantitative research approach was chosen, targeting healthcare practitioners in the public health sector of the rural Vhembe district. A purposive judgmental sampling method was used to select a representative sample, and structured survey questionnaires with a seven-point Likert scale were employed for data collection. The collected data was analysed using descriptive statistics and hypothesis testing with SPSS software. Ethical considerations included obtaining informed consent and ensuring confidentiality. This systematic methodology aims to improve healthcare outcomes and diagnostics in underserved communities.

The viable market was demonstrated by the population of Vhembe district of approximately 1.6 million according to Stats SA, 2022, in comparison to the available eight laboratories that are located in semi-urban areas of Limpopo that are servicing this population together with the public NHLS laboratory. This methodology provided insights into the viability and demand for establishing medical testing laboratories in rural Vhembe. By understanding the perceptions and attitudes of healthcare practitioners towards accessible diagnostic testing facilities, the impact of such establishments on healthcare outcomes, and existing challenges, the research substantiated the value proposition of the proposed business venture. Building upon these findings, the business plan outlined in Chapter 5 was developed to address the identified gaps and capitalize on opportunities to enhance healthcare delivery in rural areas.

3.1 Research Approach

The three research approaches are qualitative (primarily exploratory), quantitative, and mixed methods (a combination of both qualitative and quantitative).

A quantitative approach was used to collect data to determine the feasibility of this business venture proposal. According to Creswell (2009), quantitative research involves the systematic empirical investigation of observable phenomena through computational, mathematical, or statistical techniques. This is an appropriate approach as it allows for hypothesis testing, cause-and-effect relationship establishment, and generalization of findings to a broader population (Bryman, 2012; Creswell, 2009).

3.2 Research Paradigm

This is the lens through which the researcher views and interprets the world; as per Saunders et al. (2019), research paradigm includes critical realism, Critical theory, Design Science, Interpretivism, Positivism, and Pragmatism.

Positivism is the paradigm relevant for this proposal as it is based on hypothesis testing of the expansion of medical laboratories in rural areas of Vhembe to improve diagnostic and healthcare outcomes through shortened results TAT. According to Creswell and

Creswell (2017), positivism emphasises the importance of empirical observation, and hypothesis testing, as well as the regularities search and causal relationships in natural and social world.

3.3 Research design

The selected method of data collection for this proposal is the survey with questions arranged into self-administered questionnaires.

The survey questionnaire method is chosen as according to Bryman (2016), it is very effective for large quantitative data collection as it allows for a quick turnaround of data collection and analysis, targeted questioning, and confidentiality, which can encourage honest and candid responses; all of which is relevant for this proposal in pursuit of honest answers from the purposefully targeted respondents to be able to determine if there is a need and if it is feasible to expand more medical laboratories in rural areas of Vhembe.

3.4 Population and Sampling

3.4.1 Population

The population of interest for this venture proposal is healthcare practitioners from the public health of the rural parts of Vhembe districts who order, request, and utilises laboratory services. This includes medical doctors and nurses where relevant.

A population is defined as the entire group of events, people, or things of researcher's interest that they wish to investigate (Bougie & Sekaran, 2019).

In terms of public health facilities, the district has a total number of six District hospitals one Regional Hospital, and 116 clinics (Vhembe District Municipality profile, 2020). These facilities render comprehensive healthcare package to communities.

According to Statistics South Africa (2022), Vhembe public health system had an estimation of 113 doctors, with 108 being medical officers and the remaining five being specialists.

This population of doctors was believed to be correctly targeted as the expectation was for them to be able to supply the needed answers to the problem the study is trying to solve and address the proposal hypotheses as they are the population that utilises laboratory services.

3.4.2 Sample and Sample size

A subset of the population is a sample, with only some members selected from it, not all elements of the population form the sample, only some, whereas sampling is the process of selecting the right objects, individuals, or events as representatives for the entire population (Bougie & Sekaran, 2019).

For this venture proposal, a simple random probability sampling design was used where the selected participants are approximately 113 practitioners in public health with the assumption, that they will be able to give more information to determine the need and feasibility of this venture proposal as they are the direct users of medical laboratories and usually depend on the outcome of the results from these laboratories to be able to make critical diagnostic decisions.

The representative sample size from which the conclusion about the entire population is drawn and for generalisation made is a minimum of 44 participants' responses. The factor determining this is the estimated population of approximately 113 public health doctors, and the number is calculated as follows: Sample size 113*1.96/0.05*= 44.3=44, where 1.96 is the static level of confidence (K) and 0.05 significance level (p) (Bougie & Sekaran, 2019).

Results estimates are correct if they fall within the 95% confidence level, with only a 5% probability of the results being inaccurate for the proposal or hypothesis to be confirmed or rejected.

3.4.3 Sampling Method

Sampling may be in two types, probability, and non-probability sampling.

Non-probability purposeful sampling refers to obtaining information from a specific choice of subjects who are in the best position to provide the required information (Bougie & Sekaran, 2019).

A non-probability, purposive judgemental sampling is the sampling method chosen for this venture proposal based on the participation judgment that they should be knowledgeable and be able to provide information to assist solve the hypothesis of the establishment of laboratories on Vhembe to improve the healthcare outcome and diagnostic. The researcher purposefully selected healthcare professionals from Vhembe Public Health as they were believed to be able to provide the required information based on their current experiences with laboratory services.

Structured survey questionnaires were drafted using Redcap in such a way that made it possible for the hypothesis to be addressed, this was electronically distributed to Vhembe healthcare practitioners as a link via provided email addresses for voluntary completion.

3.5 Data collection

3.5.1 Instrument

Data was collected through a one-stop electronic survey questionnaire with a set of pre-determined questions that were distributed to participants (Doctors from Vhembe Hospitals) via emails they provided for them to complete.

An electronic questionnaire was the preferred choice because of its perceived efficiency in reaching a diverse and large audience. The survey questionnaire consisted of closed questions; an electronic link was developed using Redcap. According to Bougie and Sekaran (2019), closed questions assist respondents in making quick decisions of choosing among several presented alternatives which should be collectively exhausting and mutually exclusive to avoid respondent confusion. They also help with information coding for the researcher for subsequent analysis.

A seven-point Likert scale survey tool was used to enable the assignment of numbers to object attributes, and this was used to examine how strongly respondents agreed or disagreed with questionnaire statements or questions. This helped provide a structured way to measure attitudes, opinions, or perceptions by capturing the intensity of respondents' agreement or disagreement with a statement (Bougie & Sekaran, 2019).

3.5.2 Data collection procedure

This was a cross-sectional study or a one-shot study as data was only gathered once for approximately two weeks. The proposal ensured compliance with the ethical guidelines and regulations from the WBS Ethics Committee.

Meetings with Vhembe Hospital doctors were set up through hospital Clinical Managers after the Provincial, District, and Hospital CEO's approvals; the research proposal, participation information, confidentiality, consent, and participation requests were presented during the meetings.

A developed electronic survey link from Redcap was distributed by forwarding it to participants' email addresses they provided during the meetings for their voluntary completion. The questionnaire aimed to seek an understanding of participants' perceptions and attitudes regarding the importance of accessible diagnostic testing facilities, the impact of establishing medical laboratories on access to diagnostic testing and healthcare outcomes, resource accessibility, sample referral processes, transportation challenges, and turnaround time for diagnostic test results.

By collecting responses from participants, the survey aimed to assess the current state of diagnostic testing facilities in rural areas, assess the need for medical testing laboratories in rural areas, and gauge the potential benefits of expanding and enhancing medical laboratories in these regions. Ultimately, the goal is to inform decision-making processes aimed at improving healthcare delivery and outcomes in rural communities by expanding and enhancing medical laboratories.

Pre-testing to ensure that questionnaire questions are clear and understandable for the proposal feasibility was done first with the colleagues before data collection. Collected

data was extracted from Redcap to an Excel spreadsheet and imported to SPSS for analysis.

Data collected was crucial in determining feasibility and if there was indeed a need for the venture proposal of establishing more laboratories in rural Vhembe areas to improve diagnostic and healthcare outcomes. The data collected was extracted into a Microsoft Excel spreadsheet and imported onto the Statistical Packages for Social Science (SPSS), a widely used program for statistical analysis for it to be analysed and interpreted including its reliability and validity determination.

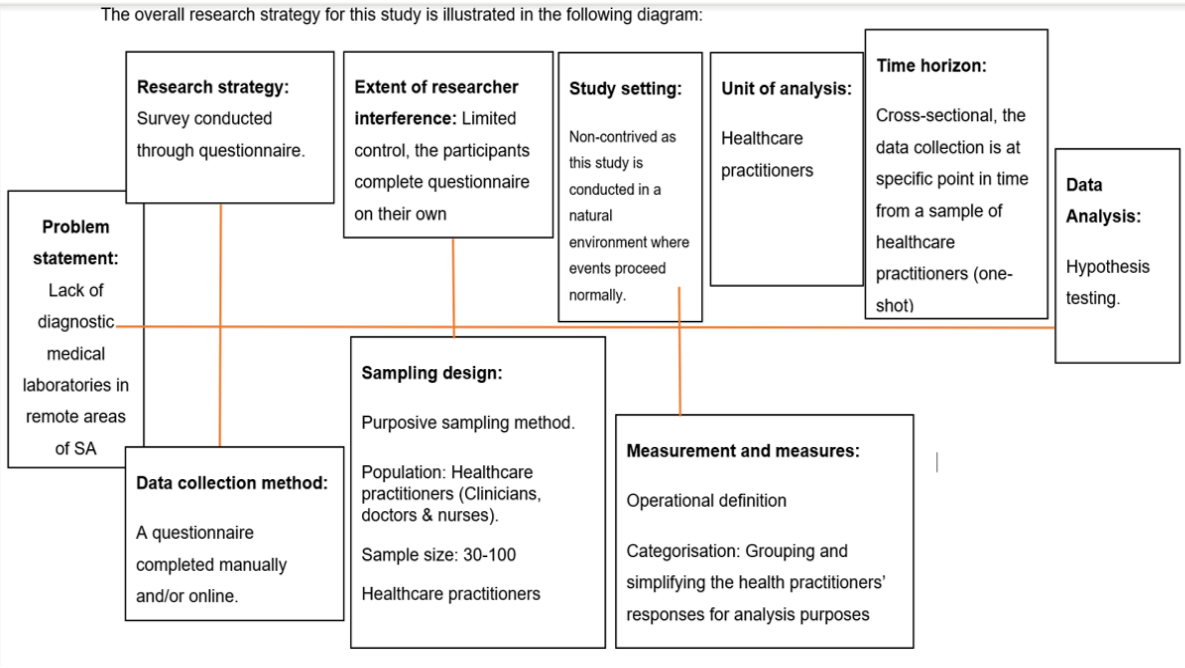


Figure 5: The overall strategy for the study. Source: (Bougie & Sekeran, 2019, page 96)

3.6 Data Analysis Techniques

For this proposal, descriptive statistics with an emphasis on hypothesis testing were selected as the method of data analysis for the provision of a comprehensive understanding of the survey data collected and for the provision of summary statistics such as mean, standard deviation, and frequency distributions, which was used to summarise and describe data characteristics.

Exploratory Factor Analysis (EFA) was employed to identify underlying constructs or factors within the dataset. This technique helped in reducing the dimensionality of the data and identifying patterns or relationships between observed variables.

Reliability analysis, specifically Cronbach's Alpha coefficient, was used to assess the internal consistency or reliability of scales constructed from multiple items within each identified construct. This analysis ensured that the measurement scales used in the survey were reliable and consistent in capturing the intended constructs, such as sample referral, diagnostic testing accessibility, turnaround time, resource accessibility, and sample transportation.

Inferential statistics, such as correlation and regression analysis were used to test the hypotheses of the venture proposal to test the relationships between variables and answer the research questions. Correlation analysis was conducted to examine the relationships between different variables measured in the survey. Pearson's correlation coefficient was calculated to assess the strength and direction of linear relationships between variables such as turnaround time and sample referral processes, resource accessibility, diagnostic testing accessibility, and sample transportation.

Multiple regression analysis was employed to examine the predictive relationships between the dependent variable (turnaround time) and the independent variables (sample transportation, resource accessibility, diagnostic testing accessibility, and sample referral). This technique helped in understanding how changes in independent variables impact the dependent variable and identifying significant predictors of turnaround time in rural healthcare settings.

3.7 Ethical Considerations

When conducting a survey questionnaire with healthcare practitioners, several ethical considerations should be considered to ensure that the research is conducted responsibly and respectfully. All relevant guidelines and regulations were considered and adhered to while conducting this research proposal. This is crucial and will ensure the protection, well-being, and rights of individuals involved, ensure that research

integrity is maintained, and contribute to the overall trustworthiness and credibility of the research findings.

The following are some ethical considerations:

Informed consent: Participants were informed through the information sheet of the purpose of the study, the voluntary nature of participation, and any potential risks or benefits. They will be allowed to ask questions and withdraw their consent at any time.

Confidentiality: All responses received by the researcher will be kept confidential, and any data collected stored securely on Google Cloud and password protected. Confidentiality assurance of the provided information was emphasized to the participants to allow less biased answers.

Avoidance of coercion or undue influence: Healthcare practitioners were not pressured or coerced into participating in the study, participation was voluntary, with participants allowed to decline or withdraw their participation at any given time.

Summary:

This chapter outlines a systematic research methodology aimed at improving healthcare outcomes and diagnostics in underserved communities by assessing the feasibility of expanding medical testing laboratories in the rural Vhembe district. It employs a quantitative approach, targeting healthcare practitioners through a survey. Data collection involved electronic questionnaires that were emailed to participants, while analysis included descriptive and inferential statistics. Ethical considerations were carefully addressed. Overall, the methodology aims to improve healthcare outcomes in underserved communities through the establishment of medical laboratories in rural areas of SA.

CHAPTER 4:

Results Analysis and Interpretation

4.0. Introduction

In the context of this venture proposal, this analysis of data and interpretation section is important in determining the feasibility and need for establishment of medical laboratories in rural areas of South Africa for improved diagnostic testing and healthcare outcomes. The data collected from the survey questionnaire conducted using a seven-point Likert scale is analysed to identify any patterns that may exist among studied variables. Based on the literature review, quicker results TAT is critical for improved access to diagnostic services for underserved populations, this may lead to early diagnosis and treatment thus preventing morbidity and mortality, contributing to better healthcare outcomes; and the hypothesis is that this can be achieved by the establishment and expansion of private laboratories in rural areas of SA.

The questionnaire drafted consisted of five selected variables from the literature review, namely TAT, transportation, sample referral, access to diagnostic testing, and resource accessibility, with TAT chosen as the dependent variable because it is believed to be more critical for the improvement of diagnostic services and healthcare outcome, and the other four independent variables.

4.1 Data screening

The sample was made up of 50 professionals from six of the seven Vhembe hospitals and none of the responses had missing data. Therefore, there was no need for data imputation. There were no responses received from he seventh hospital upon data analysis.

4.2. Sample Characteristics/ Demographic

4.2.1 Hospital represented

Results presented in Figure 5 show that the highest proportion of respondents, constituting 28% of the sample, were affiliated with Donald Fraser hospital, followed closely by Tshilidzini hospital with 24%. Additionally, respondents from Elim hospital make up 20% of the sample, while those from Siloam hospital contribute 16%. Malamulele hospital was represented by 10% of the sample, and the smallest proportion, 2%, was from Messina hospital. This indicates a coverage of Vhembe District hospitals in Limpopo province, with no responders from Louis Trichardt hospital

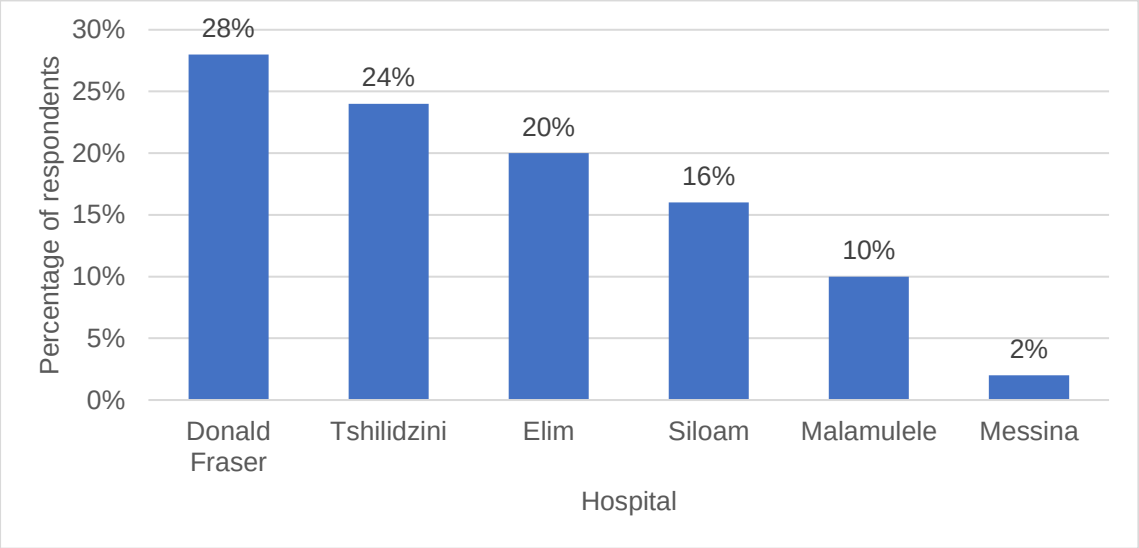


Figure 6: Hospital represented.

4.2.2 Profession

The sample consisted predominantly of medical doctors, comprising 50% of the respondents. Following closely behind are medical officers, representing 44% of the sample. A smaller proportion, 4%, were medical interns, while family physicians make up the remaining 2%. This breakdown illustrates the occupational diversity within the medical field among the respondents. The results are illustrated in Figure 6.

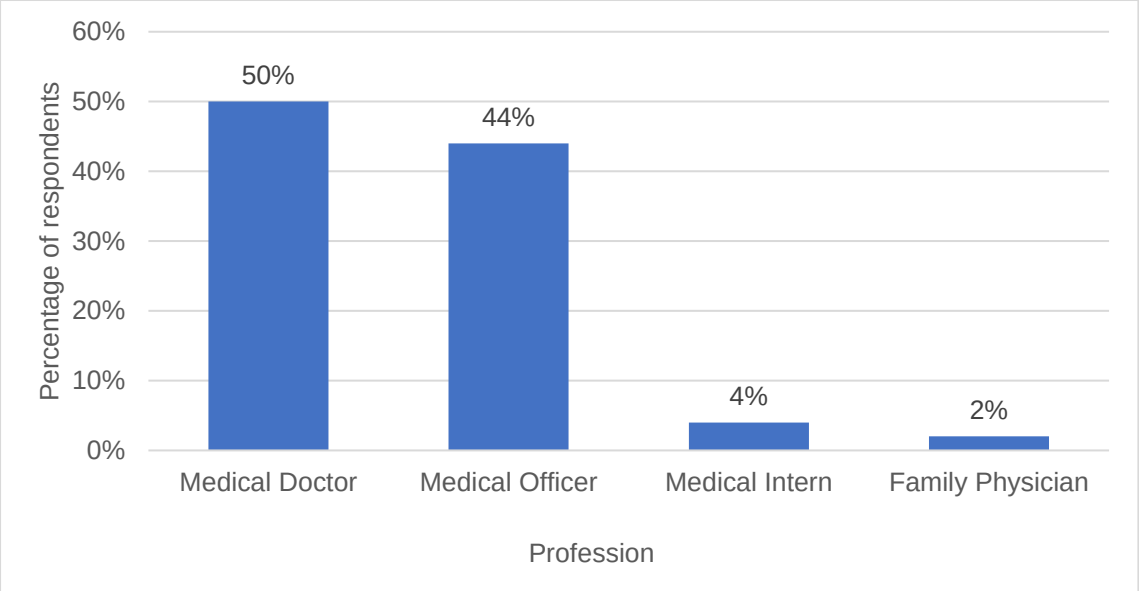


Figure 7: Profession.

4.2.3 Years of laboratory usage experience

The descriptive statistics for years of laboratory usage experience showed that the minimum reported years of experience is 1, while the maximum reported is 28. The average number of years of experience was 5.44 ± 4.949 years. The skewness value is 2.665, suggesting a moderate positive skew in the distribution, and the kurtosis value is 8.991, indicating heavy-picked. The kurtosis was above the highest acceptable value of at most 7 for the data to be considered normally distributed. The median years of laboratory usage experience was 4 years, with a lower quartile (Q1) at 3 years and the upper quartile (Q3) at 7.25 years. Indicating that 75% of the sample had a laboratory experience of not more than 7.25 years.

Table 2: Years of laboratory usage experience

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis	Median (IQR)
Years of laboratory usage experience	50	1	28	5.44	4.949	2.665	8.991	4.00 (3,7.25)

4.3 Descriptive statistics

4.3.1 Testing Accessibility – Descriptive Statistics

It can be noted from results presented in Table 2 that it is crucial to have accessible diagnostic testing facilities in rural areas for improving healthcare outcomes (mean = 6.78 ± 0.418), the majority strongly agree that such facilities would positively impact healthcare outcomes. Similarly, the significance of accessible diagnostic testing facilities in rural areas is underscored by a mean rating of 6.70 ± 1.035. Additionally, respondents express considerable belief in the potential of establishing medical laboratories in rural areas to enhance access to diagnostic testing, as evidenced by a mean rating of 6.64 ± 0.827. Confidence in the ability of these facilities to deliver more timely and accurate diagnoses is also notable, with a mean rating of 6.52 ± 0.789. However, satisfaction with the current availability of diagnostic testing laboratories in rural areas appears notably lower, with a mean rating of 3.40 ± 1.565, indicating room for improvement in meeting the community's needs. Overall, the findings underscore the urgent need for enhancing accessibility to diagnostic testing in rural areas to improve healthcare outcomes and address existing gaps in service provision.

Table 3: Testing Accessibility – Descriptive Statistics

Item	1-3	4	5-7	Mean	Std. Deviation
TA1: How significant is the importance of accessible diagnostic testing facilities in rural areas?2	4%	0%	96%	6.70	1.035
TA2: To what extent do you believe the establishment of medical laboratories in rural areas would enhance access to diagnostic testing for the local population?	2%	2%	96%	6.64	.827
TA3: How satisfied are you with the current availability of diagnostic testing laboratories in rural areas?	60%	14%	26%	3.40	1.565
TA4: How confident are you that establishing medical laboratories in rural areas would lead to more timely and accurate diagnoses?	0%	2%	98%	6.52	.789
TA5: To what extent do you agree or disagree that accessible diagnostic testing facilities in rural areas would positively impact healthcare outcomes?	0%	0%	100%	6.78	.418

4.3.2 Resource Accessibility – Descriptive Statistics

The results pertaining to resource accessibility of medical laboratories in rural areas presented in Table 3 revealed a consistent acknowledgment of the importance of adequate resource availability for enhancing healthcare outcomes. The highest rated

attribute was that adequate resource availability would improve healthcare outcomes (mean = 6.76 ± 0.517). Furthermore, the significance of having access to resources such as equipment, supplies, and trained staff in operating medical laboratories in rural areas was emphasised, with a mean rating of 6.68 ± 1.22. Confidence in the potential of establishing medical laboratories to improve resource availability garnered a mean rating of 6.46 ± 0.838, indicating a notable level of trust in this approach. Additionally, respondents recognised the potential of medical laboratory establishment to address skilled resource limitations in rural areas, as evidenced by a mean rating of 6.3 ± 0.814. However, satisfaction with the current availability of resources for medical laboratories in rural areas was comparatively lower, with a mean rating of 3.90 ± 1.344, suggesting room for improvement in meeting resource needs.

Table 4: Resource Accessibility – Descriptive Statistics

Item	1-3	4	5-7	Mean	Std. Deviation
RA6: How important is it to have access to adequate resources (equipment, supplies, trained staff) for operating medical laboratories in rural areas?	4%	0%	96%	6.68	1.220
RA7: To what extent do you agree that the establishment of medical laboratories in rural areas would address the skilled resource limitations in these areas?	0%	2%	98%	6.30	.814
RA8: How satisfied are you with the current availability of resources (including trained staff, advanced instrumentation, and reagents) for medical laboratories in rural areas?	38%	18%	44%	3.90	1.344
RA9: To what degree are you confident that establishing medical laboratories in rural areas would lead to improved resource availability for healthcare providers?	2%	0%	98%	6.46	.838
RA10: To what extent do you agree or disagree that adequate resource availability in medical laboratories in rural areas would enhance healthcare outcomes?	0%	0%	100%	6.76	.517

4.3.3 Sample Referral – Descriptive Statistics

The presented in Table 4 indicate a strong agreement that establishing medical laboratories in rural areas would reduce the need for sample referral to larger testing facilities, with mean ratings of 6.62 ± 0.753 and so does having more medical laboratories in rural areas (mean = 6.50 ± 0.863). Respondents expressed confidence in the ability of these laboratories to streamline sample referral processes (mean = 6.44 ± 0.812). While acknowledging the current need for sample referral due to laboratory inaccessibility (mean = 5.98 ± 0.795), satisfaction with the current sample transportation and referral process was rated relatively lower than the rest of the attributes (mean = 3.38 ± 1.689).

Table 5: Sample Referral – Descriptive Statistics

Item	1-3	4	5-7	Mean	Std. Deviation
SR11: How frequent is the need to refer samples from rural areas to larger testing facilities due to laboratory inaccessibility?	2%	2%	96%	5.98	.795
SR12: To what extent do you agree that the establishment of medical laboratories in rural areas would reduce the necessity for sample referral to larger testing facilities?	0%	2%	98%	6.62	.753
SR13: How satisfied are you with the current process of sample transportation and referral from rural areas to larger testing facilities?	66%	10%	24%	3.38	1.689
SR14: To what degree are you confident that establishing medical laboratories in rural areas would streamline the sample referral process and reduce reliance on larger testing facilities?	2%	0%	98%	6.44	.812
SR15: To what extent do you agree or disagree that more medical laboratories in rural areas would decrease the need of sample referral to larger testing facilities?	2%	2%	96%	6.50	.863

4.3.4 Sample Transportation – Descriptive Statistics

The results pertaining to sample transportation highlighted the significance of timely transportation in healthcare settings, with respondents rating its importance highly (mean = 6.74 ± 0.664). There was an agreement that the establishment of medical laboratories in rural areas could mitigate the need for sample transportation to larger facilities, with a mean rating of 6.60 ± 0.728. Furthermore, respondents agreed that rural medical laboratories could alleviate challenges associated with sample transportation, as indicated by a mean rating of 6.50 ± 0.647. However, confidence in the ability of these laboratories to streamline sample transportation processes and reduce reliance on larger facilities is slightly lower, with a mean rating of 6.14 ± 1.309. Satisfaction with the current sample transportation process from rural areas to larger facilities remains relatively low, scoring 3.84 ± 1.658. These findings highlighted the importance of addressing transportation challenges in rural healthcare settings and suggest a promising role for medical laboratories in mitigating these issues.

Table 6: Sample Transportation – Descriptive Statistics

Item	1-3	4	5-7	Mean	Std. Deviation
TRA16: How important do you think the timeframe of sample transportation is?	0%	4%	96%	6.74	.664
TRA17: What do you think is the likelihood that the establishment of medical laboratories in rural areas would decrease the need for sample transportation to larger testing facilities?	2%	0%	98%	6.60	.728
TRA18: How satisfied are you with the current process of sample transportation process from rural areas to larger testing facilities?	48%	14%	38%	3.84	1.658
TRA19: How confident are you that establishing medical laboratories in rural areas would streamline the sample transportation processes and reduce reliance on larger testing facilities?	6%	2%	92%	6.14	1.309
TRA20: To what extent do you agree or disagree that medical laboratories in rural areas would minimise the challenges associated with sample transportation?	0%	0%	100%	6.50	.647

4.3.5 Turnaround time (TAT) – Descriptive Statistics

The results concerning turnaround time (TAT) for diagnostic test presented in Table 6 emphasised the paramount importance of shorter TAT in healthcare settings, with respondents rating its significance highly (mean = 6.86 ± 0.495). There was also consensus that the establishment of more medical laboratories in rural areas would improve accessibility and healthcare outcomes by providing faster diagnostic test results or shorter turnaround times (mean = 6.58 ± 0.673). Additionally, respondents expressed belief in the potential of these rural medical laboratories to lead to shorter TAT for diagnostic test results (mean = 6.56 ± 0.733. Confidence in the ability of establishing medical laboratories to significantly reduce TAT for diagnostic test results was also rated high (mean = 6.46 ± 0.93). However, satisfaction with the current TAT for diagnostic test results was relatively low, scoring 3.54 ± 1.568. These findings underscore the critical role of medical laboratories in improving TAT for diagnostic test results in rural areas, while also highlighting the need for enhancements to current turnaround processes to better meet healthcare needs.

Table 7: Turnaround time (TAT) – Descriptive Statistics

Item	1-3	4	5-7	Mean	Std. Deviation
TAT21: How significant is the importance of having a shorter turnaround time (TAT) for diagnostic test results?	0%	2%	98%	6.86	.495
TAT22: To what extent do you believe the establishment of medical laboratories in rural areas would lead to shorter turnaround times for diagnostic test results?	0%	2%	98%	6.56	.733
TAT23: How satisfied are you with the current turnaround time for diagnostic test results?	56%	12%	32%	3.54	1.568
TAT24: To what degree are you confident that establishing medical laboratories in rural areas would significantly reduce the turnaround time for diagnostic test results?	2%	6%	92%	6.46	.930
TAT25: To what extent do you agree or disagree that more medical laboratories in rural areas would enhance accessibility and healthcare outcomes through faster diagnostic test results or shorter turnaround times?	0%	2%	98%	6.58	.673

Conclusion

The descriptive statistics provide valuable insights into the perceptions and experiences regarding diagnostic testing and healthcare outcomes in rural areas of South Africa. Overall, respondents emphasize the critical importance of accessible diagnostic testing facilities and adequate resource availability in improving healthcare outcomes. While there is confidence in the potential of establishing medical laboratories in rural areas to enhance access to diagnostic testing and reduce turnaround times (TAT) for test results, satisfaction with the current availability of such facilities remains low. These findings underscore the urgent need for infrastructure improvements and resource allocation to meet the healthcare needs of rural communities effectively. Additionally, addressing challenges related to sample referral processes and sample transportation is crucial for enhancing overall healthcare service delivery in rural areas.

4.4 Validity

Exploratory factor analysis (EFA) was conducted with principal component analysis (PCA) as the extraction method and varimax as the rotation. PCA extraction method was chosen as is it more robust with small sample sizes than is principal axis factoring. PCA assumes orthogonal components, making Varimax rotation a natural choice to further simplify and interpret the extracted components.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.620, indicating an adequate sample size as the KMO value was greater than the minimum requirement of at least 0.5. The Bartlett's test was significant (p-value = 0.000 < 0.05) confirming that the correlation among variables was sufficiently different from what would be expected by chance alone, indicating that the data was suitable for factor analysis.

Table 8: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.620
Bartlett's Test of Sphericity	Approx. Chi-Square	551.004
	df	136
	Sig.	.000

Table 8 shows that EFA resulted in five constructs / factor being extracted as indicated by five factors with eigenvalues greater than 1. The retained five factors explained 74.497% of variation in the initial items.

Table 9: Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.298	31.166	31.166	5.298	31.166	31.166	3.694	21.732	21.732
2	2.250	13.236	44.402	2.250	13.236	44.402	2.493	14.665	36.397
3	2.031	11.945	56.347	2.031	11.945	56.347	2.369	13.935	50.332
4	1.605	9.440	65.787	1.605	9.440	65.787	2.080	12.233	62.565
5	1.481	8.709	74.497	1.481	8.709	74.497	2.028	11.931	74.497
6	.819	4.820	79.317						
7	.733	4.312	83.629						
8	.653	3.838	87.467						
9	.546	3.209	90.677						
10	.410	2.413	93.090						
11	.355	2.087	95.177						
12	.243	1.427	96.604						
13	.213	1.253	97.857						
14	.179	1.050	98.907						
15	.114	.669	99.576						
16	.043	.254	99.830						
17	.029	.170	100.000						
Extraction Method: Principal Component Analysis.									

Figure 7 illustrates the scree plot from EFA. The scree plot confirms that there were indeed five factors that were extracted as indicated by the line graph ceasing to be steeper after five factors. This shows that the first five factors explain a substantial amount of variance in the initial items. After the fifth factor, the addition of more factors does not contribute significantly to explaining additional variance.

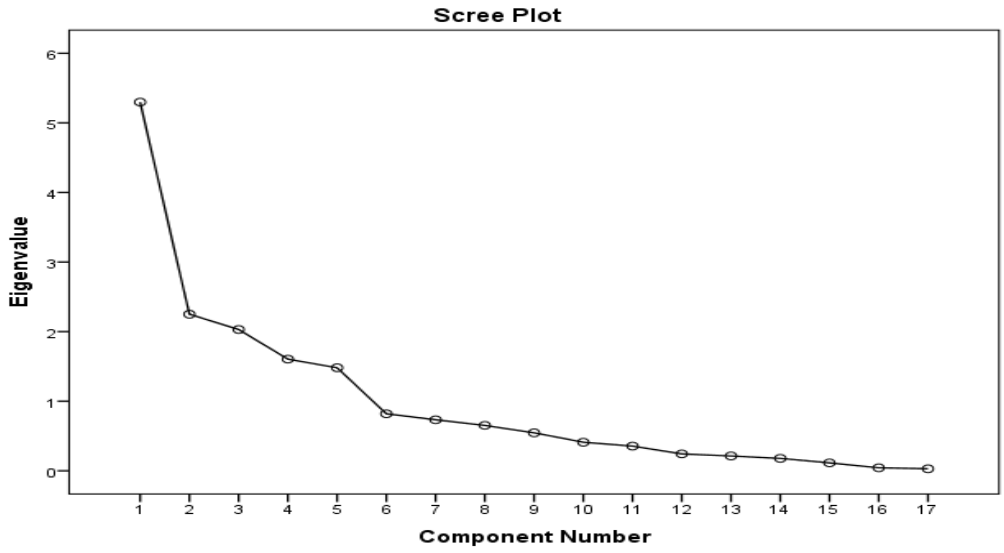


***Figure 7**: Scree plot*

The final composition of the five factors that were extracted is presented in Table 10. It can be noted that items loaded highly onto their respective factors with a minimum factor loading of 0.647, which is higher than the minimum requirement of at least 0.4. Thus, there were five valid constructs namely, Sample referral, Diagnostic Testing accessibility, Turnaround time, Resource accessibility, and Sample transportation.

Table 10: Final Factor composition

Construct	Item	Factor				
		1	2	3	4	5
Sample referral	SR12: To what extent do you agree that the establishment of medical laboratories in rural areas would reduce the necessity for sample referral to larger testing facilities?	.874				
	SR15: To what extent do you agree or disagree that more medical laboratories in rural areas would decrease the need of sample referral to larger testing facilities?	.814				
	RA9: To what degree are you confident that establishing medical laboratories in rural areas would lead to improved resource availability for healthcare providers?	.752				
	RA7: To what extent do you agree that the establishment of medical laboratories in rural areas would address the skilled resource limitations in these areas?	.719				
	SR14: To what degree are you confident that establishing medical laboratories in rural areas would streamline the sample referral process and reduce reliance on larger testing facilities?	.647				
Diagnostic Testing accessibility	TA1: How significant is the importance of accessible diagnostic testing facilities in rural areas?2		.942			
	RA6: How important is it to have access to adequate resources (equipment, supplies, trained staff) for operating medical laboratories in rural areas?		.905			
	TA2: To what extent do you believe the establishment of medical laboratories in rural areas would enhance access to diagnostic testing for the local population?		.683			
Turnaround Time	TAT24: To what degree are you confident that establishing medical laboratories in rural areas would significantly reduce the turnaround time for diagnostic test results?			.858		
	TAT21: How significant is the importance of having a shorter turnaround time (TAT) for diagnostic test results?			.789		
	TAT22: To what extent do you believe the establishment of medical laboratories in rural areas would lead to shorter turnaround times for diagnostic test results?			.739		
Resource accessibility	RA10: To what extent do you agree or disagree that adequate resource availability in medical laboratories in rural areas would enhance healthcare outcomes?				.839	
	TA5: To what extent do you agree or disagree that accessible diagnostic testing facilities in rural areas would positively impact healthcare outcomes?				.781	
	TA4: How confident are you that establishing medical laboratories in rural areas would lead to more timely and accurate diagnoses?				.652	
Sample transportation	SR13: How satisfied are you with the current process of sample transportation and referral from rural areas to larger testing facilities?					.856
	TAT23: How satisfied are you with the current turnaround time for diagnostic test results?					.844
	TRA18: How satisfied are you with the current process of sample transportation process from rural areas to larger testing facilities?					.672

4.5 Reliability

The reliability of scale for the five constructs was conducted using Cronbach's Alpha and the results are presented in Table 10. In general, reliabilities over 0.8 are less than 0.60 are considered to good, those in 0.70 range are acceptable, and those less than 0.60 are poor. (Bougie & Sekeran, 2019).

The construct of Sample referral exhibits a high level of internal consistency, with a Cronbach's Alpha coefficient of 0.862, indicating very good reliability across its five

constituent items. Similarly, the constructs of Diagnostic Testing accessibility and Turnaround time also demonstrate strong internal consistency, showing Cronbach's Alpha values of 0.836 and 0.817, respectively, both falling within the very good reliability range. However, constructs such as Resource accessibility and Sample transportation, while still demonstrating acceptable reliability levels with Cronbach's Alpha coefficients of 0.708 and 0.718, respectively, possess slightly lower internal consistency compared to the other constructs. The results confirmed the reliability of the five constructs as measures of their respective underlying concepts since all Cronbach's Alpha values were greater than the minimum requirement of at least 0.7.

Since all five constructs were valid and reliable, a composite scale was computed for each construct by taking the average of the items retained within each valid construct. Further analysis was done using these composite scales.

Table 11: Reliability of scale

Construct	Cronbach's Alpha	N of Items	Reliability level
Sample referral	.862	5	Good
Diagnostic Testing accessibility	.836	3	Good
Turnaround time	.817	3	Good
Resource accessibility	.708	3	Acceptable
Sample transportation	.718	3	Acceptable

4.6 Hypothesis testing

4.6.1 Correlation

The descriptive statistics for the five constructs presented in Table 12 show that Resource accessibility emerged as the highest-rated, with a mean score of 6.69 ± 0.473. It was closely followed by Diagnostic Testing accessibility, which received a mean rating of 6.67 ± 0.902, and Turnaround time, with a mean score of 6.63 ± 0.634. Sample referral attained a somewhat lower mean rating of 6.46 ± 0.656. In contrast, Sample transportation received the lowest rating among the constructs, with a mean score of 3.59 ± 1.31.4.

The correlation analysis indicated that there was a positive and significant correlation between Turnaround time and each of sample referral ($r = 0.458$, p-value < 0.001), and

Resource accessibility (r = 0.373, p-value < 0.001). The correlation between Turnaround time and Diagnostic Testing accessibility (r = 0.115, p-value > 0.05) was positive but non-significant while the correlation between Turnaround time and Sample transportation (r = -0.031, p-value > 0.05) was negative and non-significant.

Table 12: Descriptive statistics and Pearson's Correlation

	Descriptive Statistics		**Pearson Correlation**				
Construct	**Mean**	**SD**	**1.**	**2.**	**3.**	**4.**	**5.**
1.Sample referral	6.46	.656	1				
2.Diagnostic Testing accessibility	6.67	.902	.358*	1			
3.Resource accessibility	6.69	.473	.491**	.217	1		
4.Sample transportation	3.59	1.310	.009	-.071	-.008	1	
5.Turnaround time	6.63	.634	.458**	.115	.373**	-.031	1

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

4.6.2 Regression

A multiple regression model was fitted with Turnaround time as the dependent variable and Sample transportation, Resource accessibility, Diagnostic Testing accessibility, and Sample referral and independent variables.

4.6.2.1 Regression Assumptions Diagnostics

Test for Linearity

The correlation results presented in Table 12 show that the all the correlation coefficients between each of the independent variables and the turnaround time were all non-zero. Thus, the linearity assumption was met.

Test for Normality

A histogram of the residuals plotted in figure 9 show that most of the bar graph were below the regression line, Therefore the residuals approximated the normal distribution. This also implies that the normality assumption was also met.

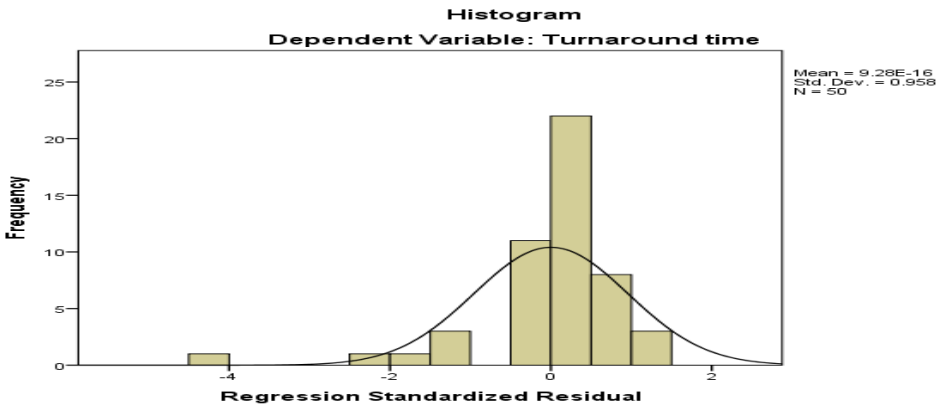


***Figure 9**: Histogram of regression residuals*

Test for Multicollinearity

The variance inflation factors (VIF) values presented in Table 13 show that all of them were less than 10, this implies that there was no multicollinearity. Thus, the no multicollinearity assumption was also met.

Table 13:Regression Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	2.829	1.258		2.249	.029		
	Sample referral	.372	.151	.385	2.471	.017	.692	1.446
	Diagnostic Testing accessibility	-.048	.098	-.068	-.489	.627	.864	1.157
	Resource accessibility	.266	.200	.198	1.331	.190	.757	1.321
	Sample transportation	-.018	.063	-.038	-.292	.772	.994	1.006
a. Dependent Variable: Turnaround time								

Test for Equality of variance of error terms (Homoscedastic)

A plot of the residuals against the regression standardised predicted values showed no defined pattern, and the values were randomly distributed around zero. This indicates that there was Homoscedastic. This the Homoscedastic assumption was also met.

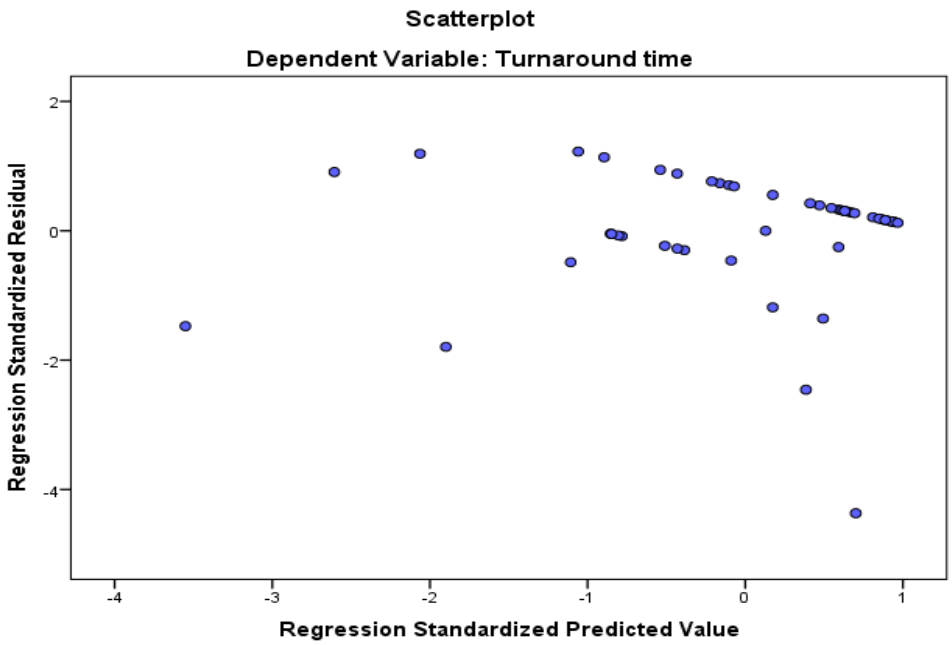


***Figure 10**: Scatter plot of residuals*

Independent errors

The Durbin-Watson value was 1.862, which was close to the required value of 2. This shows also that the independency of error terms was also met.

Thus, all regression assumptions were met.

4.6.2.2 Regression Results

The model summary results shown in Table 14 shows that Sample transportation, Resource accessibility, Diagnostic Testing accessibility, and Sample referral explained 24.4% variation in Turnaround time as indicated by an r-square value of 0.244.

Table 14: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.494[a]	.244	.176	.57540	1.862
a. Predictors: (Constant), Sample transportation, Resource accessibility, Diagnostic Testing accessibility, Sample referral					
b. Dependent Variable: Turnaround time					

The ANOVA illustrated in Table 15 shows that a model with Sample transportation, Resource accessibility, Diagnostic Testing accessibility, and Sample referral was

significant in predicting Turnaround time as indicated by a p-value of 0.012, which was less than 0.05.

Table 15: ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.799	4	1.200	3.624	.012[b]
	Residual	14.899	45	.331		
	Total	19.698	49			
a. Dependent Variable: Turnaround time						
b. Predictors: (Constant), Sample transportation, Resource accessibility, Diagnostic Testing accessibility, Sample referral						

Table 16: Summary of hypotheses

Hypothesis		**Conclusion**
H1	Sample referral has an effect on Turnaround time.	Supported Positive and Significant
H2	Diagnostic Testing accessibility has an effect on Turnaround time.	Not Supported Negative, and non-significant
H3	Resource accessibility has an effect on Turnaround time.	Not Supported, Positive, and non-significant
H4	Sample transportation has an effect on Turnaround time	Not Supported, Negative, and Non-significant

Summary

The analysis and interpretation of results in this study aimed to assess the feasibility and need for establishing medical laboratories in rural areas of South Africa to enhance diagnostic testing and healthcare outcomes. A survey questionnaire with Likert scale responses from 50 professionals from the six Vhembe hospitals was analysed, focusing on variables such as turnaround time (TAT), transportation, sample referral, access to diagnostic testing, and resource accessibility. Descriptive statistics revealed the critical importance of accessible diagnostic testing facilities and adequate resource availability in improving healthcare outcomes. Additionally, validity and reliability tests confirmed the robustness of the data and measurement instruments used in the study.

Correlation analysis showed significant relationships between turnaround time and sample referral, as well as resource accessibility, highlighting the interconnectedness of these factors in healthcare delivery. A multiple regression analysis further supported

these findings, indicating that sample transportation, resource accessibility, diagnostic testing accessibility, and sample referral collectively explained 24.4% of the variation in turnaround time.

Hypothesis testing findings suggest that improvements in sample referral processes and resource accessibility within medical laboratories are associated with shorter turnaround times for diagnostic test results. However, the ease of accessing diagnostic testing facilities and the efficiency of sample transportation do not seem to have significant effects on turnaround time in this context.

Overall, the study underscores the urgent need for infrastructure improvements and resource allocation in rural healthcare settings to address existing gaps in service provision. Establishing medical laboratories in rural areas holds promise for enhancing diagnostic testing accessibility and reducing turnaround times, thereby contributing to improved healthcare outcomes for underserved populations.

CHAPTER 5:

5. Business Venture Proposal

5.1 Executive Summary

This venture aims to establish medical laboratories in underserved rural areas of Vhembe district in Limpopo, South Africa. With a population of 1,653,077, Vhembe has about eight private labs in semi-urban areas, along with public hospital laboratories. Limited access to laboratories impacts healthcare outcomes significantly (CDC, 2018). The primary objective is to improve healthcare accessibility and diagnostic efficiency, thereby enhancing overall health outcomes for the underserved population in these regions. Healthcare laboratories aim to address this gap by providing advanced diagnostic services.

The proximity of our labs to rural communities improves Turnaround Time (TAT) significantly, a crucial performance indicator for laboratories (Cassim et al., 2020). Local

laboratories minimise reliance on external facilities, reducing transportation costs and logistical challenges as well as the need for sample referral which in turn improves TAT. This improves healthcare accessibility and streamlines diagnostic services (Coetzee et al., 2022).

Problem Statement

Limited access to medical testing laboratories in rural areas, leads to compromised diagnostic and healthcare outcomes.

Lack of convenient and timely access to essential diagnostic tests hinders early detection, treatment, and disease management.

5.1.1 Vision, Mission, and Objectives

Vision

To establish and expand medical testing laboratories in rural areas to improve access, diagnostic capabilities, and healthcare outcomes for underserved populations.

Mission

To bridge the gap in healthcare services by providing timeous, convenient, accessible, affordable, and reliable diagnostic testing options in remote locations and communities.

To enhance diagnostic accuracy, early disease detection, and overall healthcare outcomes through innovation, collaboration, and a patient-centric approach.

Organisational objectives

The business venture aims to:

- Expand access by establishing modern medical testing laboratories in underserved rural areas.
- Enhance healthcare outcomes by ensuring quick turnaround times for accurate and timely diagnostic testing.
- Ensure quality assurance by implementing stringent quality control measures.

- Empower communities through education on diagnostic testing and disease prevention.
- Offer affordable pricing structures and explore partnerships with insurance schemes.
- Foster partnerships with healthcare providers, government agencies, and non-profits.
- Uphold ethical standards, including patient confidentiality and regulatory compliance.

5.1.2 Current state of the business

The venture aims to establish medical laboratories in rural areas of Vhembe, South Africa, addressing the unmet demand for diagnostic testing services in these underserved regions. It seeks to improve healthcare outcomes by providing timely and accurate diagnostic services to the local population.

5.1.3 Products and Services

The venture offers diagnostic testing services, including laboratory tests for various medical conditions. These services are designed to be accessible, high-quality, and competitively priced, addressing the healthcare needs of Vhembe communities.

5.1.4 Strategy and sources of sustainable competitive advantage

The venture's strategy revolves around leveraging its first-mover advantage in establishing medical laboratories in rural areas. By being one of the few providers in these regions, it aims to capture a significant share of the market demand. Additionally, the venture plans to differentiate itself through its commitment to quick TAT, quality, accessibility, and community engagement, building trust and loyalty among customers.

5.1.5 Customer acceptance

The venture anticipates strong customer acceptance due to the pressing need for improved healthcare services in rural areas. The availability of diagnostic testing services closer to home is expected to be well-received by the local population, leading to high demand for the venture's services.

5.1.6 Summary Financial Forecasts

The financial forecast includes projections for revenue growth, cost management, and profitability over five years. Based on assumptions such as market demand, pricing strategy, and operational efficiency, the forecast predicts steady revenue growth, positive cash flow, and increasing profitability over time.

5.1.7 Money required, timing, and deal on offer.

The venture seeks R1,000,000 to establish medical labs in Vhembe District within 18-24 months to expedite the setup process and capitalize on the market demand for diagnostic testing services. Investors can join a socially impactful venture improving rural healthcare and will receive equity stakes in exchange for their investment, with potential for dividends and capital growth.

5.2 Basic Business Information

Below **Table16** indicates business venture information:

Name	Healthcare Laboratories
Business Contact	Tel: 066 527 4065
Business Sector	Healthcare Laboratories
Industry	Clinical laboratory services
Ownership	An equity split of 70% and 30%
Number of staff	4
Age of the business	0 years

Target Market	Vhembe rural communities (including healthcare workers from Vhembe Clinics and Hospitals).
Capital structure	Venture Capital
Suppliers	Biomerieux, Kat Laboratory Medicals, Roche Diagnostics and Siemens

5.3 Strategic Analysis

The strategic analysis focuses on the business's competitive positioning, differentiation, and value proposition:

Value Proposition: The value proposition is to strategically locate medical testing laboratories in remote rural areas where diagnostic services are limited and offer quality, affordable private laboratory services for:

Improved access to diagnostic services for underserved populations, reduced turnaround time (TAT) for test results, leading to early diagnosis and treatment, contribution to better healthcare outcomes, preventive care, and disease management, and support for the NHI program's goals by providing quality diagnostic services to a wider population.

Reduce the need for patients to travel long distances for testing, promoting timely diagnosis and treatment.

Differentiation: The business will differentiate itself from other private laboratories such as Lancet, Ampath, and Pathcare by:

- Being a pioneer in establishing medical laboratories in rural areas, addressing a critical need
- Offering a comprehensive test menu that meets the healthcare needs of the local population.
- Focusing on quality assurance, accreditation, and compliance to ensure reliable results.

- Collaborating with local healthcare practitioners and clinics to create a network of support.

Competitive Strategy:

This will include differentiating through localised services and quick turnaround times can set the proposed laboratories apart from existing competitors; and establishing a reputation for accuracy, reliability, and quality services will be crucial for gaining trust in the market.

Innovation Strategy:

This will include leveraging innovative diagnostic technologies that can improve service delivery and outreach in remote areas and incorporating electronic reporting systems to enhance the overall patient experience.

Product Positioning Statement:

This business venture positioning statement is the dedication to bringing high-quality medical laboratory services to the heart of rural communities of Vhembe with the mission to ensure that the underserved community has access to timely and accurate medical diagnostic testing, for improved healthcare outcomes.

5.4 Market Analysis

Target Market and Segmentation:

The primary target market for the medical laboratory expansion is the underserved rural population within the Vhembe district of Limpopo, South Africa with limited access to medical testing laboratories. This includes patients seeking diagnostic services, healthcare practitioners (doctors, nurses, clinics), and potentially government healthcare programs, including the NHI.

Primary customers are healthcare practitioners who require diagnostic testing for their patients.

Market Size:

The underserved rural areas in South Africa, particularly the Vhembe district, represent a significant untapped market for medical diagnostic services.

The market size can be estimated based on the population of the Vhembe district, the prevalence of diseases requiring diagnostic tests, and the potential volume of tests required**.** The population of Vhembe district is approximately 1.4 million. With limited access to medical laboratories, the potential demand for diagnostic testing is significant.

The NHI program's goal of providing equitable healthcare access could expand the potential market for private laboratories.

Market Trends:

Increasing awareness of the importance of early detection, accurate diagnosis, and prevention, government initiatives to improve healthcare access, as well as the upcoming NHI program are likely to drive demand for diagnostic services.

Market Needs:

Timely and accurate diagnostic testing, accessible and affordable laboratory services, convenience

for healthcare providers and patients and reliable result reporting are some of the market needs.

Competitive Landscape:

While there might be limited direct competition in rural areas, established laboratory chains such as Lancet, Ampath, and Pathcare and public facilities such as the NHLS could expand their services to capture this market. These laboratories offer a wide range of diagnostic tests and typically focus on quality, reliability, and efficiency. However, their presence in rural areas is limited, leaving underserved populations with fewer options for diagnostic services. There are currently very few private Laboratories in Vhembe district, namely, the LLM laboratory in Louis Trichardt, and Capricon diagnostix medical laboratory in Thohoyandou; Lancet laboratory is in Malamulele, Louis Trichardt, and Thohoyandou, while Ampath is in Louis Trichardt and Thohoyandou.

By strategically locating laboratories in underserved areas and investing in infrastructure and logistics, these players could broaden their reach and gain a competitive advantage in the market.

The NHLS dominates the public sector, providing diagnostic services primarily to government hospitals and healthcare facilities. However, NHLS often faces challenges such as capacity constraints and sample transportation delays, resulting in longer turnaround times for test results and unfortunately this does affect health outcomes in some instances.

The shift towards personalised medicine and preventive healthcare creates a demand for accurate and timely diagnostic services.

Increasing awareness of the importance of early diagnosis and disease monitoring can drive demand for accessible laboratories.

5.5 Marketing Mix

The marketing mix outlines the strategies for product, price, place, and promotion:

Product

The primary product offered by medical laboratories is high quality and reliable diagnostic testing services. The laboratory will focus on providing a diverse and comprehensive range of tests relevant to the local healthcare needs or conditions, with an emphasis on accuracy, reliability, and rapid TAT.

Price

Pricing strategies should be balanced and consider affordability for the rural population while ensuring sustainability for the business. Potential pricing models include Competitive pricing to ensure affordability for the local population; discounts for profile tests from clinicians, clinics, and hospitals; and potential collaborations with insurance schemes and government healthcare programs and initiatives to support cost-effective service are the potential pricing model for this proposal.

The competitive price list of the test scope is in Appendix 1 and has been drawn after

price market analysis of private laboratories such as Lancet and Pathcare, as well as consulting the price list for Medical Technologist from Discovery Health medical aid (Appendix 9).

Place

Strategic placement of laboratories in underserved rural areas, focusing on the Vhembe district initially by locating laboratories within or near healthcare facilities in remote areas to make the services easily accessible to healthcare practitioners and patients.

Partnerships with existing clinics, hospitals, and local healthcare providers for sample collection to enhance accessibility will be established.

Promotion

Promotional activities focus on creating awareness of the new laboratory services, emphasizing the importance of timely and accurate diagnostics and healthcare outcomes as benefits of improved TAT, and support for the NHI program. Collaborations with local healthcare providers, workshops, and informational campaigns can be effective promotional tools.

Partnering with local community leaders and healthcare workers to build trust and rapport, including the use of digital marketing, and leverage word-of-mouth in communities.

People

In the context of the expansion of medical laboratories in rural areas, the "People" aspect of the marketing mix refers to all the individuals involved in the process, including employees, healthcare professionals, laboratory technicians, administrative staff, and even the patients themselves.

Employees and Healthcare Professionals:

Skilled laboratory technicians and pathologists will play a critical role in conducting accurate tests and providing reliable, quality results.

Administrative staff will manage appointments, capturing of patient and doctor's information, and patient records, and ensure smooth operations including efficient communication between the laboratory and healthcare providers and handling of

patient queries.

Couriers or drivers responsible for the safe, timely collection, transportation, and delivery of samples from healthcare providers to the laboratory.

Medical practitioners and healthcare workers who refer patients for testing and interpret results.

Ongoing training and skill development programs for all staff ensure they stay up to date with the latest advancements in diagnostic technology and maintain high service standards is a requirement.

Process

Streamlined sample collection, transportation, testing, and reporting processes to ensure quick and accurate results.

The "Process" aspect of the marketing mix refers to the operational procedures, protocols, and workflows involved in delivering the laboratory services. For a medical laboratory, efficient and accurate processes are critical to ensuring quality diagnostic services.

Sample Collection and Transportation: This process involves effective coordination and communication with healthcare providers to ensure proper sample collection, appropriate handling, and timely transportation to the laboratory to avoid delays and ensure sample integrity.

Sample Processing and Analysis: This step involves laboratory technicians conducting tests according to established protocols. Ensuring accuracy, minimizing errors, and maintaining quality control measures are vital to reliable results.

Result Reporting and TAT: The laboratory process includes the reporting of results to healthcare providers and patients. This step requires clear and standardized reporting formats, as well as efficient communication channels and streamlined processes to deliver results promptly.

Quality Assurance and Compliance: Compliance with regulatory standards, accreditation requirements, and quality assurance protocols is a continuous process. Regular audits, proficiency testing, and internal quality control checks are essential to

maintain accurate and reliable testing.

Physical Evidence

Well-equipped and modern laboratories with reliable diagnostic equipment, clean and hygienic environment, and excellent customer service.
The "Physical Evidence" aspect of the marketing mix pertains to the tangible elements that customers can perceive when interacting with the service. In the case of medical laboratories in rural areas, physical evidence plays a significant role in building trust and credibility.

Laboratory Facilities: The physical appearance and layout of the laboratory can influence the perception of quality. Clean, organized, and well-equipped facilities convey professionalism and reliability.

Equipment and Technology: Modern and well-maintained laboratory equipment signifies technological advancement and the capability to provide accurate test results.

Sample Collection Centers: If the laboratory collaborates with healthcare providers Sample collection serves as an extension of the laboratory's brand image and should be easily identifiable and established in collaboration with healthcare providers for convenient specimen submission. They should have comfortable waiting areas and friendly staff to ensure a positive patient experience.

Branding and Marketing Collateral: Physical evidence also includes branding elements such as logos, signage, brochures, and online presence. This should communicate the laboratory's commitment to quality, accuracy, and accessibility in rural areas.

Accreditation Certifications: Displaying accreditation certificates and quality certifications in the laboratory and on promotional materials provides tangible evidence of adherence to high standards.

5.6 Situational Analysis (environmental, industry, and competitor analysis)

5.6.1 Macro Environmental Analysis

Table 17: PESTEL Analysis

Issue	Impact on business	Issue	Impact on business
Political		**Economic**	
Government policy support for improving healthcare access in rural areas,	can provide favourable policies, funding, and incentives for the expansion of medical laboratories.	Economic growth and development in rural areas,	could lead to increased healthcare spending creating a potential market for private medical laboratories.
The South African government's commitment to implementing the National Health Insurance (NHI) program,	creates a favourable environment for private medical laboratories to support the program's objectives.	The economic condition of the country, including GDP growth, income levels, and healthcare expenditure,	will impact the financial feasibility of establishing and sustaining medical laboratories in rural areas.
		Government policies on healthcare funding and subsidies,	can significantly affect and promote the business of establishing laboratories in underserved areas.
		The potential increase in demand for healthcare services due to the NHI implementation	could create business opportunities for private medical laboratories.
Social		**Technological**	
The inadequate healthcare infrastructure in rural areas,	highlights the social need for improved access to diagnostic services.	Advancements in medical technology, equipment, and diagnostic tools,	could make it feasible to establish efficient and cost-effective laboratories in remote areas, and can enable efficient and accurate testing, contributing to improved healthcare outcomes.
Growing awareness of the importance of early diagnosis and healthcare access,	could drive demand for medical testing laboratories.	The availability of reliable telecommunication infrastructure,	can enable remote result reporting and data management.
Cultural factors and health behaviours of the local population,	can also influence the utilization of laboratory services.	Adoption of digital health platforms and integrating these systems,	will make results to be readily available once completed for early disease detection and treatment.
Environmental		**Legal**	
Environmental regulations adherence for safety waste disposal and sustainability considerations	might impact the establishment and operation of laboratories in these areas.	Regulatory approvals, quality standards, accreditation requirements, licensing, and compliance with healthcare regulations essential for maintaining quality and ensuring patient safety,	will play a critical role in the establishment and functioning of medical laboratories.
The physical environment of rural areas, including transportation infrastructure, access to utilities, and the availability of suitable locations for laboratory facilities,	will impact the operational logistics and costs.	Any changes in healthcare policies and regulations,	can affect the business's viability.

5.6.2 Industry analysis

The medical diagnostics industry plays a critical role in the healthcare ecosystem. The need for accurate and timely diagnostic services is ever-growing due to increased awareness, aging populations, and the rising prevalence of chronic diseases (Porter & Lee, 2013). The demand for diagnostics is further amplified in underserved rural areas due to limited access to healthcare facilities and services (Lancet, 2021). As South Africa advances toward the implementation of the NHI program, the importance of accessible and quality diagnostic services becomes even more pronounced.

Competitor Analysis

Existing Medical Laboratories:

Existing competitors in the medical diagnostics sector include public healthcare laboratories, NHLS, and private diagnostic laboratories (e.g., Ampath, Lancet, Pathcare). The NHLS dominates the public sector, but it often faces challenges of capacity, resource constraints, and sample transportation delays, leading to longer turnaround times. Private laboratories, on the other hand, focus on urban, and semi-urban areas and private healthcare providers, leaving underserved rural areas with limited options. The proposed venture aims to address this gap by providing accessible and efficient diagnostic services in remote areas, thereby potentially gaining a competitive advantage through geographic expansion and improved turnaround times.

Private laboratory chains could potentially expand their services to rural regions.

Local entrepreneurs or start-ups might recognize the market gap and establish small-scale laboratories to serve their communities.

SWOT Analysis

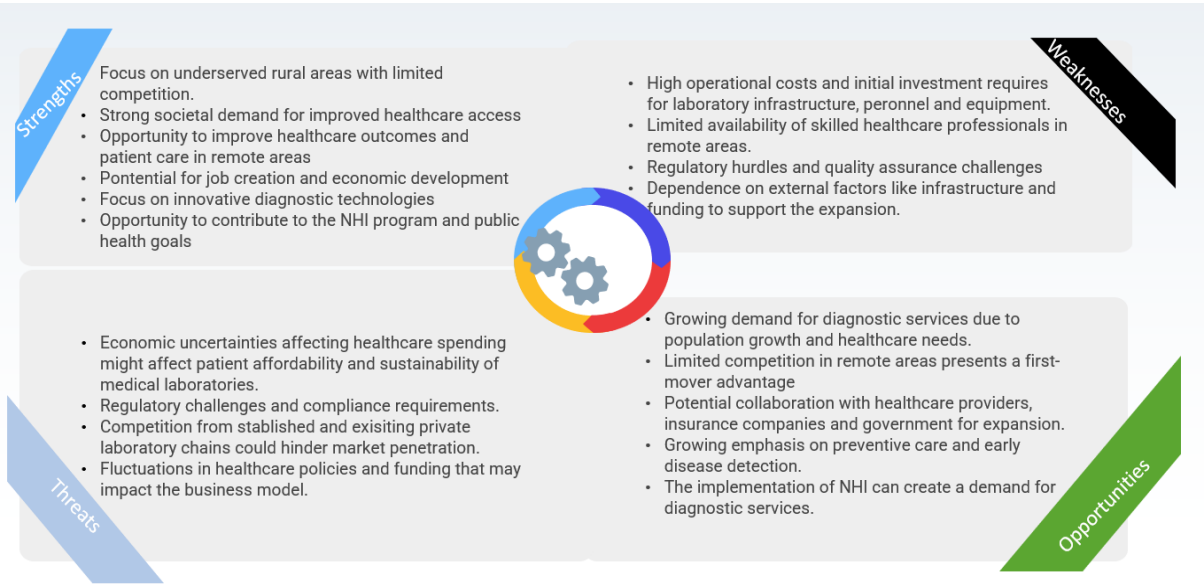


Figure 12: SWOT Analysis

VRIO analysis was further used to assess the capabilities of the venture proposal.

Table 18 : VRIO Analysis

V	Value: Convenient and unique diagnostic testing services tailored to Vhembe rural areas, addressing a critical need for improved healthcare outcomes.
R	Limited Competition for diagnostic testing services in rural areas of Vhembe giving the venture a rarity advantage.
I	High Entry Barriers due to significant investment, specialised equipment, and regulatory approvals that are required, make it difficult for competitors to imitate. Building partnerships with local healthcare providers and communities creates a unique network that is challenging for competitors to replicate.
O	Streamlined processes and efficient resource utilisation enhance the venture's capability to deliver high-quality diagnostic services in rural areas.

5.6 Research and Development (R&D)

The following key initiatives can be implemented:

Community Outreach: Develop tailored outreach programs to educate rural communities on preventive care and the importance of diagnostic testing, collaborating with local stakeholders for culturally sensitive materials.

Quality Improvement: Launch projects to enhance testing accuracy and reliability, including innovative quality assurance methods and standardized procedures, while investing in staff training for consistent service and regulatory compliance.

Academic Partnerships: Forge collaborations with academic institutions to leverage expertise in research and technology for joint ventures exploring new diagnostic methods and conducting trials in rural healthcare settings.

Continuous Innovation: Foster a culture of ongoing innovation by encouraging staff involvement in R&D, implementing feedback mechanisms from healthcare providers and communities, and adapting to emerging needs.

5.7 Management and Organisation

Healthcare Laboratory Diagnostics is comprised of Shareholders, a CEO, and a Laboratory Manager who form part of management, as well as an administrator and a courier/messenger.

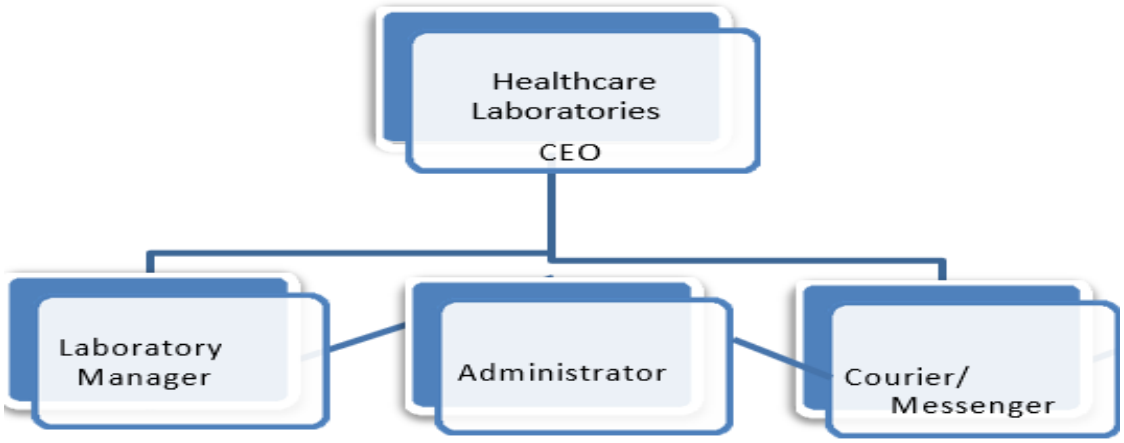


Figure 12: Company organogram

5.8 Business Financials

R1000 000 is the total start-up capital needed for this business, the capital will come from Angel investors as well as the Industrial Development Corporation (IDC) - the largest state-owned development finance institution that provides funding in SA and the rest of Africa for industry development (IDC, 2023)

Summary of operations before financing

Before seeking financing, the venture will focus on laying the groundwork for its operations, establishing essential infrastructure, and conducting in-depth market research to assess the demand for diagnostic testing services in rural areas of Vhembe District. This will involve analysing demographic data, healthcare trends, competitor analysis, and potential customer preferences to identify market gaps and opportunities.

Infrastructure requirements will also be looked at, including required licenses, permits, and regulatory requirements, and physical infrastructure including laboratory facilities, and equipment.

Current Shareholder Loans Outstanding: As of the present, there are no outstanding shareholder loans.

Funds Required and Timing: The venture requires a total funding of R1,000,000 to initiate operations and establish medical laboratories in rural areas of Vhembe District. The timing for obtaining this funding is within the next 12 months to expedite the setup process and capitalize on the market demand for diagnostic testing services.

Use of Proceeds: The funds will be allocated towards various operational expenses including infrastructure setup, equipment procurement, staff recruitment and training, regulatory compliance, marketing and branding activities, and initial working capital requirements.

The Deal on Offer: The venture offers investors an opportunity to participate in a socially impactful business venture that aims to improve healthcare outcomes in underserved rural communities. Investors will receive equity stakes in the company in exchange for their investment, with the potential for dividend distributions and capital appreciation over time.

Anticipated Gearing and Interest Cover: The venture plans to optimise its capital structure by balancing debt and equity financing to minimize financing costs and maximize returns for investors. Anticipated gearing will be kept at a conservative level to ensure manageable debt servicing obligations. Interest cover ratios will be monitored closely to ensure sufficient cash flow to meet interest payments.

Expected Returns: Investors can expect attractive returns on their investment, driven by revenue growth from expanding service offerings, capturing market share, and delivering high-quality diagnostic testing services. The venture aims to achieve sustainable profitability and provide competitive returns to investors over the long term.

Exit Routes for Investors: The venture will explore opportunities to exit through strategic partnerships or buy-back arrangements, providing liquidity and potential capital gains for investors seeking to divest their holdings.

Cost projections and Sales Forecasts

The estimated cost projections in Appendix 2 as well as the sales forecast in Appendix 3 are based on the market analysis. Reagents prices were obtained from different suppliers including Biorom Medical Supplies with online Roche diagnostic prices and Beckman Coulter, Biomerieaux, and Kat Medicals quotations (Appendix 7), The baseline test profiles consist of Urea and electrolytes (U&E), Liver Function Test (LFT), Calcium, Magnesium and Phosphate (CMP), C- Reactive Protein (CRP), Lipid Profile, Troponin T, Pro-BNP, and Full Blood Count (FBC) with the expansion of scope not ruled out. These are the routine and urgent tests that clinicians frequently request. The pricing of the test repertoire came from analysing the price data from private laboratories such as Pathcare which is available online, as well as the Discovery Health Medical Technologist rates spreadsheet (Appendix 8). The estimated number of tests was influenced and recommended by the investigation done on the newly established medical laboratories, with information provided by my former colleagues whom I interviewed, who are now directors of Bled Pathology and Arise Health Laboratories.

The sales forecast is predicated on projected volume increases of 25% in the second year, 20% in the third year, 15% in the fourth year, and 10% in the fifth year, with due consideration to customer loyalty. Additionally, a 6% price projection increase is applied to both reagent costs and sales costs, aligning with the maximum inflation rate (Stassa, 2023). This approach ensures that anticipated growth in sales volume and prudent pricing adjustments are factored into the financial projections, maintaining competitiveness while accounting for market dynamics.

Summary of performance ratios

Appendix 6 indicates the Healthcare Laboratories' financial ratios which collectively reflect a positive trend, indicating sound financial health and operational efficiency. Profitability ratios show consistent improvement, with both gross and net profit margins increasing over time. Liquidity ratios demonstrate strengthening liquidity positions, while efficiency ratios suggest improved inventory management. Although the growth rate has slowed, the venture continues to exhibit positive revenue growth. Return ratios indicate positive returns on assets and equity, albeit with some fluctuations. Overall, the venture's performance across various financial metrics suggests a stable and growing business with effective management practices.

Table 19: Projected Statement of Comprehensive Income (Income Statement)

Revenue	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Gross Sale	1 995 600	R2 676 000	R3 439 080	R4 234 320	R4 988 640
Costs	1 681 692	1 717 016	1 809 877	1 911 612	2 021 571
Gross Profit/ Loss	**313 908**	**958 984**	**1 629 203**	**2 322 708**	**2 967 069**
Operating Expenses (Projected increases based on 2023 inflation rate of 6%)					
HPCSA Annual Registration	369	369	369	369	369
Advertising	10 000	10 000	5000	3000	3000
Salaries	1 152 000	1 221 120	1 294 387	1 372 050	1 454 373
Equipment	134 600	69 600	69 600	69 600	69 600
Reagents	129 235	136 989	145 208	153 920	163 155
Furniture	40 000	-	-	-	-
Rent	10 000	10 600	11 236	11 910	12 625
Miscellaneous	18000	19080	20225	21439	22725
Car and Petrol Expenses	223 000(175+48000)	50 880	53 933	57 169	60 599
Telephone and WIFI (Fixed)	6000	6000	6000	6000	6000
Insurance	1200	1272	1348	1429	1515
Employer Contribution (UIF, SDL, COIDA)-	30 528 (2.65% of salaries)	32 360	34 301	36 359	38 541
Pension Fund Contribution (13%)	149 760	158 746	168 270	178 367	189 069
Total Expenses	**(1 681 692)**	**(1 717 016)**	**(1 809 877)**	**(1 911 612)**	**(2 021 571)**
Profit Before Tax	313 908	958 984	1 629 203	2 322 708	2 967 069
Corporate Tax Payable (27% Gross sale)	538 812	722 520	928 552	1 143 266	1 346 933
Net Profit	**(224 904)**	**236 464**	**700 651**	**1 179 442**	**1 620 136**

Based on Table 19 (Income statement), Healthcare laboratories will make a profit from the second year of operation. The income statement indicates a positive outlook for the venture, with steady revenue growth, improving profitability, and effective cost management. However, it's essential to monitor and manage expenses carefully to ensure continued financial health and sustainable growth.

Table 20: Projected Statement of Financial

	Year 1	Year 2	Year 3	Year 4	Year 5
Current Assets	**1461143**	**1351517**	**2495287**	**3677509**	**4773085**
• **Investment/ Cash**	1000 000	236 464	700 651	1179442	1 620 136
• **Profit**	313 908	958 984	1 629 203	2 322 708	2 967 069
• **Inventory**					
Reagents	129 235	136 989	145208	153920	163155
Miscellaneous	18000	19080	20225	21439	22725
Fixed Assets	**280000**	**251000**	**218000**	**189000**	**163000**
Car	175 000	156000	133000	112000	94000
Equipment	65 000	59000	53000	48000	43000
Furniture	40 000	36000	32000	29000	26000
(Car depreciation calculator values and 10% depreciation for equipment & furniture).					
Total Assets	**1741143**	**1602517**	**2713287**	**3866509**	**4936085**
Current Liabilities	**1193728**	**1265352**	**1341272**	**1421747**	**1507054**
Rent	10000	10600	11236	11910	12625
Salary costs	1152000	1221120	1294387	1372050	1454373
Employer contributions	30528	32360	34301	36358	38541
Insurance	1200	1272	1348	1429	1515
Tax payable	538812	722520	928552	1143266	1346933
Long Term Liabilities	**149760**	**158746**	**168270**	**178367**	**189069**
Pension Contributions	149760	158746	168270	178367	189069
Total Liabilities	**1882300**	**2146618**	**2438094**	**2743380**	**3043056**
Net Asset/ Owner's Equity (TA-TL)	**(141157)**	**(544101)**	**275193**	**1123129**	**1893029**
Total Liabilities and Stakeholder Equity	**1741143**	**1602517**	**2713287**	**3866509**	**4936085**

The venture's balance sheet demonstrates positive growth trends, manageable liabilities, and increasing owner's equity, indicating financial health and sustainability over the projected five years.

Assumptions underpinning financial forecasts.

The industry analysis has revealed a scarcity of private testing laboratories in the rural areas of Vhembe. Therefore, the assumption is that a substantial unmet demand for diagnostic testing services exists in these regions. By establishing the venture in these underserved areas, accessibility to timely and accurate diagnostic services will improve, consequently enhancing health outcomes.

Despite the demand, the significant capital required acts as a barrier to entry for new ventures in the market. However, the assumption is that the venture will secure the startup funding of R1,000,000 on favorable terms. This will include funding capital from Angel investors and institutions such as IDC to optimize the capital structure while minimising financing costs.

Projections for revenue growth are based on a five-year business plan. These projections consider factors such as customer acceptance and loyalty, market growth trends, pricing strategies relative to inflation rates, and the introduction of new services or tests. The underlying assumptions include a yearly increase in test volumes from the second to the fifth year, with growth rates of 25%, 20%, 15%, and 10%, respectively as the market gets saturated. Economic indicators, such as the inflation rate, will be closely monitored to facilitate adjustments in pricing and cost projections, thereby mitigating the impact of external economic factors. Sales assumptions include an annual price increase relative to a 6% inflation rate.

The cost structure will be carefully managed by optimising labour, equipment, and supply chain expenses while ensuring compliance with quality standards and regulatory requirements. This disciplined approach will help in maintaining profitability and operational efficiency.

Capital expenditures will be strategically allocated to support the establishment and expansion of medical laboratories. Priority will be given to expenditures such as setting up and maintaining medical laboratories, purchasing equipment and reagents, upgrading technology, and expanding infrastructure. This strategic allocation will ensure the efficient utilisation of financial resources.

Leveraging insights from Chapter 4, which underscored the urgent need for improved healthcare outcomes in rural areas, the assumption is that the venture will experience steady revenue growth over time. This growth will occur as the venture expands its service offerings and reaches more communities, thereby positively impacting health outcomes.

While the company's projections are conservative, it's important to acknowledge that the assumptions underlying these forecasts may not guarantee their accuracy or the achievement of forecasted sales. Monitoring and adjustment of these assumptions will be necessary to adapt to changing market conditions and ensure the financial viability of the venture.

The company will purchase small equipment such as centrifuges, microscopes, rotators, pipettes, etc. while leasing big analysing instruments such as Hematology and Chemistry automated instruments. The procurement will also include maintenance services and a

five-year guarantee to ensure the reliability and performance of the equipment. The equipment will be depreciated over three to five years, depending on the type of equipment. This depreciation schedule will be applied to accurately reflect the wear and tear of the equipment over its useful life and to allocate its cost appropriately over time.

Summary:

The venture proposal outlines a strategic plan to expand medical laboratories in underserved rural areas, particularly in South Africa's Vhembe district, to improve healthcare accessibility. Through comprehensive situational and market analyses, the proposal identifies a unique market position due to limited competition in rural areas. Leveraging SWOT analysis, it capitalizes on strengths, addresses weaknesses, and seizes opportunities while mitigating threats.

Targeting the underserved rural population, the venture aims to meet the demand for diagnostic services by strategically locating laboratories and offering a diverse range of tests at competitive prices. The marketing strategy emphasizes product excellence, competitive pricing, strategic placement, and effective promotion to build trust and accessibility.

Financial projections demonstrate the venture's viability and profitability over five years, with startup capital sourced from various investors. Detailed cost estimates and sales forecasts are based on market analysis, consultations, and data from existing laboratories. Overall, the proposal underscores the potential of the venture to address critical healthcare needs while achieving sustainable growth and profitability in the market.

CHAPTER 6:

6. CONCLUSION

In conclusion, expanding medical laboratories in rural areas is a promising business proposal considering the unmet demand for diagnostic services, the potential for contributing to public health goals, and the anticipated changes in healthcare access through programs like NHI. The proposed expansion of medical laboratories in rural areas, specifically within Vhembe district of Limpopo, presents a significant opportunity to bridge the healthcare gap and improve diagnostic services, healthcare outcomes, and overall quality of life for underserved populations. The proposed venture aligns with the goals of the NHI program, responds to social and economic needs, and capitalizes on technological advancements to deliver effective and efficient healthcare solutions.

However, the venture would need to address various challenges related to funding, regulatory compliance, infrastructure development, and skilled personnel recruitment to ensure its success in improving healthcare outcomes and bridging the healthcare gap in underserved regions.

By analysing the macro environment, industry dynamics, and competition, and conducting a SWOT analysis, the business can position itself strategically. A detailed understanding of the target market, value proposition, differentiation, and marketing strategies will be crucial for the successful establishment and growth of the medical laboratories.

Business Risk Analysis:

This venture's risk analysis aims to identify potential threats and vulnerabilities, develop mitigation strategies, and minimize adverse outcomes. By assessing market, operational, and financial risks, the analysis provides insights to prioritise risk management efforts. The outcome helps in understanding vulnerabilities and implementing measures to enhance resilience and achieve long-term success in the healthcare industry. A detailed Healthcare laboratory risk analysis is in Appendix 3.

List of References:

Abraham, C., & Sheeran, P. (2015). *The Health Belief Model*. Retrieved from https://www.researchgate.net/publication/290193215_The_Health_Belief_Model. Accessed 26 April 2023.

Alrawahi, S., Alsalahi, N., Al-Mawali, A., & Al-Mawali, S. (2018). *Factors affecting job satisfaction among medical laboratory technologists in University Hospital, Oman*: An exploratory study. Retrieved from https://www.researchgate.net/publication/328634530_Factors_affecting_job_satisfaction_among_medical_laboratory_technologists_in_University_Hospital_Oman_An_exploratory_study. Accessed on 12 February 2023.

Barron, P., Day, C., Monticelli, F., Sello, E., & Schneider, H. (2018). *South African Health Review 2018. Health Systems Trust.* Retrieved from https://www.hst.org.za/publications/South%20African%20Health%20Review%202018.pdf. Accessed on 12 February 2023.

Binangwaho, A., & Nutt, C.T. (2015). *Public-private partnership in the Rqandan health system: A unique approach to public health improvement*. The Lancet Global Health, 3(6), e319-e320. doi: 10.1016/S2214-109X(15)00090-0. Accessed 18 February 2023.

Bioprom Medical supplies (2023). Roche reagents. Retrieved from https://bioprom.gr/en/product-category/reagents/roche-reagents/cobas-c-111-en/. Accessed on 16 October 2023.

Boufford, J. I., Mariam, D. H., & Gostin, L. O.(2017). A proposed framework for developing health-focused public-private partnerships based on national sustainable development priorities. National Academy of Medicine. Retrieved from https://nam.edu/a-proposed-framework-for-developing-health-focused-public-private-partnerships-based-on-national-sustainable-development-priorities/. Accessed 19 February 2023.

Bougie, R., & Sekaran, U. (2019): Research methods for business: A skill building approach. John Wiley & Sons.

Buonanno, G., Cammarota, M., Carbone, A., Contursi, M., Grella, R., Guido, M., . . . Villani, S. (2016). *Establishing a laboratory service in a rural area*: The experience of "Laboratorio Analisi Mediche" in Melfi, Italy. Annals of Translational Medicine, 4(Suppl 1). doi: 10.3978/j.issn.2305-5839.2016.02.03

Brink et al. (2012). Carter, J. Y. (2010). *Needs assessment for strengthening laboratory human resources capacity for universal access to HIV, malaria and TB services in three sub-Saharan countries*. World Health Organization. Retrieved from https://apps.who.int/iris/bitstream/handle/10665/44496/9789241500920_eng.pdf;sequence=1. Accessed on 19 February 2023.

Burns, N., & Grove, S. K. (2005). The Practice of Nursing Research: Conduct, Critique, and Utilization (5th ed.).

Census. (2022). Provinces at a glance. Retrieved from https://census.statssa.gov.za/assets/documents/2022/Provinces_at_a_Glance.pdf. Accessed 12 April 2024.

Centers for Disease Control and Prevention. (2018). *Strengthening Clinical Laboratories.* Division of Laboratory Systems (DLS). Retrieved from https://www.cdc.gov/csels/dls/strengthening-clinical-labs.html. Accessed on 19 February 2023.

Coetzee, L. M., Cassim, N., Glencross, D. K., Coetzee, L. M., & Cassim, N. (2015). *Implementation of a new 'community' laboratory CD4 service in a rural health district in South Africa extends laboratory services and substantially improves local reporting turnaround time*. Retrieved from https://pubmed.ncbi.nlm.nih.gov/26792313/. Accessed on 20 March 2023.

Corporative Governance and Traditional Affairs. (2020). *Profile and analysis district development model.* Vhembe district municipality.

Cousera. (2023). *Market Analysis: What It Is and How to Conduct One*. Retrieved from https://www.coursera.org/articles/market-analysis. Accessed on 25 September 2023.

Creswell, J.W, (2014), *Research design:* qualitative, quantitative and mixed methods approaches. 4th edition.

Creswell. J.W. and Creswell, J.D. (2017) Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 4th Edition, Sage, Newbury Park.

Deloitte. (2019). *Using Lean Startup Methodology to Enhance Healthcare*. Retrieved from https://www2.deloitte.com/us/en/pages/life-sciences-and-health-care/articles/using-lean-startup-methodology-to-enhance-healthcare.html. Accessed on 16 May 2023.

De Vos, A.S, Strydom, H., Fouche, C.B, & Delport, C.S (2011). *Research at Grassroots for social Sciences*. Cape Town: VanSchalk Publishers.

Driessen, J., van den Hombergh, J., Mfinanga, S., & Pai, M. (2015). *Informatics solution for bridging the gap between clinical and laboratory services in a low-resource setting.* Retrieved from https://www.researchgate.net/publication/279231974_Informatics_solutions_for_bridging_the_gap_between_clinical_and_laboratory_services_in_a_low-resource_setting. Accessed on 04 March 2023.

Discovery health. (2020). Medical Technologist Test Rates Excel Spreadsheet.

Fink, A. (2003): *The Survey Handbook. Development.* Psychological Assessment, 7(3), 309-319.

Hawkins, R. C. (2007). *Laboratory Turnaround Time*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2282400/pdf/cbr28_4p179.pdf. Accessed on 20 March 2023.

Heidi, M., Neck, H. M., & Green, S. (2021). Entrepreneurship: The Practice and Mindset (2nd ed.).

Horton, S., Sullivan, R., & Flanigan, J. (2018). *Pathology and laboratory medicine in low-income and middle-income countries 3 Delivering modern, high-quality, affordable pathology and laboratory medicine to low-income and middle-income countries: a call to action*. The Lancet, 391(10133), 1953-1964. https://doi.org/10.1016/S0140-6736(18)30460-4. Accessed on 20 March 2023.

Industrial Development Corporation. (2023). *Funding Solutions Info Hub*. Retrieved from https://www.idc.co.za/funding-solutions-hub/. Accessed on 16 October 2023.

Indwe. (2022). *The importance of diagnostic testing in improving patient care*. Retrieved from https://www.indwe.co.za/indwe-blog/the-importance-of-diagnostic-testing-in-improving-patient-care/. Accessed on 20 March 2023.

Jack, S. M., Sefa, N., & Yirenya-Tawiah, D. (2014). *Measuring the health systems impact of disease control programmes: A critical reflection on the WHO building blocks framework*. Retrieved from https://www.researchgate.net/publication/261102054_Measuring_the_health_systems_impact_of_disease_control_programmes_A_critical_reflection_on_the_WHO_building_blocks_framework. Accessed on 20 March 2023.

Joudyian, N., Ahmadi, S. F., Maleki, M. R., Moghaddam, S. S., Khosravi, S., & Foroushani, A. R. (2021). *Public-private partnerships in primary healthcare*: A scoping review. BMC Health Services Research, 21(1), 270. Retrieved from https://doi.org/10.1186/s12913-020-05979-9. Accessed on 20 March 2023.

Kleinert, S., & Horton, R. (2018). *Laboratory medicine in low-income and middle-income countries*: Progress and challenges. The Lancet, 391(10133), 1873-1874. https://doi.org/10.1016/S0140-6736(18)30308-8. Accessed on 20 March 2023.

Koster, W., Delaporte, E., Cappellini, M. D., & Mbanya, D. (2021). *An oral history of medical laboratory development in francophone West African countries*. African Journal of Laboratory Medicine, 10(1), a1115. https://doi.org/10.4102/ajlm.v10i1.1115. Accessed on 20 March 2023.

Lazarus, J. V. (2014). *A new era for the WHO health system building blocks?* Retrieved from https://healthsystemsglobal.org/news/a-new-era-for-the-who-health-system-building-blocks/. Accessed on 26 April 2023.

Lazarus, J. V., Safreed-Harmon, K., Nicholson, J., Jaffar, S., & de Pinho, H. (2014). *Health service delivery models for the provision of antiretroviral therapy in sub-Saharan Africa*: a systematic review. Retrieved from https://www.researchgate.net/publication/264288544_Health_service_delivery_model

s for the provision of antiretroviral therapy in sub-Saharan Africa a systematic review. Accessed on 26 April 2023.

Lancet. (2021). The Lancet Commission on diagnostics: *transforming access to diagnostics.* Retrieved from https://bmchealthservres.biomedcentral.com/articles/10.1186/s12913-015-1114-7. Accessed on 16 October 2023.

Maphanga, T. E., Mulaudzi, M. V., & Kamanzi, A. (2019). *The challenges of establishing a medical testing laboratory in rural South Africa. African Journal of Laboratory Medicine*, 8(1), 1-7. https://doi.org/10.4102/ajlm.v8i1.675. Accessed on 21 March 2023.

Maphanga, T., & Ngoepe, M. (2019). *Evaluation of the performance of rural primary healthcare.* Retrieved from https://scholar.google.co.za/scholar. Accessed on 21 March 2023.

Maphanga, T., Mashele, S., Makhado, L., Mhlongo, M., & Kgatle, M. (2019). *Challenges of establishing medical laboratories in rural areas of South Africa*: A qualitative study. South African Journal of Laboratory Medicine, 5(1), 1-6.

Maphumulo, W. T., & Bhengu, B. R. (2019). *Challenges of quality improvement in the healthcare of South Africa post-apartheid*: A critical review. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6556866/pdf/CUR-42-1901.pdf. Accessed on 21 March 2023.

Massyn, N., English, R., McCracken, P., Ndlovu, N., Gerritsen, A, Bradshaw, D., & Groenewald, P. (2015). *Disease Profile for Vhembe Health District Limpopo*. Retrieved from https://www.hst.org.za/publications/HST%20Publications/Disease%20profile%20for%20Vhembe_2015.pdf. Accessed on 24 May 2023.

Mesfin, Y. M., Taye, B., Belay, G., & Legesse, T. (2017). *Factors affecting quality of laboratory services in public and private health facilities in Addis Ababa, Ethiopia*. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5655637/pdf/ejifcc-28-205.pdf. Accessed on 19 March 2023.

Mulaudzi, M. V., & Malema, R. N. (2017). *Rural healthcare services in South Africa*: A review. Internet Journal of Medical Update, 12(1), 1-8. Retrieved from https://www.researchgate.net/profile/Mulalo_Mulaudzi/publication/317934961_Rural_healthcare_services_in_South_Africa_A_review/links/59d20754a6fdccfd5a7ed5fb/Rural-healthcare-services-in-South-Africa-A-review.pdf. Accessed on 19 March 2023.

Moran, Z. R., Gonzalez, G., & Sanchez, A. (2019). *Tropical Laboratory Initiative*: An innovative model for laboratory medicine in rural areas. Southern African Journal of Infectious Diseases, 34(1), 20-24. Retrieved from http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S2225-20102019000100020. Accessed on 20 March 2023.

Namuhani, N., Nanyonjo, A., Sekandi, J. N., Mukimba, N., & Kiwanuka, N. (2021). *Laboratory diagnostics performance in Uganda*: A survey of test availability and constraints across

100 laboratories. Research Square. Retrieved from https://doi.org/10.21203/rs.3.rs-842323/v1. Accessed on 20 March 2023.

Naz, S., Naqvi, S. H., Ahmad, M., & Khalid, N. (2012). *Preanalytical errors and their impact on tests in clinical laboratory practice*. Pakistan Journal of Medical Research, 51(1), 27-30. Retrieved from https://applications.emro.who.int/imemrf/Pak_J_Med_Res/Pak_J_Med_Res_2012_51_1_27_30.pdf. Accessed on 19 March 2023.

Ntuli, S.T., and Maboya, E. (2017). Geographical distribution and profile of medical doctors in public secto hospitals of the Limpopo Province, South Africa. Retrieved from https://www.researchgate.net/publication/320067842_Geographical_distribution_and_profile_of_medical_doctors_in_public_sector_hospitals_of_the_Limpopo_Province_South_Africa. Accessed on 24 May 2023.

O'Driscoll, A. (2022). *The importance of laboratory quality and how to achieve it*. Lab Manager. Retrieved from https://www.labmanager.com/insights/the-importance-of-laboratory-quality-and-how-to-achieve-it-27442. Accessed on 21 March 2023.

Omali, D., Kibuule, D., Chimoyi, L., Matovu, J., Ndashimye, E., Lubbe, M. S., & Godman, B. (2023). *Building clinical pharmacology laboratory capacity in low- and middle-income countries*: Experience from Uganda. African Journal of Laboratory Medicine, 12(1), 1-10. Retrieved from https://ajlmonline.org/index.php/ajlm/article/view/1956/2561. Accessed on 19 March 2023.

Pathcare. (2023). Fees lookup. Retrieved from https://www.pathcare.co.za/fees-lookup/. Accessed on 12 Sep 2023.

Polit, D.F., & Beck, C.T. (2014). *Essential of nursing research*: Appraising evidence for nursing practice. 8th edition.

Porter, M.E., & Lee, T.H. (2013). *The Strategy that will fix Health Care.* Retrieved from https://hbr.org/2013/10/the-strategy-that-will-fix-health-care. Accessed on 10 Sep 2023.RHIhub. (2022). *Healthcare access in rural communities*. Retrieved from https://www.ruralhealthinfo.org/topics/healthcare-access. Accessed on 20 March 2023.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.

Rosenstock, I. M. (1974). *Historical origins of the health belief model*. Health Education & Behavior, 2(4), 328-335.

SA Department of Health. (2021). *Some key messages on National Health Insurance* (NHI). Retrieved from https://www.health.gov.za/wp-content/uploads/2020/11/some-key-messages-on-nhi.pdf. Accessed on 29 January 2023.

SA Department of Health. (2017). *National Health Insurance Bill Project Details*. Retrieved from https://www.parliament.gov.za/project-event-details/54. Accessed on 29 January 2023.

Saunders, M.N.K., Lewis, P. and Thornhill, A. (2019) Research Methods for Business Students. 8th Edition, Pearson, New York.

Sayed, S., Cherniak, W., Lawler, M., Tan, N., El-Sadr, W., Wolf, N., ... & Mills, E. J. (2018). *Pathology and laboratory medicine in low-income and middle-income countries* 2 Improving pathology and laboratory medicine in low-income and middle-income countries: Roadmap to solutions. The Lancet, 391(10133), 1939-1952. https://doi.org/10.1016/S0140-6736(18)30459-8. Accessed on 12 February 2023.

Shrivastava, R., Shrivastava, S., & Ramasamy, J. (2016). *Importance of public private partnerships: Strengthening laboratory medicine systems and clinical practice in Africa*. Journal of Infectious Diseases, 213(suppl_2), S35-S40. https://doi.org/10.1093/infdis/jiv543. Accessed on 20 March 2023.

Sinha, S. (2017). T*he Lean Startup Methodology:* A Novel Approach to Management of Healthcare Delivery Organizations. Indian Journal of Community Medicine, 42(3), 139-142.

Smit, S., Odendaal, W., & Kruger, C. (2020). *Establishing a point-of-care testing service in a primary healthcare clinic in a rural setting in South Africa*. African Journal of Laboratory Medicine, 9(1), 1-7. https://doi.org/10.4102/ajlm.v9i1.1006. Accessed on 20 March 2023.

Stuckler, D., Basu, S., & McKee, M. (2011). *Health care capacity and allocations among South Africa's provinces: Infrastructure-inequality traps after the end of Apartheid*. American Journal of Public Health, 101(1), 165-172. https://doi.org/10.2105/AJPH.2009.184895. Accessed on 21 March 2023.

The Worsley Times. (2022). *Free Healthcare- An opinion on a long-time debate*. Retrieved from https://theworsleytimes.co.uk/2022/01/28/free-healthcare-an-opinion-on-a-long-time-debate/. Accessed on 22 March 2023.

Wilson, L. M., Flemming, K., Kuti, M., Looi, L., Lago, N., & Ru, K. (2018). *Access to pathology and laboratory medicine services: a crucial gap*. The Lancet, 391(10133), 1927-1938. https://doi.org/10.1016/S0140-6736(18)30458-6. Accessed on 12 February 2023.

World Health Organization. (2014). *Public-private partnerships for health: A toolkit*. Retrieved from https://www.who.int/health_financing/documents/toolkit/en/. Accessed on 26 March 2023.

Appendices:

Appendix 1: Appendix 5: Survey Questionnaire form



Name of the hospital: _____

Profession of the participant: _____

Years of laboratory usage experience: _____

Answer the following questions by selective relevant answer from 1-7 scale.

1- being highly unlikely/ highly unimportant/ highly unconfident/ highly infrequent

2- unlikely/ unimportant/ not confident/ not frequent

3- somewhat unlikely/ somewhat unimportant/ somewhat unconfident/ not so frequent

4- Neutral

5- somewhat likely/ somewhat important/ somewhat confident/ somewhat frequent

6- likely/ important/ confident/ frequent

7- highly likely/ highly confident/ highly important/ very frequent

Section 1: Diagnostic Testing Accessibility

Question 1: How significant is the importance of accessible diagnostic testing facilities in rural areas?

Question 2: To what extent do you believe the establishment of medical laboratories in rural areas would enhance access to diagnostic testing for the local population?

Question 2: How likely do you think the establishment of medical laboratories in rural areas would improve access to diagnostic testing for the local population?

Question 3: How satisfied are you with the current availability of diagnostic testing facilities in rural areas?

Question 4: How confident are you that establishing medical laboratories in rural areas would lead to more timely and accurate diagnoses?

Question 5: To what extent do you agree or disagree that accessible diagnostic testing facilities in rural areas would positively impact healthcare outcomes?

Section 2: Resource Accessibility

Question 6: How crucial is it to have access to adequate resources (equipment, supplies, trained staff) for operating medical laboratories in rural areas?

Question 7: To what extent do you agree that the establishment of medical laboratories in rural areas would address the skilled resource limitations in these areas?

Question 8: How satisfied are you with the current availability of resources for medical laboratories in rural areas?

Question 9: To what degree are you confident that establishing medical laboratories in rural areas would lead to improved resource availability for healthcare providers?

Question 10: To what extent do you agree or disagree that adequate resource availability in medical laboratories in rural areas would enhance healthcare outcomes?

Section 3: Sample Referral

Question 11: How frequent is the need to refer samples from rural areas to larger testing facilities due to laboratory inaccessibility?

Question 12: To what extent do you agree that the establishment of medical laboratories in rural areas would reduce the necessity for sample referral to larger testing facilities?

Question 13: How satisfied are you with the current process of sample transportation and referral from rural areas to larger testing facilities?

Question 14: To what degree are you confident that establishing medical laboratories in rural areas would streamline the sample referral process and reduce reliance on larger testing facilities?

Question 15: To what extent do you agree or disagree that more medical laboratories in rural areas would decrease the need of sample referral to larger testing facilities?

Section 4: Transportation

Question 16: How important do you think the timeframe of sample transportation is?

Question 17: To what extent do you think the establishment of medical laboratories in rural areas would decrease the need for sample transportation to larger testing facilities?

Question 18: How satisfied are you with the current process of sample transportation process from rural areas to larger testing facilities?

Question 19: How confident are you that establishing medical laboratories in rural areas would streamline the sample transportation processes and reduce reliance on larger testing facilities?

Question 20: To what extent do you agree or disagree that medical laboratories in rural areas would minimise the challenges associated with sample transportation?

Section 5: TAT

Question 21: How significant is the importance of having a shorter turnaround time (TAT) for diagnostic test results?

Question 22: To what extent do you believe the establishment of medical laboratories in rural areas would lead to shorter turnaround times for diagnostic test results?

Question 23: How satisfied are you with the current turnaround time for diagnostic test results?

Question 24: To what degree are you confident that establishing medical laboratories in rural areas would significantly reduce the turnaround time for diagnostic test results?

Question 25: To what extent do you agree or disagree that more medical laboratories in rural areas would enhance accessibility and healthcare outcomes through faster diagnostic test results or shorter turnaround times?

Appendix 2: Questionnaire Results Spreadsheet

record_id	Name of the hospital	Profession of the part	Years of laborato	1	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16	17.	18.	19.	20.	21.	22.	23.	24.	25.	Completed?
1	Elim hospital	Medical officer	8 years	7	7	2	7	7	7	7	3	7	7	5	7	2	7	7	7	7	5	7	7	7	7	2	7	7	Complete
2	siloam	medical officer	14	7	7	7	5	7	5	7	4	7	5	4	7	1	5	7	7	7	2	6	7	7	7	2	7	7	Complete
3	Donald Fraser Hospital	Medical Doctor	8	7	7	5	7	7	7	6	5	5	7	7	7	3	7	7	7	7	3	7	7	7	7	3	7	7	Complete
4	Donald fraser	Doctor	3	7	7	2	7	7	7	7	3	7	7	6	7	3	7	7	6	7	5	7	7	7	7	3	7	7	Complete
5	ELim	Medical officer	10	7	7	4	7	6	7	7	4	7	7	5	7	4	7	7	7	6	5	7	7	7	7	3	7	7	Complete
6	Donald Fraser	Doctor	3	6	5	4	5	6	7	5	1	5	5	6	7	5	7	5	7	5	4	6	5	6	5	5	4	5	Complete
7	Malamulele Hospital	Medical Doctor	20	7	7	3	6	7	7	7	3	7	7	5	6	3	6	6	7	6	2	6	6	7	6	3	6	6	Complete
8	tshilidzini	medical doctor	1 year	7	6	5	7	7	7	7	4	6	7	3	7	5	7	6	6	7	4	5	5	7	5	4	4	6	Complete
9	Tshilidzini	Medical doctor	1	7	6	1	6	6	6	6	2	6	7	7	7	7	7	7	7	7	1	7	7	7	7	2	7	7	Complete
10	Tshilidzini	Medical doctor	3 years	7	7	3	6	6	7	5	3	7	6	6	5	3	5	4	6	7	2	6	6	7	6	2	7	6	Complete
11	Elim Hospital	Doctor (medical officer)	4	7	7	3	7	7	7	5	5	6	7	6	5	6	6	6	7	6	5	5	6	7	7	4	7	7	Complete
12	Messina	Medical officer	5	7	7	3	7	7	7	7	5	7	7	6	7	5	7	6	6	7	6	7	6	6	6	6	6	6	Complete
13	Siloam hospital	Medical officer	3	7	4	5	7	6	7	5	3	7	7	5	6	3	6	6	7	7	4	6	6	7	7	2	7	7	Complete
14	Elim	Medical Intern	1	7	7	4	7	7	7	7	4	7	7	7	7	4	7	7	7	7	4	7	7	7	7	5	7	7	Complete
15	Elim	Medical practitioner	1year	7	7	3	6	7	7	6	3	7	7	6	6	4	6	6	7	6	3	6	6	7	6	4	6	6	Complete
16	ELIM HOSPITAL	MEDICAL INTERN	3	7	7	2	7	7	7	7	2	7	7	6	7	4	7	7	7	7	2	7	7	7	7	3	7	7	Complete
17	Donald Fraser	Medical Doctor	3	7	7	5	7	7	7	5	3	7	7	6	7	2	6	7	7	7	3	7	6	7	5	4	6	5	Complete
18	Donald Fraser hospital	Medical doctor	4	7	7	2	7	7	7	7	2	7	7	6	7	1	7	7	7	7	2	7	7	7	7	2	7	7	Complete
19	Siloam hospital	Medical Officer	8	7	7	5	7	7	7	5	5	5	7	5	7	3	7	7	7	7	6	7	7	7	7	5	7	7	Complete
20	Donald Fraser Hospital	Medical officer	4	3	7	4	7	7	1	4	2	5	7	6	5	3	6	5	7	6	5	4	6	7	7	5	7	6	Complete
21	Tshilidzini	Medicine	2	7	6	2	6	6	7	6	2	6	6	6	7	1	5	7	7	7	2	6	7	7	6	2	6	7	Complete
22	siloam	medical office	12	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	Complete
23	Malamulele	Medical Doctor	12 years	7	6	7	7	7	7	7	4	7	7	6	7	3	7	7	7	7	4	7	7	7	7	3	7	7	Complete
24	Tshilidzini Hospital	Doctor	3 yrs	6	6	3	5	7	7	6	3	6	6	7	5	3	6	7	7	6	5	6	6	6	6	4	6	6	Complete
25	Tshilidzini Hospital	Family Physician	28 years	7	7	5	7	7	7	7	2	7	7	7	7	2	7	7	7	7	2	7	7	7	7	5	7	7	Complete
26	malamulele	medical doctor	5 years	6	6	3	6	6	7	7	4	7	6	6	7	6	6	6	4	6	6	6	6	6	7	6	6	6	Complete
27	Tshilidzini	Medical Doctor	3	7	7	5	7	7	7	7	6	6	7	6	7	3	7	7	7	7	5	7	7	7	7	4	6	7	Complete
28	Donald fraser hospital	medical officer	8	7	7	4	7	7	7	7	5	7	7	6	7	3	6	7	4	7	3	7	7	7	7	6	7	7	Complete
29	Donald Fraser Hospital	Medical Doctor	3 years	7	7	3	7	7	7	7	3	7	7	7	7	2	7	7	7	7	2	7	7	7	7	2	7	7	Complete
30	Donald Fraser Hospital	Medical doctor	2	7	6	2	7	7	7	7	1	7	7	5	7	3	6	7	7	6	4	5	5	4	5	2	4	6	Complete
31	Donald Fraser	Medical officer	2	7	7	6	4	6	7	6	5	5	6	6	5	6	6	5	6	6	6	6	6	7	6	6	6	6	Complete
32	Siloam Hospital	Medical Officer	2	7	7	4	6	6	7	5	5	6	6	6	7	1	6	7	7	6	2	6	6	7	6	3	6	6	Complete
33	Siloam	MO	4	6	5	5	5	7	7	5	2	3	7	7	4	1	3	3	7	3	6	5	5	7	4	1	3	4	Complete
34	Tshilidzini	Medical officer	5	1	3	2	5	7	1	6	5	7	7	6	7	5	5	6	7	7	5	5	6	7	7	2	6	7	Complete
35	donald Fraser hospital	medical practitioner	2	7	7	6	7	7	7	7	5	7	7	7	7	7	7	7	6	6	6	7	7	7	7	7	7	7	Complete
36	Malamulele Hospital	Medical Doctor	3	7	7	4	6	6	6	6	4	6	7	5	6	3	6	6	7	6	3	5	6	7	6	5	6	6	Complete
37	malamulele	medical officer	5	7	7	3	7	7	7	7	4	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	5	7	Complete
38	Elim	medical doctor	3	7	7	2	5	7	7	6	5	6	7	7	7	5	7	7	7	7	2	7	7	7	7	5	7	7	Complete
39	ELIM	Medical Officer	4	7	7	2	6	7	7	6	5	6	6	6	7	3	6	7	7	6	3	7	6	7	6	5	6	7	Complete
40	Elim	Medical Doctor	2	7	7	2	7	6	7	6	3	6	6	6	6	3	6	6	7	6	3	6	6	7	6	2	6	7	Complete
41	Tshilidzini	Medical doctor	6	7	7	2	7	7	7	7	5	6	7	6	7	2	7	6	7	7	2	6	7	7	7	2	7	7	Complete
42	Tshilidzini	medical doctor	7	7	7	2	7	7	7	6	5	6	7	6	7	3	7	7	7	7	3	7	7	7	7	3	7	7	Complete
43	Donald Fraser	Medical Doctor	2	7	7	2	7	7	7	7	5	7	7	6	7	2	7	7	7	7	2	7	7	7	7	3	7	7	Complete
44	DF	MO	4	7	7	2	7	7	7	7	5	7	7	6	7	2	7	7	7	7	2	7	7	7	7	2	7	7	Complete
45	DF	MO	4	7	7	2	7	7	7	7	5	7	7	6	7	2	7	7	7	7	2	7	7	7	7	2	7	7	Complete
46	Siloam	Medical doctor	5	7	7	2	7	7	7	6	5	7	7	6	7	3	7	7	7	7	3	7	7	7	7	5	7	7	Complete
47	Siloam	Medical Officer	05	7	7	3	7	7	7	7	4	7	7	6	7	4	7	7	7	6	4	7	7	7	7	2	7	7	Complete
48	Tshilidzini	Medical doctor	9	7	7	2	7	7	7	6	5	7	7	6	7	2	7	7	7	6	2	7	7	7	7	2	7	6	Complete
49	Tshilidzini	Medical doctor	9	7	7	2	7	7	7	6	5	7	7	6	7	2	7	7	7	6	2	7	7	7	7	2	7	6	Complete
50	Elim	Medical Doctor	4	7	7	2	7	7	7	6	5	7	7	6	6	2	6	6	7	6	2	6	7	7	7	3	7	7	Complete
				336	332	170	326	339	334	315	195	323	338	299	331	169	322	325	338	326	180	321	326	343	328	177	323	329	0
				6,7	6,6	3,4	6,5	6,8	6,7	6,3	3,9	6,5	6,76	5,98	6,62	3,38	6,44	6,5	6,76	6,52	3,6	6,42	6,52	6,86	6,56	3,54	6,46	6,58	

Appendix 3: Risk Analysis

Healthcare Laboratories Risk Analysis

	Risk name	Root causes to the risk	Consequences of the risk	Impact		Likelihood		Inherent risk exposure		Current business processes / controls in place to manage identified risks	Risk owner	Perceived control effectiveness		Residual risk exposure		Mitigating action plans to further address the residual risk exposure
	Market Risks															
1	Market Competition	Competition from existing and established laboratories that may go for the same opportunity of servicing Vhembe rural areas	Loss of market share, decreased revenue, and erosion of profitability due to competitors capturing market demand.	Major	70	Possible	40%	Moderate	28	The lab conducts market research to identify rural competitors and understand their offerings and pricing. This informs differentiation strategy like faster TAT and superior service. Agility in operations helps adapt to market changes. Regular evaluations and benchmarking identify areas for improvement, ensuring competitiveness.	CEO	Satisfactory	0,65	FALSE	9,80	The lab invests in innovation and technology upgrades to lead in diagnostics. Assessments of emerging tech guide strategic decisions. Service excellence and customer satisfaction build loyalty and differentiation. Agility in operations adapts to market changes. Regular evaluations and strategic reviews ensure competitiveness through proactive measures.
2	Demand Fluctuations	due to changes in economic conditions or healthcare policies	Revenue volatility, underutilisation of resources during periods of low demand, and potential inability to meet financial obligations.	Major	70	Rare	10%	Low	20	The lab tracks healthcare policies, regulations, demographics, and economic indicators to predict demand for tests. This guides planning and resource allocation. Offering individual tests alongside test profiles enables flexibility to adapt to market shifts and customer preferences.	CEO	Satisfactory	0,65	FALSE	7,00	The lab adjusts its capacity flexibly to match demand fluctuations, employing strategies like cross-training staff and collaborating with stakeholders to broaden its customer base. This ensures operational efficiency and resilience during market shifts.
3	Technological Disruption	due to advances in Technology that may render existing services obsolete	Obsolescence of existing services or equipment, loss of competitive edge, and reduced market	Minor	30	Rare	10%	FALSE	3	The lab regularly assesses emerging tech and market trends to anticipate disruptions. Strategic partnerships with tech vendors keep them innovative, adapting to evolving customer needs.	CEO	Satisfactory	0,65	FALSE	1,05	Strategic partnerships with startups, academics, and experts offer access to innovations and expertise. Through collaboration, the lab leverages external resources to address disruptions effectively. Pilot programs and new tests based on stakeholder feedback.
	Operational Risks															01-Feb
4	Staffing Challenges	Difficulty in recruiting and retaining skilled technicians and healthcare professionals	Reduced productivity, compromised service quality, and increased recruitment costs due to staff turnover.	Moder ate	50	Likely	65%	Moderate	33	The lab partners with institutions to recruit skilled professionals and is registered as a training lab. Job openings are advertised widely, offering competitive salaries and benefits. Salary reviews and professional development programs ensure staff retention and ongoing skill enhancement.	CEO & LM	Good	0,80	FALSE	0,80	Investing in ongoing training enhances staff skills, reducing errors and ensuring high-quality service. Cross-training and fostering a positive work environment promote employee engagement through open communication, team-building, and recognition programs.
5	Supply chain Disruptions	Delays or shortages in equipment, reagents, or consumables could disrupt laboratory operations.	Delays in service delivery, inventory shortages, and increased operational expenses due to disruptions in the supply chain.	Moder ate	50	Likely	65%	Moderate	33	The lab maintains strong supplier relationships for uninterrupted equipment and material supply. Regular evaluations ensure reliability, supported by an efficient inventory system to monitor and anticipate needs. Safety stock levels mitigate supply chain disruptions.	LM	Good	0,80	FALSE	0,80	Identifying multiple suppliers for critical items and developing business continuity plans minimize disruptions. These plans outline procedures for managing emergencies, staff shortages, and equipment failures to maintain service quality and customer satisfaction.
	Quality Control.	Errors in testing processes or inaccurate results could damage the laboratory's reputation and credibility.	Damage to reputation, loss of customer trust, and potential legal liabilities resulting from errors in testing processes or inaccurate results.	Major	70	Possible	40%	Low		The lab implements strict quality control measures to ensure accurate test results. Protocols include equipment calibration, method verification, and performance monitoring. Staff receive thorough training and adhere to protocols. Regular audits and proficiency testing identify areas for improvement.	LM	Very good	0,90	FALSE	0,90	Establish SOPs for testing with quality checkpoints, offer comprehensive staff training, conduct regular competency assessments, participate in external quality assurance programs, and apply root cause analysis for failures, ensuring effective corrective actions and monitoring.
	Equipment breakdown	Due to service maintainance not being adhered to or faulty	Downtime, delayed service delivery, and increased repair or replacement costs leading to financial	Moder ate	50	Likely	65%	Low		Regular maintenance and calibration ensure equipment reliability. Emergency protocols address malfunctions promptly, minimizing service disruptions with outlined troubleshooting procedures.	LM	Good	0,80	FALSE	0,80	Implementing a Preventive Maintenance Program; Maintaining relationships with equipment suppliers to ensure timely replacement or repair in case of breakdowns; Partnership with Suppliers for Technical Support and Training; Develop contingency plans that includes
	Financial Risks															
6	Capital Constraints	Limited access to funding for equipment purchase, facility expansion, or operational expenses.	Limited capacity for expansion, inability to invest in critical infrastructure, equipment or technology upgrades, and missed growth opportunities.	Catast rophic	100	Possible	40%	Moderate	40	Exploring funding options for capital expenditures and operational expenses.	CEO	Weak	0,40	FALSE	24,00	Explore alternative sources of funding such as seeking additional investment from venture capitalists, angel investors, or government grants. Maintain a contingency fund to cover unexpected expenses and ensure adequate working capital.
7	Cash Flow Management	Inconsistent revenue streams or unexpected expenses may lead to cash flow challenges.	Inability to meet financial obligations, late payments to suppliers or creditors, and potential credit rating downgrade.	Minor	30	Possible	40%	Low	12	Financial management practices Implementation such as budgeting, forecasting, and cash flow monitoring.	CEO & LM	Weak	0,40	FALSE	7,20	Developing comprehensive contingency plans that outline procedures for managing equipment breakdowns, including temporary workarounds, alternative testing arrangements, and communication protocols to inform stakeholders about service disruptions and expected resolution timelines.
8	Regulatory Compliance Costs	Compliance with healthcare regulations and quality standards could incur additional expenses.	Increased operating expenses, potential fines or penalties for non-compliance, and diversion of resources from strategic initiatives to regulatory requirements.	Minor	30	Likely	65%	Low	20	The lab complies with healthcare regulations and quality standards for accurate, reliable, and safe testing services. Regular audits ensure compliance and identify areas for improvement. Staff receive ongoing training to stay updated on regulations and best practices.	CEO & LM	Satisfactory	0,65	FALSE	6,83	Implement Compliance Monitoring and Auditing to assess regulatory compliance and identify corrective actions. Establish proactive communication with regulatory authorities to stay updated on changes, seek clarification, and address concerns.

LM= Lab Manager

Source: NHLS Strategic Risk Analysis Template (2015).

Healthcare Laboratory — Assessment tables

Factors used in risk analysis

Each risk is evaluated in terms of potential impact, likelihood of occurrence and the perceived effectiveness of controls in place to manage the risks according to the criteria set out below:

Potential impact

Impact factor	Continuity of supply	Safety and environmental	Technical complexity	Financial
Catastrophic 100	Risk event will result in widespread and lengthy reduction in continuity of supply to customers of greater than 48 hours	Major environmental damage Serious injury (permanent disability) or death of personnel or members of the public Major negative media coverage	Use of unproven technology for critical system / project components High level of technical interdependencies between system / project components	Significant cost overruns of >20% over budget. Affect on revenue / asset base of >10%.
Major 70	Reduction in supply or disruption for a period ranging between 24 & 48 hours over a significant area	Significant injury of personnel or public Significant environmental damage Significant negative media coverage	Use of new technology not previously utilised by the entity for critical systems / project components	Major cost overruns of between 10 % & 20 % over budget Affect on revenue / asset base of between 5% & 10%
Moderate 50	Reduction in supply or disruption for a period between 8 & 24 hours over a regional area	Lower level environmental, safety or health impacts. Negative media coverage	Use of unproven or emerging technology for critical systems / project components	Moderate impact on revenue and assets base
Minor 30	Brief local inconvenience (work around possible) Loss of an asset with minor impact on operations	Little environmental, safety or health impacts Limited negative media coverage	Use of unproven or emerging technology for systems / project components	Minor impact on revenue and assets base
Insignificant 10	No impact on business or core systems	No environmental, safety or health impacts and/or negative media coverage	Use of unproven or emerging technology for non-critical systems / project components	Insignificant financial loss

Likelihood

Likelihood factor	Qualification criteria	Rating
Common	The risk is almost certain to occur in the current circumstances. The risk is already occurring, or is likely to occur more than once within the next 12 months.	90%
Likely	More than an even chance of occurring. The risk could easily occur, and is likely to occur at least once within the next 12 months.	65%
Possible	Could occur quite often. There is an above average chance that the risk will occur at least once in the next 3 years.	40%
Unlikely	Small likelihood but could happen. The risk occurs infrequently and is unlikely to occur within the next 3 years.	20%
Rare	Not expected to happen - Event would be a surprise. The risk is conceivable but is only likely to occur in extreme circumstances.	10%

Perceived control effectiveness

Effectiveness factor	Qualification criteria	Rating
Very Good	Risk exposure is effectively controlled and managed.	90%
Good	Majority of risk exposure is effectively controlled and managed.	80%
Satisfactory	There is room for some improvement.	65%
Weak	Some of the risk exposure appears to be controlled, but there are major deficiencies.	40%
Unsatisfactory	Control measures are ineffective.	20%

Inherent risk exposure

Inherent risk	Rating	
Extreme	³ 50	
High	³ 35 < 50	50
Moderate	³ 25 < 35	35
Low	³ 15 < 25	25
Insignificant	< 15	15

Residual risk exposure

Residual risk	Rating
Priority 1	³ 50
Priority 2	³ 35 < 50
Priority 3	³ 25 < 35
Priority 4	³ 15 < 25
Priority 5	< 15

Action status

Status	Description
Behind schedule	The project to implement the control improvement is behind schedule and requires management attention
Planned	The project has been planned to implement the control improvement but the start date has not yet commenced
In progress	The project to implement the control improvement is progressing as planned
Final tests and maintain	The project to implement the control improvement is virtually completed or has been added to current controls in place

Source: NHLS Strategic Risk Analysis Template (2015).

Appendix 4: Projected Market related Year One Cost Estimates

Marketing	
Word of mouth activity outreach	**NA**
Design: Website, Logo & Media	**Pro bono**
Promotional Material	**R 10 000**
Research and Development	
Annual Registration fee (HPCSA)	**R369**
Salaries	
Manager	**R600 000 (50 000 x12)**
Technologist/ Technician	**R216 000 (18 000 x12)**
Phlebotomy	**R144 000 (12 000 x12)**
Administrator/ Clerk	**R102 000 (8 500 x12)**
Courier/ Messenger	**R90 000 (7 500 x 12)**
Total	**R1 152 000 (96000 x12)**
Equipment, Reagents and Furniture	
Equipment	
• **Computers, Printer, Point of care instruments, centrifuge, fridge, and Pipettes**	**R 65 000 (Once off purchase)**
• **Rented to buy**	**R69 600 (5 800. 00 x12)**
Total	**R 134 600**
Reagents annual prices	
• **U&E**	**R14130/ 1200 Tests**
• **LFT**	**R5568/1200 Tests**
• **CMP**	**R3680/800 Tests)**
• **CRP**	**R6000/600 Tests)**
• **Lipid Profile (Cholesterol, HDL and Triglyceride)**	**R10 630/800 Tests)**
• **Glucose**	**R1000 400 tests)**
• **Pro-BNP**	**R43200/240 Tests**
• **Troponin I**	**R40 000 (2 Kits @ R5000/240 Tests)**
• **Full Blood Count (FBC)**	**R8310/1200 Tests**
Total	**R129 235**
Accommodation	
Rental (Including water and electricity)	**R120 000 (10 000 x12)**
Furniture	**R 40.000 (Once off)**
Total	**R 160 000.00**
Miscellaneous Laboratory Items	
Tips, Containers, Plastics, Gloves, etc.	**R 18 000 (1500 x12)**
Total	**R 18 000**
Others	
Car	**R 175 000 (Once off)**
Petrol	**R 48 000 (4000 x12)**
Telephone and WIFI	**R6 000 (500x12)**
Total	**R 185 000**

Overall Total	**R1 789 204**
Reagent price sources: Beckman Coulter, Biomerieux, KAT Laboratory Medical catalogues and Roche Diagnostics online prices.	

Appendix 5: Sales Forecast

Tests	Volume per week	Total volume per month	Cost per Profile/ Test	Monthly Revenue per Profile/ Test	Annual Projected Revenue
YEAR ONE					**R1 995 600**
U&E	**25**	**100**	**R300**	**R30 000**	
LFT	**25**	**100**	**R500**	**R50 000**	
CMP	**15**	**60**	**R230**	**R13 800**	
CRP	**15**	**60**	**R155**	**R9300**	
LIPID Profile	**15**	**60**	**R360**	**R21 600**	
Glucose	**15**	**60**	**R50**	**R3000**	
Pro-BNP	**5**	**20**	**R690**	**R13 800**	
Troponin T	**10**	**40**	**R270**	**R10 800**	
FBC	**25**	**100**	**R140**	**R14 000**	
TOTAL TESTS	**150**	**600**	**R2 695**	**R166 300**	
YEAR TWO (25% Volume Increase Projections, and 6% increase of price projection based on inflation rate target range of 3-6% (Stassa, 2023). Rounded off to the nearest 5 0r10.					**R2 676 000**
U&E	**32**	**125**	**R320**	**R40 000**	
LFT	**32**	**125**	**R530**	**R66 250**	
CMP	**19**	**75**	**R270**	**R20 250**	
CRP	**19**	**75**	**R165**	**R12 375**	
Lipid Profile	**19**	**75**	**R380**	**R28 500**	
Glucose	**19**	**75**	**R55**	**R4 125**	
Pro-BNP	**7**	**25**	**R730**	**R18 250**	
Troponin T	**13**	**50**	**R290**	**R14 500**	
FBC	**32**	**125**	**R150**	**R18 750**	
T0TAL	**192**	**750**	**R2 890**	**R223 000**	
YEAR THREE (20% Volume Increase Projections, and 6% Price Increase Projections)					**R3 439 080**
U&E	**37**	**150**	**R340**	**R51 000**	
LFT	**37**	**150**	**R580**	**R87 000**	
CMP	**23**	**90**	**R290**	**R25 740**	
CRP	**23**	**90**	**R175**	**R15 750**	
Lipid Profile	**23**	**90**	**R400**	**R36 000**	
Glucose	**23**	**90**	**R60**	**R5 400**	
Pro-BNP	**9**	**30**	**R770**	**R23 100**	
Troponin T	**12**	**60**	**R310**	**R18 600**	
FBC	**37**	**150**	**R160**	**R24 000**	
TOTAL	**224**	**900**	**R3 085**	**R286 590**	
YEAR FOUR (15% Volume Increase Projections, and 6% Price Increase Projections)					**R4 234 320**
U&E	**43**	**173**	**R380**	**R65 740**	

LFT	**43**	**173**	**R620**	**R103 800**	
CMP	**27**	**104**	**R310**	**R32 240**	
CRP	**27**	**104**	**R190**	**R19 760**	
Lipid Profile	**27**	**104**	**R420**	**R43 680**	
Glucose	**27**	**104**	**R65**	**R6 760**	
Pro-BNP	**11**	**35**	**R820**	**R 28 700**	
Troponin T	**14**	**69**	**R330**	**R 22 770**	
FBC	**43**	**173**	**R170**	**R 29 410**	
Total	**262**	**1039**	**R3 305**	**R352 860**	
YEAR FIVE (10% Volume Increase Projections and 6% Price Increase Projections)					**R4 988 640**
U&E	**48**	**191**	**R400**	**R74 000**	
LFT	**48**	**191**	**R660**	**R126 060**	
CMP	**30**	**115**	**R330**	**R37 950**	
CRP	**30**	**115**	**R200**	**R23 000**	
Lipid Profile	**30**	**115**	**R450**	**R51 750**	
Glucose	**30**	**115**	**R70**	**R8 050**	
Pro-BNP	**13**	**39**	**R870**	**R33 930**	
Troponin T	**16**	**76**	**R350**	**R26 600**	
FBC	**48**	**191**	**R180**	**R34 380**	
Total	**293**	**1 148**	**R3 510**	**R415 720**	
Source for Laboratory Tests Prices: Discovery Health price list for Medical Techologists (with effect from 2020), and Pathcare Fees lookup (2023).					

Appendix 6: Summary of Ratios

	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Profitability Ratios:					
Gross Profit Margin	(313908/1995600) *100 =15.73	(958984/2676000) *100 =35.84	(1629203/3439080) *100 =47.37	(2322708/4234320) *100 =54.85	(2967069/4988640) *100 =59.48
Net Profit Margin	((-224904)/1995600) *100 = (11.27)	(236464/26767000) *100 =8.84	(700651/3439080) *100 =20.37	(1179442/4234320) *100 =27.85	(1620136/4988640) *100 =32.48
Return on Investment	((-224904)/1000000) *100 = (22.49)	(236464/1000000) *100 =23.65	(700651/1000000) *100 70.07	(1179442/1000000) *100 =117.94	(1620136/1000000) *100 =162,01
Overall, although NPV and ROI where negative in the first year, there is a positive trend in profitability ratios over the five years, indicating improving performance and financial health.					
Liquidity Ratios:					
Current ratio	(1461143/1193728) =1.22	(1351517/12653520) =1.07	(2495287/1341272) =1.86	(3677509/1421747) =2.59	(4773085/1507054) =3.17
Quick ratio	((1461143-(129235+18000)/ 1193728) =1.10	((1351517-(136989+19080)/ 1265352) =0.94	((2495287-(145208+20225)/ 1341272) =1.74	((3677509-(153920+21439)/ 1421747) =2.46	((4773085-(163155+22725)/ 1507054) =3.04

Overall, both ratios paint a positive picture of the venture's financial health, showing an upward trajectory that signifies an improved ability to manage short-term financial obligations and capitalize on immediate opportunities.					
Efficiency Ratios:					
Inventory Turnover	1681692/ (129235+18000) =1.35	1717016/ (136989+19080) =11.00	1809877/ (145208+20225) =10.94	1911612/ (153920+21439) =10.90	2021571/ (163155+22725) =10.88
Overall, the trend shows a substantial improvement in inventory turnover over the years, indicating that the venture is becoming more efficient in managing its inventory. It's a positive sign for the venture's operational efficiency and financial performance.					
Growth Ratios:					
Revenue Growth Rate	N/A	(2676000-1995600)/1995600*100 =34.10	(3439080-2676000)/2676000 *100 =28.52	(4234320-3439080)/3439080 *100 =23.12	(4988640-4234320)/4234320 *100 =17.81
Overall, the venture demonstrates robust revenue growth in the early years, which gradually stabilizes as the venture matures. This growth trajectory is expected in a business's lifecycle, reflecting the dynamics of market penetration and saturation.					
Return Ratios:					
Return on Assets	1995600/1741143 =1.15	2676000/1602517 =1.67	3439080/2713387 =1.27	4234320/3866509 =1.10	4988640/4936085 =1.01
Return on Equity	1995600/ (-1411570 = -14.14	2676000/ (-544101) = -4.92	3439080/275193 =12.50	4234320/1123129 =3.77	4988640/1893029 =2.64
While there are fluctuations, the trend suggests an overall improvement in profitability and returns over time, albeit with some variability in performance.					

Appendix 7: Suppliers reagents costs catalogues
(Beckman Coulter, KAT Laboratory MEDICAL, and Biomerieux)

BLED PATHOLOGY

BECKMAN COULTER

HAEMATOLOGY

APPROVED
01 MAR 2022
SIGNATURE:

Discipline	Platform	Product Class	Item Number	Item Description	System/Panel	Price Excl VAT	VAT	Price Incl VAT
Hematology	AcT 5	Reagent	8547171	ACT 5 DIFF FIX, 1L	AcT 5diff	R 1,157.00	R 173.55	R 1,330.55
Hematology	AcT 5	Reagent	8547168	ACT 5 DIFF HGB LYSE, 400ML	AcT 5diff	R 410.00	R 61.50	R 471.50
Hematology	AcT 5	Reagent	8547167	ACT 5 DIFF RINSE, 1L	AcT 5diff	R 243.00	R 36.45	R 279.45
Hematology	AcT 5	Reagent	8547170	ACT 5 DIFF WBC LYSE, 1L	AcT 5diff	R 1,157.00	R 173.55	R 1,330.55
Hematology	AcT 5	Calibrator	7547175	ACT 5 DIFF CALIBRATOR, 2X2ML	Controls & Calibrators	R 1,218.00	R 182.70	R 1,400.70
Hematology	AcT 5	Control	7547198	ACT 5 DIFF CTL PLUS, 6 X 2.3 ML	AcT 5diff	R 2,812.00	R 421.80	R 3,233.80
Hematology	AcT 5	Consumable	8547169	ACT 5 DIFF DILUENT, 20L	AcT 5diff	R 693.00	R 103.95	R 796.95
Hematology	Cleaner	Reagent	8547113	ACT RINSE SHUTDOWN DIL,500 ML	Cleaners	R 338.00	R 50.70	R 388.70
Hematology	Cleaner	Reagent	8448222	CLENZ 5L FOR EXPORT USE	Cleaners	R 410.00	R 61.50	R 471.50
Hematology	Cleaner	Reagent	628022	FP,DXH CLEANER, 5L	Cleaners	R 358.00	R 53.70	R 411.70
Hematology	Diluent	Consumable	8547194	FP, LH SERIES DILUENT, 20L	Diluents	R 397.00	R 59.55	R 456.55
Hematology	Diluent	Consumable	628017	FP,DXH DILUENT,10L	Diluents	R 316.00	R 47.40	R 363.40
Hematology	DxH 500	Consumable	B36845	DxH 500 Diluent, 10L	DxH 500	R 490.00	R 73.50	R 563.50
Hematology	DxH 500	Consumable	GC002	DxH 500 G-CAL	DxH 500	R 1,779.00	R 266.85	R 2,045.85
Hematology	DxH 500	Consumable	DXH001	DxH 500 Linearity Kit	DxH 500	R 8,316.00	R 1,247.40	R 9,563.40
Hematology	DxH 500	Consumable	B36880	FP,DXH 500SERIES CALIBRATOR 2 X 2ML KIT ASSEMBLY	DxH 500	R 1,273.00	R 190.95	R 1,463.95
Hematology	DxH 500	Consumable	B36868	FP,DXH 500SERIES CLEANER, 0.5L	DxH 500	R 654.00	R 98.10	R 752.10
Hematology	DxH 500	Consumable	B36872	FP,DXH 500SERIES CONTROL V2.0 KIT ASSEMBLY	DxH 500	R 2,638.00	R 395.70	R 3,033.70
Hematology	DxH 500	Consumable	B36846	FP,DXH 500SERIES LYSE, 0.5L	DxH 500	R 1,621.00	R 243.15	R 1,864.15
Hematology	Haematology Calibrators	Calibrator	624519	COULTER 5-CAL Calibrator	Controls & Calibrators	R 1,304.00	R 195.60	R 1,499.60
Hematology	Haematology Calibrators	Calibrator	628026	FP,5 CAL CALIBRATOR	Controls & Calibrators	R 724.00	R 108.60	R 832.60
Hematology	Haematology Calibrators	Control	628024	COULTER LATRON CP-X	Controls & Calibrators	R 917.00	R 137.55	R 1,054.55
Hematology	Haematology Calibrators	Control	628030	FP,BODY FLUID CONTROL	Controls & Calibrators	R 3,932.00	R 589.80	R 4,521.80
Hematology	Haematology Calibrators	Control	628029	FP,LINEARITY CONTROL	Controls & Calibrators	R 6,921.00	R 1,038.15	R 7,959.15
Hematology	Haematology Calibrators	Control	7546914	LATRON (LATEX) CONTROL KIT	Controls & Calibrators	R 745.00	R 111.75	R 856.75
Hematology	Haematology Calibrators	Control	7546915	LATRON PRIMER SOLUTION KIT	Controls & Calibrators	R 745.00	R 111.75	R 856.75
Hematology	Haematology Calibrators	Control	7547065	LIN-C,5X3.3ML,KIT	Controls & Calibrators	R 3,624.00	R 543.60	R 4,167.60
Hematology	Haematology Controls	Control	7547187	4C ES TRI, ACT, 12X3.3ML	Controls & Calibrators	R 4,182.00	R 627.30	R 4,809.30
Hematology	Haematology Controls	Control	7547188	4C ES TRI, MD/MDII, 3X3.3ML	Controls & Calibrators	R 2,164.00	R 324.60	R 2,488.60
Hematology	Haematology Controls	Control	7547189	4C ES TRI, ONYX, 9X3.3ML	Controls & Calibrators	R 3,317.00	R 497.55	R 3,814.55
Hematology	Haematology Controls	Control	7547190	4C ES TRI, T SERIES, 6X3.3ML	Controls & Calibrators	R 2,375.00	R 356.25	R 2,731.25
Hematology	Haematology Controls	Control	7547001	5C CELL CONTROL TRIPAK(9X3.3ML	Controls & Calibrators	R 2,298.00	R 344.70	R 2,642.70
Hematology	Haematology Controls	Control	7547117	5C CELL CONTROL,NORM,(9X3.3ML)	Controls & Calibrators	R 3,067.00	R 460.05	R 3,527.05
Hematology	Haematology Controls	Control	7547116	5C CELL CONTROL,TRI,E,US, 5I2, LRG HEMA	Controls & Calibrators	R 3,647.00	R 547.05	R 4,194.05
Hematology	Haematology Controls	Control	C07297	FP, 6C Plus CellControl	Controls & Calibrators	R 4,396.00	R 659.40	R 5,055.40
Hematology	Haematology Controls	Control	628027	FP,6C CELL CONTROL 12X	Controls & Calibrators	R 3,528.00	R 529.20	R 4,057.20
Hematology	Haematology Controls	Control	A59925	FP,6C CELL CONTROL 9X	Controls & Calibrators	R 2,825.00	R 423.75	R 3,248.75
Hematology	Lysing Reagents	Reagent	628019	FP,DXH CELL LYSE,5L	Reagents	R 1,855.00	R 278.25	R 2,133.25
Hematology	Lysing Reagents	Reagent	8448177	LYSE S III DIFF 5L	Reagents	R 2,476.00	R 371.40	R 2,847.40
Hematology	Reagent Paks	Reagent	8547134	DIFF ACT PAK,15L	Paks	R 3,422.00	R 513.30	R 3,935.30
Hematology	Reagent Paks	Reagent	8547195	FP, LH SERIES PAK	Paks	R 1,946.00	R 291.90	R 2,237.90
Hematology	Reagent Paks	Reagent	628020	FP,DXH DIFF PACK	Paks	R 978.00	R 146.70	R 1,124.70
Hematology	Reagent Paks	Reagent	8547166	HMX PAK	Paks	R 1,540.00	R 231.00	R 1,771.00
Hematology	Retic Controls	Control	628028	FP,RETIC-X CELL CONTROL	Controls & Calibrators	R 3,235.00	R 485.25	R 3,720.25
Hematology	Retic Controls	Control	7547125	RETIC-C CONTROL KIT (9X3.3ML)	Controls & Calibrators	R 2,964.00	R 444.60	R 3,408.60
Hematology	Retic Controls	Control	7546979	RETIC-C CONTROL TRI-PAK(6X2ML)	Controls & Calibrators	R 1,584.00	R 237.60	R 1,821.60
Hematology	Retic Reagents	Reagent	8547196	FP, LH SERIES RETIC PAK	Paks	R 2,000.00	R 300.00	R 2,300.00
Hematology	Retic Reagents	Reagent	628021	FP,DXH RETIC PACK	Paks	R 1,036.00	R 155.40	R 1,191.40
Hematology	Retic Reagents	Reagent	7546978	RETIC PREP REAG KIT 1X500ML/2X15M	Paks	R 1,435.00	R 215.25	R 1,650.25
Hematology	Stains	Reagent	A50843	FP,BCI GIEMSA STAIN 3X2L	Stains & Buffers	##########	R 1,512.00	##########
Hematology	Stains	Reagent	A50832	FP,BCI WRIGHT GIEMSA STN 4X2L	Stains & Buffers	R 6,397.00	R 959.55	R 7,356.55
Hematology	Stains	Reagent	A50831	FP,BCI WRIGHT STAIN 4X2L	Stains & Buffers	R 4,279.00	R 641.85	R 4,920.85



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Fax: (+2711) 472 4420
E-mail: keith@katmedical.com
V.A.T : 4720204256 Reg.No: 2002/019591/07

Date May 12, 2020
Neo 200 Suggested Reagents

Quote No: KD20200512.1

Quote to: 'Trish Mogano'

CAT #	DESCRIPTION	QTY	UNIT PRICE	PRICE
	Suggested Start up Kits			
LFT				
COM-2-239	Albumin Liquick 30	1.00	R 580.00	R 580.00
COM-1-218	ALP Liquick 30	1.00	R 580.00	R 580.00
COM-1-221	ALT Liquick 30	1.00	R 580.00	R 580.00
COM-1-222	AST Liquick 30	1.00	R 580.00	R 580.00
COM-2-214	BIL TOTAL Liquick 30	1.00	R 580.00	R 580.00
COM-2-247	Bilirubin Direct Liquick 30	1.00	R 580.00	R 580.00
COM-1-226	Gamma GT Liquick 30	1.00	R 580.00	R 580.00
COM-2-240	Total Protein Liquick 30	1.00	R 580.00	R 580.00
U+E				
COM-2-261	Urea Liquick 30 Cormay	1.00	R 580.00	R 580.00
DIA-01007002120	Bicarbonate	1.00	R 2,025.00	R 2,025.00
DIA-13700400125	Chloride F5 5.25	1.00	R 1,465.00	R 1,465.00
COM-2-257	Creatinine Enzymatic Liquick 30	1.00	R 915.00	R 915.00
DZ-113C-K01	Liquid Potassium HK	1.00	R 3,395.00	R 3,395.00
DZ-114B-K01	Liquid Sodium HK	1.00	R 3,395.00	R 3,395.00
Lipid				
COM-2-262	TG Liquick 30	1.00	R 915.00	R 915.00
COM-2-211	Cholesterol Liquick 30	1.00	R 580.00	R 580.00
COM-2-216	LDL Direct Mini	1.00	R 1,910.00	R 1,910.00
COM-2-217	HDL Direct Mini	1.00	R 1,910.00	R 1,910.00



Contols and calibrators				
COM-5-172	Control Level 1 -HN	1.00	R 915.00	R 915.00
COM-5-173	Control Level 2 -HP	1.00	R 915.00	R 915.00
COM-5-176	Multi-calibrator Level 1	1.00	R 1,095.00	R 1,095.00
COM-5-177	Multi-calibrator Level 2	1.00	R 1,095.00	R 1,095.00
DIA-12170040018	Bicarbonate Standard	1.00	R 1,095.00	R 1,095.00
DIA-13370040009	UniLab Bicarbonate	1.00	R 880.00	R 880.00
DIA-47700400120	UniCal E (Sodium/Potassium & Chloride)	1.00	R 880.00	R 880.00
COM-5-178	HDL/LDL Calibrator	1.00	R 1,095.00	R 1,095.00
			Total Ex vat	R 29,700.00
			Vat 15%	R 4,455.00
			Total incl vat	R 34,155.00

BANKING DETAILS : FNB BANK
Acc. No: 62347009830
Branch. Code : 250655

All Quotes are valid for 30 Days.

Director : K N Dodkins

Ref: BMXI/Q/R/ESIC-LUCKNOW/001/22
Dated: 21st April, 2022

To,
The Medical Superintendent,
ESIC Hospital
Sarojini Nagar, Lucknow
Uttar Pradesh

Ref: Procurement of miniVIDAS reagents & consumables for Automated Immunoassay Analyzer System

Sub: Price List of miniVIDAS Reagents and Consumables

Dear Sir / Madam

With the subject reference, We are pleased to offer you our most competitive rates as below :-

Ref Code	MINVIDAS REAGENTS & CONSUMABLES	Size(No. / Tests	Price (INR) exclusive GST
30450	VIDAS BRAHMS PROCALCITONIN	60 T	60,000
30421	VIDAS CK MB 30TESTS	30 T	6,000
30446	VIDAS MYOGLOBINE 30 TESTS	30 T	12,000
415386	VIDAS HS TROPONIN I 60 TESTS	60 T	18,000
30458	VIDAS NT-PROBNP 2	60 T	36,000
30603	VIDAS DIGOXIN	60 T	12,000
30455	VIDAS D DIMER EXCLUSION II	60 T	30,000
30400	VIDAS TSH	60 T	4,200
30402	VIDAS FT3	60 T	6,000
30403	VIDAS T3	60 T	4,200
30404	VIDAS T4	60 T	4,299
30441	VIDAS TSH3	60 T	6,600
30459	VIDAS FT4	60 T	6,000
30405	VIDAS HCG	60 T	7,800
30406	VIDAS LH	60 T	7,800
30407	VIDAS FSH	60 T	7,800
30409	VIDAS PROGESTERONE	60 T	9,000
30410	VIDAS PROLACTIN	60 T	7,800
30418	VIDAS TESTOSTERONE	30 T	6,000
30431	VIDAS ESTRADIOL II	60 T	9,000
417011	VIDAS AMH	30 T	32,000
30461	VIDAS ANTI-TPO	30 T	7,200
30462	VIDAS ANTI-TG	30 T	7,200
422010	VIDAS PTH (1-84)	30T	12,000
30413	VIDAS AFP	60 T	12,000

bioMerieux India Pvt. Ltd.
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Toll Free No.: 18001027791 – customercare.india@biomerieux.com

30420	VIDAS BETA 2 MICROGLOBULIN	30 T	9,900
30426	VIDAS CA 125II	30 T	9,000
30427	VIDAS CA 19-9	30 T	9,000
30428	VIDAS TPSA	60 T	9,900
30429	VIDAS CA 15-3	30 T	9,000
30440	VIDAS FPSA	30 T	6,600
30453	VIDAS CEA (S)	60 T	12,000
30307	VIDAS HAV IGM	30 T	8,100
30312	VIDAS ANTI-HAV TOTAL	30 T	8,100
30315	VIDAS HBS AG ULTRA	60 T	7,200
30318	VIDAS ANTI HBST II	60 T	12,000
30305	VIDAS HBE/ANTI-HBE	30 T	7,200
30314	VIDAS ANTI-HBC TOTAL II	60 T	12,000
30439	VIDAS HBC IGM II	30 T	7,200
30308	VIDAS ANTI-HCV	60 T	9,999
418115	VIDAS HEV IGM	30 T	9,999
418116	VIDAS HEV IGG	30 T	9,999
30443	VIDAS HIV DUO ULTRA	60 T	8,100
30202	VIDAS TOXO IGM	60 T	7,800
30203	VIDAS CMV IGG AVIDITY	30 T	7,200
30204	VIDAS CMV IGG	60 T	7,800
30205	VIDAS CMV IGM	30 T	4,500
30210	VIDAS TOXO IGG II	60 T	7,800
30214	VIDAS RUB IGM	30 T	5,500
30221	VIDAS RUB IGG II	60 T	7,800
30222	VIDAS TOXO IGG AVIDITY	30 T	8,100
30118	VIDAS CD A/B	60 T	24,000
30125	VIDAS GDH	60 T	24,000
30235	VIDAS EBNA IGG	30 T	9,999
30236	VIDAS EBV VCA/EA IGG	30 T	9,999
30237	VIDAS EBV VCA IGM	30 T	9,999
30192	VIDAS H. PYLORI IGG	30 T	7,200
30217	VIDAS VARICEL. ZOSTER IGG	60 T	12,000
30218	VIDAS MUMPS IGG	60 T	12,000
30219	VIDAS MEASLES IGG	60 T	12,000
30319	VIDAS LYME IGM	60 T	12,000
30320	VIDAS LYME IGG	60 T	12,000
423077	VIDAS DENGUE NS1 AG	60T	20,490
423078	VIDAS ANTI DENGUE IgM	60T	20,490
423079	VIDAS ANTI DENGUE IgG	60T	20,490
424114	VIDAS SARS COV2 IgG II	60T	21,687
423833	VIDAS SARS COV2 IgM	60T	21,687
30450-30	VIDAS BRAHMS PROCALCITONIN	30T	31,330

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Appendix 8: Discovery Test price Spreadsheet

The Discovery Health Rates are applicable for services rendered with effect 01 October 2020. The Discovery Health Rate is applicable to all schemes administered by Discovery Health, except for Bankmed Medical Scheme and Netcare Medical Scheme.

'Blank': There is no fixed amount for this code. Discovery Health Medical Scheme will pay the claimed amount subject to the Discovery Health Medical Scheme benefit rules, available funds and benefits.

R0.00: Discovery Health Medical Scheme does not pay for this procedure code.

All rates are VAT inclusive and in ZAR.

For detailed code descriptions please visit: https://www.medicalschemes.com/Publications.aspx and select NHRPL Schedules on the left hand side and select "2006 Lists (version 0.6) from the Category dropdown list.

Practice Type	Procedure Code	Procedure Description	Scheme Rate
037	3705	Alkali resistant haemoglobin	59,70
037	3709	Antiglobulin test (Coombs' or trypsinzied red cells)	48,30
037	3710	Antibody titration	95,20
037	3712	Antibody identification	111,70
037	3713	Bleeding time (does not include the cost of the simplate device)	91,60
037	3714	Blood volume, dye method	95,20
037	3715	Buffy layer examination	263,30
037	3717	Bone marrow cytological examination only	263,30
037	3722	Capillary fragility: Hess	26,70
037	3723	Circulating anticoagulants	77,50
037	3724	Coagulation factor inhibitor assay	761,20
037	3726	Activated protein C resistance	343,80
037	3727	Coagulation time	41,80
037	3729	Cold agglutinins	47,70
037	3730	Protein S: Functional	495,80
037	3731	Compatibility for blood transfusion	47,70
037	3732	Cryoglobulin	47,70
037	3734	Protein C (chromogenic)	400,90
037	3735	Anti-thrombin III (chromogenic)	291,00
037	3736	Plasminogen (chromogenic)	815,50
037	3737	Lupus Russel Viper method	224,90
037	3738	Lupus Kaolin Exner method	330,60
037	3739	Erythrocyte count	29,50
037	3740	Factors V and VII: Qualitative	95,20
037	3741	Coagulation factor assay: Functional	125,10
037	3743	Erythrocyte sedimentation rate	39,90
037	3744	Fibrin stabilizing factor (urea test)	59,70
037	3746	Fibrin monomers	36,10
037	3753	Osmotic fragility (before and after incubation)	238,00
037	3755	Full blood count (including items 3739, 3762, 3783, 3785, 3791)	138,90
037	3756	Full cross match	95,20
037	3757	Coagulation factors: Quantitative	425,70
037	3758	Factor VIII related antigen	799,70

037	3759	Coagulation factor correction study	155,00
037	3762	Haemoglobin estimation	23,70
037	3763	Contact activated product assay	214,30
037	3764	Grouping: A B and O antigens	47,70
037	3765	Grouping: Rh antigen	47,70
037	3767	Euglobulin Lysis time	338,50
037	3768	Haemoglobin A2 (column chromatography)	198,30
037	3769	Haemoglobin electrophoresis	354,60
037	3770	Haemoglobin-S (solubility test)	47,70
037	3772	Haptoglobin: Quantitative	125,10
037	3773	Ham's acidified serum test	105,70
037	3775	Heinz bodies	29,50
037	3776	Haemosiderin in urinary sediment	29,50
037	3783	Leucocyte differential count	82,00
037	3785	Leucocytes: Total count	23,70
037	3786	QBC malaria concentration and fluorescent staining	330,60
037	3787	LE-cells	110,00
037	3789	Neutrophil alkaline phosphatase	370,30
037	3791	Packed cell volume: Haematocrit	23,70
037	3792	Plasmodium falciparum: Monoclonal immunological identification	119,00
037	3793	Plasma haemoglobin	89,10
037	3795	Platelet aggregation per aggregant	160,30
037	3797	Platelet count	29,50
037	3799	Platelet adhesiveness	59,70
037	3801	Prothrombin consumption	77,50
037	3803	Prothrombin determination (two stages)	77,50
037	3805	Prothrombin index	79,20
037	3806	Therapeutic drug level: Dosage	59,70
037	3809	Reticulocyte count	39,90
037	3810	Schumm's test	47,70
037	3811	Sickling test	29,50
037	3814	Sucrose lysis test for PNH	47,70
037	3816	T and B-cells EAC markers (limited to ONE marker only for CD4/8 counts)	279,00
037	3820	Thrombo - Elastogram	343,80
037	3825	Fibrinogen titre	47,70
037	3829	Glucose 6-phosphate-dehydrogenase: Qualitative	105,70
037	3830	Glucose 6-phosphate-dehydrogenase: Quantitative	211,40
037	3832	Red cell pyruvate kinase: Quantitative	211,40
037	3834	Red cell Rhesus phenotype	130,90
037	3835	Haemoglobin F in blood smear	77,50
037	3837	Partial thromboplastin time	77,50
037	3841	Thrombin time (screen)	94,80
037	3843	Thrombin time (serial)	101,00
037	3847	Haemoglobin H	29,50
037	3851	Fibrin degeneration products (diffusion plate)	137,00
037	3853	Fibrin degeneration products (latex slide)	59,70

037	3854	XDP (Dimer test or equivalent latex slide test)	112,50
037	3855	Haemagglutination inhibition	130,90
037	3856	D-Dimer (Quantitative)	362,50
037	3863	Autogenous vaccine	166,60
037	3864	Entomological examination	274,00
037	3865	Parasites in blood smear	74,20
037	3867	Miscellaneous (body fluids, urine, exudate, fungi, puss, scrapings, etc.)	64,80
037	3868	Fungus identification	110,00
037	3869	Faeces (including parasites)	64,80
037	3875	Inclusion bodies	59,70
037	3878	Crystal identification polarized light microscopy	59,70
037	3879	Campylobacter in stool: Fastidious culture	130,90
037	3880	Antigen detection with polyclonal antibodies	59,70
037	3881	Mycobacteria	39,90
037	3882	Antigen detection with monoclonal antibodies	143,00
037	3883	Concentration techniques for parasites	39,90
037	3884	Dark field, phase or interference contrast microscopy, Nomarski or Fontana	83,10
037	3885	Cytochemical stain	72,00
037	3887	Antibiotic susceptibility test: Per organism	105,70
037	3888	Adhesive tape preparation	36,10
037	3889	Clostridium difficile toxin: Monoclonal immunological	164,00
037	3890	Antibiotic assay of tissues and fluids	184,00
037	3891	Blood culture: Aerobic	77,50
037	3892	Blood culture: Anaerobic	77,50
037	3893	Bacteriological culture: Miscellaneous	83,10
037	3894	Radiometric blood culture	143,00
037	3895	Bacteriological culture: Fastidious organisms	130,90
037	3896	In vivo culture: Bacteria	211,40
037	3897	In vivo culture: Virus	211,40
037	3899	Bacterial exotoxin production (in vivo assay)	274,00
037	3901	Fungal culture	59,70
037	3902	Clostridium difficile (cytotoxicity neutralisation)	396,70
037	3903	Antibiotic level: Biological fluids	154,80
037	3904	Rotavirus latex slide test	74,40
037	3905	Identification of virus or rickettsia	274,00
037	3906	Identification: Chlamydia	211,40
037	3907	Culture for staphylococcus aureus	29,50
037	3908	Anaerobe culture: Comprehensive	130,90
037	3909	Anaerobe culture: Limited procedure	59,70
037	3911	Beta-lactamase assay	59,70
037	3914	Sterility control test: Biological method	59,70
037	3915	Mycobacterium culture	59,70
037	3916	Radiometric tuberculosis culture	143,00
037	3918	Mycoplasma culture: Comprehensive	130,90
037	3919	Identification of mycobacterium	130,90
037	3920	Mycobacterium: Antibiotic sensitivity	130,90

037	3921	Antibiotic synergistic study	274,00
037	3922	Viable cell count	17,60
037	3923	Biochemical identification of bacterium: Abridged	41,60
037	3924	Biochemical identification of bacterium: Extended	165,40
037	3925	Serological identification of bacterium: Abridged	41,60
037	3926	Serological identification of bacterium: Extended	134,70
037	3927	Grouping for streptococci	96,40
037	3928	Antimicrobic substances	50,40
037	3929	Radiometric mycobacterium identification	185,10
037	3930	Radiometric mycobacterium antibiotic sensitivity	330,60
037	3931	Helicobacter: Monoclonal immunological	164,00
037	3932	Antibodies to human immunodeficiency virus (HIV): ELISA	186,50
037	3933	IgE: Total: EMIT or ELISA	154,80
037	3934	Auto antibodies by labelled antibodies	211,40
037	3935	Sperm antibodies	211,40
037	3936	Virus neutralisation test: First antibody	991,80
037	3937	Virus neutralisation test: Each additional antibody	198,30
037	3938	Precipitation test per antigen	59,70
037	3939	Agglutination test per antigen	72,80
037	3940	Haemagglutination test: Per antigen	130,90
037	3941	Modified Coombs' test for brucellosis	59,70
037	3942	Hepatitis Rapid Viral Ab	160,80
037	3943	Antibody titer to bacterial exotoxin	47,70
037	3944	IgE: Specific antibody titer: ELISA/EMIT: Per Ag	164,00
037	3945	Complement fixation test	77,50
037	3946	IgM: Specific antibody titer:ELISA/EMIT: Per Ag	185,70
037	3947	C-reactive protein	143,30
037	3948	IgG: Specific antibody titer: ELISA/EMIT: Per Ag	171,10
037	3949	Qualitative Kahn, VDRL or other flocculation	29,50
037	3950	Neutrophil phagocytosis	333,50
037	3951	Quantitative Kahn, VDRL or other flocculation	47,70
037	3952	Neutrophil chemotaxis	898,70
037	3953	Tube agglutination test	54,70
037	3955	Paul Bunnell: Presumptive	29,50
037	3956	Infectious mononucleosis latex slide test (Monospot or equivalent)	112,50
037	3958	Anti Gad/Ia2 Ab	894,40
037	3959	Rose Waaler agglutination test	59,70
037	3960	Gonococcal, listeria or echinococcus agglutination	125,40
037	3961	Slide agglutination test	34,50
037	3963	Serum complement level: Each component	41,60
037	3965	Anti Ia2 Antibodies	473,20
037	3967	Auto-antibody: Sensitized erythrocytes	59,70
037	3968	Herpes virus typing: Monoclonal immunological	273,70
037	3969	Western blot technique	978,80
037	3970	Epstein-Barr virus antibody titer	89,10
037	3971	Immuno-diffusion test: Per antigen	41,60

037	3972	Respiratory syncytial virus (ELISA technique)	462,80
037	3973	Immuno electrophoresis: Per immune serum	125,10
037	3974	Polymerase chain reaction	991,80
037	3975	Indirect immuno-fluorescence test (bacterial, viral, parasitic)	158,80
037	3978	Lymphocyte transformation	683,50
037	3980	Bilharzia Ag Serum/Urine	190,90
037	3991	Abnormal pigments: Qualitative	59,70
037	3993	Abnormal pigments: Quantitative	119,00
037	3995	Acid phosphate	68,50
037	3998	Amino acids Quantitative (Post derivatisation HPLC)	1033,10
037	3999	Albumin	63,20
037	4000	Alcohol	164,00
037	4001	Alkaline phosphatase	68,50
037	4002	Alkaline phosphatase-iso-enzymes	154,80
037	4003	Ammonia: Enzymatic	102,30
037	4004	Ammonia: Monitor	59,70
037	4005	Alpha-1-antitrypsin: Total	95,20
037	4006	Amylase	68,50
037	4007	Arsenic in blood, hair or nails	479,40
037	4009	Bilirubin: Total	63,00
037	4010	Bilirubin: Conjugated	47,90
037	4014	Cadmium: Atomic absorption	239,70
037	4016	Calcium: Ionized	89,10
037	4017	Calcium: Spectrophotometric	47,90
037	4018	Calcium: Atomic absorption	95,90
037	4019	Carotene	29,50
037	4020	Carnitine (Total or free) in biological fluid: Each	154,60
037	4021	Carnitine (Total or free) in muscle: Each	309,20
037	4022	Acyl Carnitine	309,20
037	4023	Chloride	34,10
037	4025	Chol/HDL/LDL/Trig	355,80
037	4026	LDL cholesterol (chemical determination)	91,20
037	4027	Cholesterol total	70,90
037	4028	HDL cholesterol	91,20
037	4029	Cholinesterase: Serum or erythrocyte: Each	99,00
037	4030	Cholinesterase phenotype (Dibucaine or fluoride each)	119,00
037	4031	Total CO2	68,50
037	4032	Creatinine	47,90
037	4034	C1 - Esterase Inhibitor	124,60
037	4035	CSF- Albumin	124,60
037	4040	Homocysteine (random)	202,40
037	4041	Homocysteine (after Methionine load)	239,40
037	4042	D-Xylose absorption test: Two hours	173,90
037	4045	Fibrinogen: Quantitative	47,70
037	4049	Glucose tolerance test (2 specimens)	118,60
037	4050	Glucose strip-test with photometric reading	23,70

037	4051	Galactose	148,60
037	4052	Glucose tolerance test (3 specimens)	174,10
037	4053	Glucose tolerance test (4 specimens)	229,90
037	4057	Glucose: Quantitative	47,90
037	4061	Glucose tolerance test (5 specimens)	285,10
037	4062	Galactose-1-phosphate uridyl transferase	211,40
037	4063	Fructosamine	95,20
037	4064	Glycated haemoglobin: Chromatography	188,50
037	4066	Immunofixation: Total protein, IgG, IgA, IgM, Kappa, Lambda	620,20
037	4067	Lithium: Flame ionisation	68,50
037	4068	Lithium: Atomic absorption	99,00
037	4071	Iron	89,10
037	4073	Iron-binding capacity	101,00
037	4076	Blood gases: Astrup/pO2 and ancillary tests	251,30
037	4078	Oximetry analysis: MetHb, COHb, O2Hb, RHb, SulfHb	89,10
037	4079	Ketones in plasma: Qualitative	29,50
037	4081	Drug level-biological fluid: Quantitative	143,00
037	4083	Lysosomal enzyme assay	483,50
037	4085	Lipase	68,50
037	4091	Lipoprotein electrophoresis	119,00
037	4093	Osmolality: Serum or urine	89,10
037	4094	Magnesium: Spectrophotometric	47,90
037	4095	Magnesium: Atomic absorption	95,90
037	4096	Mercury: Atomic absorption	239,70
037	4098	Copper: Atomic absorption	239,70
037	4105	Protein electrophoresis	119,00
037	4106	IgG sub-class 1, 2, 3 or 4: Per sub-class	264,40
037	4109	Phosphate	47,90
037	4113	Potassium	47,90
037	4114	Sodium	47,90
037	4117	Protein: Total	40,90
037	4121	pH, pCO2 or pO2: Each	89,10
037	4123	Pyruvic acid	59,70
037	4125	Salicylates	59,70
037	4127	Caeruloplasmin	59,70
037	4128	Phenylalanine: Quantitative	148,60
037	4130	Aspartate aminotransferase (AST)	71,30
037	4131	Alanine aminotransferase (ALT)	71,30
037	4132	Creatine kinase (CK)	71,30
037	4133	Lactate dehidrogenase (LD)	71,30
037	4134	Gamma glutamyl transferase (GGT)	71,30
037	4135	Aldolase	71,30
037	4136	Angiotensin converting enzyme (ACE)	119,00
037	4137	Lactate dehydrogenase isoenzyme	143,00
037	4138	CK-MB: Immunoinhibition/precipitation	143,00
037	4139	Adenosine deaminase	71,30

037	4143	Serum/plasma enzymes	71,30
037	4144	Transferrin	154,80
037	4146	Lead: Atomic absorption	198,30
037	4147	Triglyceride	105,00
037	4149	Red cell magnesium	154,80
037	4151	Urea	47,90
037	4152	CK-MB: Mass determination: Quantitative (Automated)	164,00
037	4153	CK-MB: Mass determination: Quantitative (Not automated)	231,00
037	4154	Myoglobin quantitative: Monoclonal immunological	164,00
037	4155	Uric acid	50,00
037	4156	Vitamin D3	163,40
037	4157	Vitamin A-saturation test	202,40
037	4158	Vitamin E (tocopherol)	47,70
037	4159	Vitamin A	83,10
037	4161	Troponin isoforms: Each	264,40
037	4163	Apoprotein AI: Turbidometric method	109,70
037	4165	Apoprotein AII: Turbidometric method	109,70
037	4167	Apoprotein B: Turbidometric method	109,70
037	4170	Lipoprotein (a)(Lp(a)) assay	164,10
037	4171	Sodium + potassium + chloride + CO2 + urea	209,70
037	4172	ELISA/EMIT technique	164,10
037	4181	Quantitative protein estimation: Mancini method	102,70
037	4182	Quantitative protein estimation: Nephelometer or Turbidometeric method	109,70
037	4183	Quantitative protein estimation: Labelled antibody	164,10
037	4184	C- reactive protein (Ultra sensitive)	153,70
037	4185	Lactose	143,00
037	4186	Vitamin B6	201,40
037	4187	Zinc: Atomic absorption	239,70
037	4188	Urine dipstick, per stick (irrespective of the number of tests on stick)	19,80
037	4189	Abnormal pigments	59,70
037	4193	Alkapton test: Homogentisic acid	59,70
037	4194	Amino acids: Quantitative (Post derivatisation HPLC)	1033,10
037	4195	Amino laevulinic acid	238,00
037	4197	Amylase	68,50
037	4198	Arsenic	239,70
037	4199	Ascorbic acid	29,50
037	4201	Bence-Jones protein	36,10
037	4204	Calcium: Atomic absorption	95,90
037	4205	Calcium: Spectrophotometric	47,90
037	4209	Lead: Atomic absorption	198,30
037	4211	Bile pigments: Qualitative	29,50
037	4213	Protein: Quantitative	29,50
037	4216	Mucopolysaccharides: Qualitative	47,70
037	4217	Oxalate	123,90
037	4218	Glucose: Quantitative	29,50
037	4219	Steroids: Chromatography (each)	95,20

037	4221	Creatinine	47,90
037	4223	Creatinine clearance	101,00
037	4227	Electrophoresis: Qualitative	59,70
037	4230	Urine /Fluid - Specific Gravity	11,90
037	4235	Inborn errors of metabolism (IEM) screening test by Tandem Mass Spectrometry for the detection of aminoacidopathies and cacylcamtine metabolic defects	879,10
037	4237	5-Hydroxy-indole-acetic acid: Screen test	36,10
037	4247	Ketones: Excluding dip-stick method	29,50
037	4248	Reducing substances	23,70
037	4251	Metanephrines: Column chromatography	291,50
037	4253	Aromatic amines (gas chromatography/mass spectrophotometry)	356,90
037	4254	Nitrosonaphtol test for tyrosine	29,50
037	4261	Micro Albumin : Quantitative	163,40
037	4262	Micro Albumin : Qualitative	59,30
037	4263	pH: Excluding dip-stick method	12,00
037	4265	Thin layer chromatography: One way	89,10
037	4266	Thin layer chromatography: Two way	148,60
037	4268	Organic acids: Quantitative: GCMS	1446,40
037	4269	Phenylpyruvic acid: Ferric chloride	29,50
037	4271	Phosphate excretion index	291,50
037	4272	Porphobilinogen qualitative screen: Urine	65,90
037	4273	Porphobilinogen/ALA: Quantitative each	198,30
037	4283	Magnesium: Spectrophotometric	47,90
037	4284	Magnesium: Atomic absorption	95,90
037	4285	Identification of carbohydrate	101,00
037	4287	Identification of drug: Qualitative	59,70
037	4288	Identification of drug: Quantitative	143,00
037	4293	Urea clearance	71,30
037	4297	Copper: Spectrophotometric	47,90
037	4298	Copper: Atomic absorption	239,70
037	4301	Chloride	34,10
037	4309	Urobilinogen: Quantitative	89,10
037	4313	Phosphates	47,90
037	4315	Potassium	47,90
037	4316	Sodium	47,90
037	4319	Urea	47,90
037	4321	Uric acid	47,90
037	4323	Total protein and protein electrophoresis	148,60
037	4325	VMA: Quantitative	148,60
037	4326	Catecholamines (HPLC)	1033,10
037	4327	Immunofixation: Total protein, IgG, IgA, IgM, Kappa, Lambda	620,20
037	4335	Cystine: Quantitative	166,60
037	4336	Dinitrophenol hydrazine test: Ketoacids	29,50
037	4339	Chloride	34,10
037	4343	Fat: Qualitative	41,60

037	4345	Fat: Quantitative	291,50
037	4347	Ph	12,00
037	4351	Occult blood: Chemical test	29,50
037	4352	Occult blood: Monoclonal antibodies	132,10
037	4357	Potassium	47,90
037	4358	Sodium	47,90
037	4362	Elastase quantitative ELISA	621,50
037	4363	Stercobilinogen: Quantitative	89,10
037	4366	Porphyrin screen qualitative: Urine, stool, red blood cells: Each	65,90
037	4367	Porphyrin qualitative analysis by TLC: Urine, stool, red blood cells: Each	264,40
037	4368	Porphyrin: Total quantisation: Urine, stool, red blood cells: Each	264,40
037	4369	Porphyrin quantitative analysis by TLC/HPLC: Urine, stool, red blood cells: Each	396,70
037	4370	Drug level in biological fluid: Monoclonal immunological	164,00
037	4371	Amylase in exudate	68,50
037	4372	Fluoride in biological fluids and water	206,50
037	4374	Trace metals in biological fluid: Atomic absorption	239,90
037	4375	Calcium in fluid: Spectrophotometric	47,90
037	4376	Calcium in fluid: Atomic absorption	95,90
037	4377	Gallstone analysis: (Bilirubin, Ca, P, Oxalate, Cholesterol)	289,30
037	4380	Lecithin in amniotic fluid: L/S ratio	356,90
037	4390	Foam test: Amniotic fluid	41,60
037	4391	Renal calculus: Chemistry	71,30
037	4392	Renal calculus: Crystallography	215,10
037	4395	Sweat: Sodium	47,90
037	4396	Sweat: Potassium	47,90
037	4397	Sweat: Chloride	34,10
037	4399	Sweat collection by iontophoresis (excluding collection material)	59,70
037	4400	Tryptophane loading test	291,50
037	4401	Cell count	45,70
037	4407	Cell count, protein, glucose and chloride	101,00
037	4409	Chloride	34,10
037	4416	Sodium	47,90
037	4417	Protein: Qualitative	12,00
037	4419	Protein: Quantitative	40,90
037	4421	Glucose	47,90
037	4423	Urea	47,90
037	4425	Protein electrophoresis	166,60
037	4429	Quantitative PCR (DNA/RNA)	1109,50
037	4430	Recombinant DNA technique	330,60
037	4431	Ribosomal RNA targeting for bacteriological identification	462,80
037	4432	Ribosomal RNA amplification for bacteriological identification	991,80
037	4433	Bacteriological DNA identification (LCR)	330,60
037	4434	Bacteriological DNA identification (PCR)	991,80
037	4435	Mixed antiglobulin reaction: Semen	87,70
037	4436	Friberg test: Semen	191,70
037	4437	Kremer test: Semen	47,70

037	4439	Quantitative PCR-viral load (not HIV) - hepatitis C,hepatitis B,CMV	1974,10
037	4440	Semen analysis: Cell count	101,00
037	4441	Semen analysis: Cytology	95,20
037	4442	Semen analysis: Viability + motility - 6 hours	79,20
037	4443	Semen analysis: Supravital stain	71,80
037	4445	Seminal fluid: Alpha glucosidase	264,40
037	4446	Seminal fluid fructose	41,60
037	4447	Seminal fluid: Acid phosphatase	68,50
037	4448	HCG: Latex agglutination: Qualitative (side room)	53,10
037	4449	HCG: Latex agglutination: Semi-quantitative (side room)	122,90
037	4450	HCG: Monoclonal immunological: Qualitative	132,10
037	4451	HCG: Monoclonal immunological: Quantitative	164,00
037	4455	Anti IgE receptor antibody test (10 samples and dilution)	2136,70
037	4456	Eosinophil cationic protein	367,70
037	4457	Mast cell tryptase	1280,80
037	4458	Micro-albuminuria: Radio-isotope method	164,10
037	4459	Acetyl choline receptor antibody	2091,20
037	4460	CA-199 tumour marker	264,40
037	4462	CA-125 tumour marker	264,40
037	4463	C6 complement functional essay	595,00
037	4466	Beta-2-microglobulin	164,10
037	4467	Chromogranin A	618,60
037	4468	CA-549	264,40
037	4469	Tumour markers: Monoclonal immunological (each)	264,40
037	4470	CA-195 tumour marker	264,40
037	4471	Carcino-embryonic antigen	264,40
037	4474	Cast Per Allergen	365,90
037	4475	CA- 724	263,10
037	4477	Neuron specific enolase	264,40
037	4478	Osteocalcin	413,40
037	4479	Vitamin B12-absorption: Shilling test	154,80
037	4480	Serotonin	248,00
037	4482	Free thyroxine (FT4)	231,10
037	4484	Thyrotropin (TSH) + Free Thyroxine (FT4)	488,00
037	4485	Insulin	164,10
037	4486	C- Peptide	163,30
037	4487	Calcitonin	248,40
037	4488	B- Type Natriuretic Peptide	618,60
037	4490	Releasing hormone response	661,20
037	4491	Vitamin B12	164,10
037	4492	Vitamin D3: Calcitroil (RIA)	991,80
037	4493	Drug concentration: Quantitative	164,10
037	4494	Free hormone assay	231,10
037	4495	Growth hormone	164,10
037	4496	Hormone concentration: Quantitative	164,10
037	4497	Carbohydrate deficient transferrin	384,50

037	4499	Cortisol	164,10
037	4500	DHEA sulphate	164,10
037	4501	Testosterone	164,10
037	4502	Free testosterone	231,10
037	4503	Oestradiol	164,10
037	4505	Oestriol	143,00
037	4506	Multiple antigen specific IgE screening test for Atopy	492,70
037	4507	Thyrotropin (TSH)	259,20
037	4508	Combined antigen specific IgE	323,70
037	4509	Free tri-iodothyronine (FT3)	231,10
037	4512	Parathormone	225,60
037	4513	IgE: Total	164,10
037	4514	Antigen specific IgE	164,10
037	4515	Aldosterone	164,10
037	4516	Follitropin (FSH)	164,10
037	4517	Lutropin (LH)	164,10
037	4519	Prostate specific antigen	191,50
037	4520	17 Hydroxy progesterone	164,10
037	4521	Progesterone	164,10
037	4522	Alpha-feto protein	164,10
037	4523	ACTH	287,60
037	4524	Free PSA	263,00
037	4526	Sex hormone binding globulin	164,10
037	4527	Gastrin	164,10
037	4528	Ferritin	164,10
037	4529	Anti-DNA antibodies	164,10
037	4530	Antiplatelet antibodies	202,40
037	4531	Hepatitis: Per antigen or antibody	191,50
037	4532	Transcobalamine	164,10
037	4533	Folic acid	164,10
037	4534	Prostatic acid phosphatase	164,10
037	4536	Erythrocyte folate	231,10
037	4537	Prolactin	164,10
037	4538	Procalcitonin: Semi-quantitative	421,40
037	4539	Procalcitonin: Quantitative	605,10
037	4540	HCG: Quantitative as used for Down's screen	198,30
037	4544	Attendance in theatre	356,90
037	4546	First Trimester Down's screen	703,10
037	4552	Second Trimester Down's screen	441,90
037	4553	Thyroglobulin	263,10
037	4559	Liquid Based Cytology	203,30
037	4561	Sputum, all body fluids and tumour aspirates: First unit	204,30
037	4563	Sputum, all body fluids and tumour aspirates: Each additional unit	119,00
037	4564	Performance of fine-needle aspiration for cytology	228,70
037	4565	Examination of fine needle aspiration in theatre	1372,40
037	4566	Vaginal or cervical smears, each	167,70

037	4600	Anti- CCP	229,40
037	4601	Panel typing: Antibody detection: Class I	476,00
037	4602	Panel typing: Antibody detection: Class II	582,00
037	4603	HLA test for specific locus/antigen - serology	356,90
037	4604	HLA typing: Class I - serology	687,90
037	4605	HLA typing: Class II - serology	687,90
037	4606	HLA typing: Class I & II - serology	1190,10
037	4607	Cross matching T-cells (per tray)	238,00
037	4608	Cross matching B-cells	502,70
037	4609	Cross matching T- & B-cells	634,80
037	4610	Helicobacter : Pylori antigen test	455,20
037	4614	HIV Ab - Rapid Test	157,60
037	4650	Antibiotic MIC per organism per antibiotic	105,70
037	4651	Non-radiometric automated blood cultures	184,00
037	4652	Rapid automated bacterial identification per organism	198,30
037	4653	Rapid automated antibiotic susceptibility per organism	224,90
037	4654	Rapid automated MIC per organism per antibiotic	224,90
037	4655	Mycobacteria : MIC determination -E test	216,70
037	4656	Mycobacteria : Identification HPLC	459,90
037	4657	Mycobacteria : Liquefied ,concentrated ,fluorochrome stain	130,20
037	4750	Cell culture: Lymphocytes, cord blood	203,30
037	4751	Cell culture: Amniotic fluid, fibroblasts, leukaemia bloods, bone marrow, other specialised cultures	609,50
037	4752	Cell culture: Chorionic villi	812,80
037	4754	Cytogenetic analysis: Lymphocytes: Idiograms, karyotyping, one staining technique	1828,20
037	4755	Cytogenetic analysis: Amniotic fluid, fibroblasts, chorionic villi, products of conception, bone marrow, leukamia bloods: Idiograms, karyotyping, one straining technique	3656,50
037	4757	Specified additional analysis e.g. mosaicism, Fanconi anaemia, Fra X, additional staining techniques	947,80
037	4760	FISH procedure, including cell culture	1557,40
037	4761	FISH analysis per probe system	474,00
037	4763	Blood: DNA extraction	609,50
037	4764	Blood: Genotype per person: Southern blotting	1205,50
037	4765	Blood: Genotype per person: PCR	812,80
037	4767	Prenatal diagnosis: Amniotic fluid or chorionic tissue: DNA extraction	1218,80
037	4768	Prenatal diagnosis: Amniotic fluid or chorionic tissue: Genotype per person: Southern blotting	2546,00
037	4769	Prenatal diagnosis: Amniotic fluid or chorionic tissue: Genotype per person: PCR	1625,00

Appendix 9: Approval Letters

(Limpopo Department of Health, Vhembe District Department of Health, Elim, Donald Fraser, Louis Trichardt, Malamulele, Musina, Siloam and Tshilidzini.

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
HEALTH

Ref : LP_2023-11-024
Enquires : Legodi P
Tel : 015-293 6028/6410
Email : Malesela.Legodi@dhsd.limpopo.gov.za

TSHIFHIWA PATRICIA TSHAVHUNGWE

PERMISSION TO CONDUCT RESEARCH IN DEPARTMENTAL FACILITIES

Your Study Topic as indicated below;

EXPANDING AND ENHANCING MEDICAL TESTING LABORATORIES IN RURAL AREAS OF SOUTH AFRICA

1. Permission to conduct research study as per your research proposal is hereby Granted.
2. Kindly note the following:
   a. Present this letter of permission to the Office of District Executive Manager a week before the study is conducted.
   b. This permission is **ONLY** for Vhembe District Offices
   c. In the course of your study, there should be no action that disrupts the routine services or incur any cost on the Department.
   d. After completion of study, it is mandatory that the findings should be submitted to the Department to serve as a resource.
   e. The researcher should be prepared to assist in the interpretation and implementation of the study recommendation where possible.
   f. **The approval is only valid for a 1-year period.**
   g. If the proposal has been amended, a new approval should be sought from the Department of Health
   h. Kindly note that, the Department can withdraw the approval at any time.

Your cooperation will be highly appreciated.

pp **Head of Department** 5/2/2024 **Date**

Private Bag X9302, Polokwane 0700
Fidel Castro Ruz House, 18 College Street, Polokwane 0700
Tel: 015 293 6000. Fax: 015 293 6211. Website: www.doh.limpopo.gov.za

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LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
HEALTH
VHEMBE DISTRICT

Ret: 58/4/2/3

Eng: Gertrude Baloyi

Date: 19 February 2024

TO: Tshifhiwa Patricia Tshavhungwe
University of the Witwatersrand

SUBJECT: REQUEST TO CONDUCT A STUDY (RESEARCH) AT PHC FACILITIES IN VHEMBE DISTRICT

Your study topic: Expanding and enhancing medical testing laboratories in rural areas of South Africa in Vhembe District, Limpopo Province

1. The above matter has reference

2. The Department of Health has acknowledged your communiqué received on the 12 February 2024 for the above mentioned. Kindly be informed that permission has been granted to conduct a research at **PHC facilities in Vhembe District from 22 February 2024-05 February 2025.**

3. You are also advised to comply or adhere with the Departmental Policies, rules and regulations during your operations.

Hoping that you will find this in order.

.....
CHIEF DIRECTOR: HEALTH SERVICES

19/02/2024
DATE

VHEMBE DISTRICT, Private Bag X5009 THOHOYANDOU 0950
Old Parliamentary Building Tel: (015) 962 1848, (015) 962 1852, (015) 962 1754, (015) 962 1001/2/3/4/5/6 Fax (015) 962 2373.

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
HEALTH
DONALD FRASER HOSPITAL

Ref 4/1/4/1
Enq: MS NEMANASHI N.F
Date:01/03/2024

To: TSHIFHIWA PATRICIA TSHAVHUNGWE
UNIVERSITY OF THE WITWATERSRAND

LP _ 2023-11-024

SUBJECT: APPROVAL TO CONDUCT RESEARCH AT DONALD FRASER HOSPITAL
RESEARCH TOPIC: Expanding and Enhancing medical testing laboratories in rural areas of South Africa in Vhembe District, Limpopo province

1. The above matter has reference
2. This is to confirm that the above mentioned student is approved to come and collect data at Donald Fraser hospital
3. Risk assessment of the research topic was done and rated as medium
4. The researcher is requested to respect patients' rights charter and bathopele principles during data collection
5. The researcher is supposed to consult Assistant Director Quality assurance if meet challenges at this number 0822323570

THANK YOU

ACEO

01/03/2024
DATE

Private Bag x 1172, VHUFULI, 0971
Mukumbani Road -Tel: 015-963 9200, Fax No. 015 963 1773, 015 963 1796

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LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
HEALTH

Ref : S5/3/2
Enq : Ramaru M.J
Tel : 015 556 3201
Email : Jane.Ramaru@dhsd.limpopo.gov.za

To : Tshavhungwe T.P

Cc : Senior Clinical Manager: Dr. Mushadu .S.M

From : Human Resource Utilization and Capacity Development

SUBJECT: REQUEST TO CONDUCT A STUDY RESEARCH ON EXPANDING AND ENHANCING MEDICAL TESTING LABORATIES IN RURAL AREAS OF SOUTH AFRICA.

1. The above matter bears reference.
2. Receipt of your letter dated 15 February 2024 together with the approval from the Provincial and District offices is hereby acknowledged with thanks.
3. You are hereby granted permission to access the hospital to conduct the research as requested.
4. When collecting the data, you are kindly advised to liaise with Dr Mushadu M.S Senior Clinical Manager regarding issues of the availability of documentations and employees to assist you on your research.
5. Your urgent attention is always appreciated.

MATODZI

MR MATODZI P.T
CHIEF EXECUTIVE OFFICER

28/02/2024
DATE

Elim Hospital, Private Bag x312, ELIM HOSPITAL, 0960
145 Mahangeskraal, R578 Elim –Giyani Road, Elim Hospital, 0960. Tel: 015-556-3201. Fax: 015-556-3160
Email address: elimhospital@dhsd.limpopo.gov.za

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PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
HEALTH
LOUIS TRICHARDT HOSPITAL

Ref:8/1/1

Enq: Ramulongo LC

29 February 2024

DEPARTMENT OF HEALTH
LOUISTRICHARDT HOSPITAL
P/BAG X2417, MAKHADO, 0920
29 FEB 2024
CHIEF EXECUTIVE OFFICER
LIMPOPO PROVINCE

To: Ms Tshifhiwa Patricia Tshavhungwe

University of Witswatersrand

From: Office of the CEO
Louis Trichardt Hospital

RE: REQUEST TO CONDUCT A STUDY RESEARCH AT PHC FACILITIES IN VHEMBE DISTRICT.

1. The above matter refers.
2. This office would like to acknowledge the receipt of your approval to conduct a study research at PHC facilities in Vhembe District.
3. You are hereby advised to comply or adhere with the departmental policies, rules and regulations.
4. Hope you will find the above in order.

Acting Head of Institution

29/02/2024
Date

Private Bag x2417, Louis Trichardt, 0920. Cnr Hospital and Snyman Street, Louis Trichardt, 0920
Tel: (015) 516 0148, Fax: (015) 516 3252

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LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF HEALTH
MALAMULELE HOSPITAL

REF : S 4/5

ENQ : Siwela T.S

DATE : 28/02/2024

TO WHOM IT MAY CONCERN

SUBJECT: PERMISSION TO CONDUCT A RESEARCH IRO : TSHAVHUNGWE T.P

1. This serves to acknowledge the receipt your application to conduct a research study at Malamulele hospital and the research topic is **" Expanding and enhancing medical testing Laboratories in rural areas of South Africa"**

2. The permission to conduct the study in question is recommended since the application meets the requirements as prescribed by departmental circular no 24 of 2015.

3. Hopping for an effective cooperation between the participants of this research

Thank you

.....

CHIEF EXECUTIVE OFFICER
MALAMULELE HOSPITAL

29/02/2024
DATE

DEPARTMENT OF HEALTH
MALAMULELE HOSPITAL, P/BAG X9245
MALAMULELE, 0982
29 FEB 2024
REGISTRY

CONFIDENTIAL

Private Bag x9245 Malamulele
(015)851 0026/1020/1017/1019 Fax :(015)851 0620

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
HEALTH
MESSINA HOSPITAL

Ref: 9/1/3
Enq: Radzilani AC
Date: 01 March 2024

FROM: HUMAN RESOURCE DEVELOPMENT

TO: TSHIFHIWA PATRICIA TSHAVHUNGWE

RE: REQUEST TO CONDUCT A RESEARCH STUDY AT MUSINA HOSPITAL IN THE VHEMBE DISTRICT, LIMPOPO PROVINCE. THE STUDY TOPIC IS: EXPANDING AND ENHANCING MEDICAL TESTING LABORATORIES IN RURAL AREAS OF SOUTH AFRICA

1. The above matter has reference.
2. This office wishes to inform you that your application has been approved as per conditions stipulated on the approval letter by Head of Department. You are requested to liaise with office of the Acting Head of Institution on your commencement date.
3. Your co-operation will be highly appreciated.

.....
ACTING HEAD OF INSTITUTION

04/03/2024
.....
DATE

Private Bag X4006 MUSINA 0900
Tel:(015) 534 0446 Fax(015) 534 0819
CNR CALDERWOOD AND WHITHYE STREET

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LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
HEALTH
SILOAM HOSPITAL

DEPARTMENT OF HEALTH
SILOAM HOSPITAL
HUMAN RESOURCE
2024 -02- 23
P/BAG X2432 LOUIS TRICHARDT
0920
LIMPOPO PROVINCE

Ref : S4/1/5/2/1/5
Enq : Mushaphi N.T
Tel :015 973 0004/ 082 740 8641
Email :ndivhuwo.mushaphi@dhsd.limpopo.gov.za

TO: TSHIFHIWA PATRICIA TSHAVHUNGWE
UNIVERSITY OF THE WITWATERSRAND

SUBJECT: PERMISSION TO CONDUCT RESEARCH: YOURSELF

1. The above matter refers,
2. The Hospital highly acknowledges the receipt of your application letter regarding the above matter.
3. Kindly note that the institution is granting you permission to come and conduct research in **EXPANDING AND ENHANCING MEDICAL TESTING LABORATORIES IN RURAL AREAS OF SOUTH AFRICA**
4. You are kindly requested to adhere to the conditions as set out in your approval from the Provincial Office.
5. Hope you will find the above in order.

.....
Chief Executive Officer

.....
Date

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF
HEALTH
TSHILIDZINI HOSPITAL

DEPARTMENT OF HEALTH
TSHILIDZINI HOSPITAL
06 MAR 2024
P/BAG X 924 SHAYANDIMA 0945
LIMPOPO PROVINCE

Ref: 8/1/1
Enquiries: Netshifhefhe L.E
Date: 05 March 2024

To: Tshifhiwa Patricia Tshavhungwe

Subject: Expanding and enhancing medical testing laboratories in rural areas of South Africa.

1. The above matter refers.

2. Your letter received on the 20 February 2024 requesting for permission to conduct a study is hereby acknowledged.

3. Permission is therefore granted for the study to be conducted in Tshilidzini Hospital based on the approval letter you provided from the Head of Department Limpopo Department of Health and the Chief Director Health Services Vhembe District.

Wishing you success in your studies.

Chief Executive Officer

2024/03/06
Date

Tshilidzini Hospital.Private Bag X924, SHAYANDIMA, 0945Tel:015 964 4384, FAX 015 964 1492/015 964 1072
Physical Address: R524 PUNDA MARIA ROAD
An accessible, caring quality health and social development service for the people of Vhembe District.

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Appendix 10: Ethics Documents

Consent Form

Title of project: Expanding Medical Laboratories in South Africa Remote Areas for Improved Quality Diagnostic Services and Healthcare Outcomes.

Name of researcher: Tshifhiwa Tshavhungwe

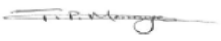
I, ……., agree to participate in this research project.

I agree to the following:

(Please mark the relevant options below)

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study	YES	NO
I agree that my questionnaire responses may be documented and analysed for research purposes.	YES	NO
I agree that direct quotations from my questionnaire responses may be used by the researcher in their research report/ manuscript.	YES	NO
I agree that my participation will remain anonymous (my name or other identifying data will not be used by the researcher in their research report/manuscript/book chapter)	YES	NO
I agree that other researchers may use the information I provide in my questionnaire responses (depending on their own ethics clearance being obtained) but my name and any personal information will not be used or passed on.	YES	NO

…… (signature)
…… (name of participant)
…… (date)


… (signature)
Tshifhiwa Tshavhungwe…… (Name of researcher/person seeking consent)
12 February 2024……(date)

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Confidentiality Agreement

I, (print full names) Tshifhiwa Tshavhungwe hereby agree not to disclose any information received from survey questionnaire or TAT data. The survey will be confidential and anonymous. When I share the results of the research study, I will not include participants names or anything else that could identify them.

Only with participants permission will other researchers use the data collected from this research study, but without participants names.

TPTshavhungwe — Researcher Signature

09 June 2023 — Date