CHANGES IN THE QUALITY OF VOLUNTARY MEDICAL MALE CIRCUMCISION SERVICES IN SELECTED DISTRICTS OF THE MPUMALANGA, EASTERN CAPE, FREE STATE AND NORTH WEST PROVINCES OF SOUTH AFRICA.

By

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A research report submitted to the Wits School of Public Health, Faculty of Health Sciences, University of the Witwatersrand in partial fulfilment of the requirements for the degree of Master of Science Epidemiology and Biostatistics by combination of coursework and research

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DECLARATION

I declare that this research report is my own unaided work. It is being submitted for the degree of Master of Science Epidemiology and Biostatistics by combination of coursework and research at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

Signature of candidate: 

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[24th] day of [June] in the year [2021].

DEDICATION

My dedication goes to my lovely wife Elizabeth who has been providing tremendous family support, words of motivation and encouragement for my studies, and our daughters Caroline, Phyllis and Nadine, thank you guys for your support and patience even during difficult periods. And to my late mother Joyce Nyengerai Nee Nyamunda who mentored and raised me during my childhood, and my father, Fanuel Chirombo Nyengerai who has been providing financial support in my educational life and to all my other siblings, not forgetting my sister Rosemary for consistent support.

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ABSTRACT

Objective: Voluntary Male Medical Circumcision (VMMC) as an HIV prevention strategy, has been widely adopted in several countries over the years, and its expansion has brought about quality gaps requiring urgent interventions. A key intervention strategy has been the implementation of continuous quality improvement (CQI). However, less has been focused on the changes in quality of services across all quality standards after implementation of quality improvement support. Therefore, this study sought to evaluate the effect of CQI on the quality of service in VMMC programmes across Right to Care supported sites in the North West, Mpumalanga, Eastern Cape and Free State provinces in South Africa.

Design: This was a pre-post design intervention study based on secondary data collected from the National Department of Health sites supported by Right to Care (RTC) on VMMC services in South Africa.

Method: Data for baseline CQI assessment and re-assessments was collected using a standardized National Department of Health (NDoH) CQI assessment tool for VMMC services. The assessments were conducted through staff interviews, checklists and direct observation of facility activities in line with the NDoH and WHO VMMC quality guidelines. Quality improvement support was provided through a combination of coaching, provision of standard operating procedures and guidelines, mentoring and on-site in-service trainings on quality improvement planning and implementation. A paired sample t-test was used to compare the quality of service mean scores before and after CQI implementation by quality standard. Linear mixed modelling was applied for multivariate analysis to adjust for clustering and to determine changes in quality of service by type of service delivery and facility structure using the overall quality of service across quality standards.

Results: During the period July 2018 to October 2019, 96 sites offered VMMC services [16 in the Eastern Cape, 19 in Free State, 19 in Mpumalanga and 42 in the North West province]. Out of these, 40 sites were assessed at both baseline and after CQI support visits and 13 were from Mpumalanga, 6 from Free State and 21 from the North West provinces. Results showed significant increases for the overall changes in quality of service after CQI support intervention of 11.89% for infection prevention (95%CI: 6.60-17.15; $p<0.001$) and 8.28% for male circumcision surgical procedure, (95%CI: 3.25-13.30; $p<0.01$). Similarly, individual counselling, and HIV testing increased by 13.56%, (95%CI: 6.94-20.19; $p<0.001$), group counselling, registration and

communication by 8.5%, (z=3.529; p<0.001), and 35.08% for monitoring and evaluation, (95%CI: 28.03-42.12; p<0.001). In addition, there were significant increases for management systems of 28.65%, (95%CI: 22.30-35.00; p<0.001), leadership and planning 23%, (95%CI: 12.85-33.88; p<0.001%) and supplies, equipment, environment and emergency 5.10%, (95%CI: 1.09-9.11; p<0.01). The overall quality of service performance across provinces had increased by 19.32% (95%CI: 15.67-22.97; p<0.001) on adjustment to facility structure and urban-rural classification. Furthermore, the overall quality of service performance was 9.9% higher in urban facilities compared to rural sites (95%CI: 4.10-15.81; p<0.001). Similarly, the overall quality of service performance for outreach facilities was 4.92% higher compared to fixed facilities (95%CI: 5.21-19.91; p<0.001) after CQI support intervention.

Conclusion: The overall quality of service performance across provinces was significantly improved after implementation of CQI support intervention program. However, provinces showed lack of positive improvement for specific quality standards. For instance, no significant improvements were observed for group counselling, registration and communication in the Free State and Mpumalanga provinces. Furthermore, the overall quality of service performance was highest at outreach and urban facilities compared to fixed and rural facilities respectively. Results from this study did not find any significant differences on the overall change in quality of service between types of service delivery (routine and campaign) and between provinces.

Key words: circumcision; quality of service; quality improvement; quality standards; implementation; training; monitoring; site assessment.

LIST OF ACRONYMS

AIC	Akaike Information Criterion
AIDS	Acquired Immune Deficiency Syndrome
CQI	Continuous Quality Improvement
DMAIC	Define, Measure, Analyze, Improve, Control
HAART	Highly Active Antiretroviral Therapy
HPV	Human papillomavirus
HIV	Human immunodeficiency virus
ICC	Intra-level correlation coefficient
LMIS	logistics management information system
LMM	Linear mixed modelling
LRT	likelihood ratio test
MBNQA	Malcolm Baldrige National Quality Awards
NDoH	National Department of Health
PDSA	Plan Do Study Act
PEPFAR	U.S. President's Emergency Plan For AIDS Relief
RTC	Right to Care
SIMS	Site Improvement through Monitoring Systems
STI	Sexually transmitted infections
UNAIDS	Joint United Nations Programme on HIV and AIDS
SYMMACS	Systematic Monitoring of the Voluntary Medical Male Circumcision Scale-Up
VMMC	Voluntary medical male circumcision
WHO	World Health Organisation

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CHAPTER ONE

1.1 Chapter overview

The chapter provides a brief background using reviewed literature about the current global and South African statistics for the people living with HIV (PLHIV). HIV statistics were further related to the costs associated with diagnosis, treatment and disease management. This led to the basis for the scaling up and strengthening of the current prevention strategies which include the voluntary medical male circumcision (VMMC) program. A brief highlight about the quality of service gaps and the need to determine changes in quality of service after continuous quality improvement (CQI) support was provided. Furthermore, reviewed literature was used to highlight the importance of CQI initiatives in addressing quality of service gaps. This resulted in the discussion about the minimum set of VMMC quality standards that are required to assess quality of service at VMMC sites, and the current state of affairs in South Africa. Sources of the research problem in line with changes in quality of service after CQI support and benefits associated with the study were provided.

1.2 BACKGROUND TO THE STUDY

United Nations Programme on HIV and AIDS (UNAIDS) global HIV statistics shows that an estimated 37.9 million people were HIV infected by end of 2018 and that 1.7 million became newly infected during the same year (1). This was an increase of about 1 million from 2017 where 36.9 million people where HIV infected (2). The total number of 2018 new infections translate to approximately 4700 people becoming newly infected daily. In South Africa alone, the total number of people living with HIV has increased from 6.4 million in 2012 (3) to 7.7 million in 2018 (4). Literature shows a sharp increase in the number of people on HAART in South Africa from 45500 in 2004 to 3.39 million in mid-2015 (5).

This is evidence that the number of people becoming newly infected and those on HAART is continuously increasing in South Africa and globally. The costs associated with HIV diagnosis, treatment and management of the disease will similarly continue to increase. Recent studies have shown that the average costs-per-HIV infection averted were highest in South Africa (6). Hence there was a need for cost effective strategies to strengthen and scale-up the current prevention methods. Voluntary medical male circumcision (VMMC) was among the cost effective and recommended prevention strategies in South Africa (6). Evidence from literature confirms that it saves costs through the prevention of new HIV infections and by minimising the proportion of people on antiretroviral treatment (6–8).

However, the expansion of VMMC programs have raised the need to address issues related to quality of service (9). Therefore, VMMC programs require more monitoring and evaluation to continuously improve quality of service through continuous quality improvement strategies. Quality of service can be defined in eight dimensions that include reliability, responsiveness, accessibility, performance and conformance to standards (10). In the context of VMMC, quality of service cut across several standard elements that include staff competency, client communications, supply logistics, surgical procedures and infection prevention. Quality assessments are therefore conducted periodically to assess the extent of compliance for service providers against the approved set of quality standards.

Recent literature indicate gaps and challenges for VMMC quality of service in most countries (11). In 2012, 86% of VMMC priority countries were operating with inadequate supplies (12). This could have been as a result of the scaling-up of the VMMC programs in the VMMC priority countries. Evidence from research findings shows that a significant proportion of sites

in South Africa were operating without guideline documents and with inadequate VMMC supplies and equipment (13,14). However, less has been focused on the changes in quality of service across all quality standard parameters after continuous quality improvement (CQI) support. The changes in quality of service after CQI support remains unclear.

This shows the need to continuously monitor and assess the VMMC programs' quality of service in South Africa for continuous quality improvement planning. Challenges experienced by sites that provide VMMC services differ and these should be regularly identified to maintain a high quality of service (15). VMMC quality improvement assessments work towards identifying quality gaps in order to develop strategies for planning and implementation of the action plans. This will help to increase demand creation since service-related quality barriers associated with negative health outcomes will be identified.

This study, therefore, aims to determine changes in quality of service at Right to Care (RTC) supported VMMC sites in South Africa from July 2018 to October 2019. The RTC VMMC programme was funded to provide quality improvement support to all sites aligned with the United States President's Emergency Plan for AIDS Relief (PEPFAR), National Department of Health (NDoH) and World Health Organisation (WHO) standards and guidelines. Data for the primary study was collected through VMMC CQI site assessments, based on the core essential quality standard elements.

Baseline comprehensive assessments were done in line with PEPFAR and WHO guidelines. Follow-up assessments were conducted to check for improvements and further identification of service quality gaps. The assessments were conducted through staff interviews, checklists and direct observation of all the facility value chain processes and activities. The activities included counselling sessions, infection prevention and VMMC surgical procedures. Client registers, records and material resource inventories such as equipment and supplies were also reviewed during the assessments.

1.3 LITERATURE REVIEW

1.3.1 Overview of voluntary medical male circumcision (VMMC)

"VMMC refers to the complete removal of the penile foreskin under aseptic conditions" (16). Clinical trials that were conducted in Kenya, Uganda and South Africa have demonstrated evidence that medical male circumcision reduces the risk of female-to-male sexual transmission of HIV by approximately 60% (16,17). In addition to the reduction in HIV transmission risk, VMMC minimises the risk of other sexually transmitted infections (STIs) and this include herpes and syphilis (15). Evidence for risk reduction associated with penile human papillomavirus (HPV) that causes cervical cancer in women was also reported in recent literature (18).

Furthermore, research findings have attested that VMMC saves costs through the prevention of new HIV infections and also by minimising the proportion of people on highly active antiretroviral treatment (HAART) (7). Mathematical modelling studies have also demonstrated that more than 3 million HIV infections can be prevented by 2025 if VMMC coverage is maintained above 80% (19–21). In line with these positive developments in research, countries with high HIV prevalence were encouraged by WHO and UNAIDS to use VMMC as an additional strategy for HIV prevention (18,21,22). South Africa introduced VMMC as one of the prevention methods for HIV transmission in 2010 (21).

1.3.2 Regional VMMC uptake

Fourteen Eastern and Southern African nations were identified as priority countries for scale up of VMMC and these include Botswana, Kenya, Lesotho, Ethiopia, Malawi, Mozambique, Namibia, Rwanda, South Africa, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe (23). South Sudan was identified and included under VMMC priority countries in 2017, and this has brought the number to 15 (24).

Globally, the WHO has reported that among the priority countries, nearly 18.6 million men were circumcised between 2008 and 2017 (23). Of this total, 4 million voluntary circumcisions were performed in 2017 alone (24). Among the priority countries, Kenya has been highly successful in scaling up its VMMC programs. It surpassed its annual target of 940,000 circumcisions in 2015 by approximately 100,000. It has achieved coverage among communities that did not previously practice male circumcision such as the Nyanza region (25). In South Africa, 2.3 million males were circumcised by August 2019 (26). Recent

literature also shows that in 2018 alone, 572 000 men were circumcised in South Africa (21). During the same year (2018), the highest number of medical male circumcisions was in Gauteng, followed by the Western Cape and the Northern Cape had lowest (27).

Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Uganda, and Zimbabwe were assessed in a recent feasibility study for scaling up of VMMC between 2017 and 2021 (28). Findings showed that only Tanzania was likely to reach 90% coverage. Mozambique, South Africa, and Lesotho were projected as coming close to reaching the target coverage(28). However, scaling up of medical circumcision may compromise the quality of service delivery (13,29–31). Hence it is important to adopt CQI approaches to identify challenges and quality of service gaps. In addition, there is limited information relating to changes in VMMC quality of service after CQI support in South Africa.

1.3.3 Quality of service

Service quality is the ability of an organization to meet or exceed the expectations of clients (10). It can be defined in several dimensions that include reliability, responsiveness, accessibility, performance and conformance to standards (31). Poor quality of service can result in increased cost of operations, negative health outcomes, customer dissatisfaction and negative word of mouth (30). Recent studies shows that clients are even prepared to bypass local health facilities with low quality of service to access services from geographically distant health service providers (32). Research also indicate that communication, medical staff skills and availability of resources such as equipment and supplies can affect the attitudes and perceptions of clients on the quality of service offered (30).

In the context of VMMC, quality of service cut across several core essential standard elements that include staff competency, client communications, supply logistics, surgical procedures and infection prevention. Hence, for the effective management of VMMC quality of service, there is need for successful execution of quality assurance and continuous quality improvement (10).

1.3.4 VMMC quality assurance approaches

Quality assurance is a strategy of prevention that ensures compliance of healthcare service delivery to quality regulatory standards (33). It is focused on planning, documenting and agreeing on a set of guidelines that are necessary to assure quality (34,35). The typical outcomes of quality assurance activities are quality plans, inspections and training of people in

the selected methods and processes (34). Quality assurance review for VMMC processes involve the use of documented patient files to evaluate performance and to ensure satisfaction with the relevant quality standards (33). WHO quality standards are the VMMC pillars that ensures provision of high-quality of services and patient safety (11). A deviation from quality standards will result in poor patient outcomes and demand-creation (35). Literature shows that without a strategic quality plan, an enormous amount of time and effort will be wasted by the organization dealing with failures and customer complaints (10). VMMC quality assurance strategies are therefore required in order to realise the highest quality of service.

1.3.5 VMMC continuous quality improvement (CQ1)

CQI is about change in processes and outcomes (32). It ensures understanding of the systems and processes for doing work to identify prevailing gaps (33). It is a continuous process that improves efficiency, effectiveness and outcomes. It was designed to streamline and improve processes and systems (36). VMMC CQI is aimed at bridging the gaps between the expected quality of service according to PEPFAR and WHO standards and the actual quality of service being provided by the VMMC sites (37–40). 'Zimbabwe was able to scale up while at the same time improving service quality, probably due to a strong quality assurance and quality improvement component and training of providers…' (13). Hence, a combination of CQI and quality assurance for VMMC programs is expected to yield positive results for quality of service.

Further evidence from research indicates that CQI principles, strategies and techniques are critical drivers of new quality of service models (10). CQI is therefore, a critical element required to achieve a good quality of service for VMMC programs. In addition, literature supports the use of routine VMMC site assessments to identify deviations from the expected levels of quality (36). Hence there is a need for VMMC sites to conduct routine self-assessments for CQI planning. Recent literature shows that CQI planning can be achieved through the Plan-Do-Study-Act (PDSA) cycle and site implementation and monitoring system (SIMS) (38). This is in support of the need to continuously evaluate the changes in quality of service after implementation of CQI plans at VMMC sites. However, most recent studies were focused on identifying gaps and challenges and less has been done on assessing changes in quality of service after implementation of CQI action plans.

1.3.6 Site Improvement through Monitoring Systems (SIMS).

SIMS is a quality assurance methodology that was developed by PEPFAR to improve the quality of services for VMMC programs through a standardized monitoring system at health facilities (38). The Link between quality improvement, quality assurance and SIMS on figure 1, was adopted from PEPFAR's best practices for VMMC site operations (11). Site implementation and monitoring system incorporates the Plan-Do-Study-Act approach (PDSA). It is an approach to evaluate VMMC sites compliance to WHO quality standards and to determine the level of quality improvement support required (9).

The monitoring process involves comprehensive and follow-up CQI site assessments. Comprehensive assessment is the baseline site evaluation of all the relevant quality standard elements, and follow-up assessments helps to determine if the action plans were successfully implemented (38). Implementation and support for CQI activities involves creating site level quality improvement teams that will focus on addressing quality of service gaps (12,22). The composition of the CQI teams includes clinicians, counsellors, cleaners, assistants, and data managers that are involved in VMMC service delivery (9). Literature shows that facilities with functional CQI teams, demonstrated faster improvement compared to facilities without quality improvement teams (9,22). A quality improvement framework with roles and responsibilities for facility-based CQI teams helps in the delivery of positive quality improvement outcomes and this was demonstrated in Uganda (9,36).

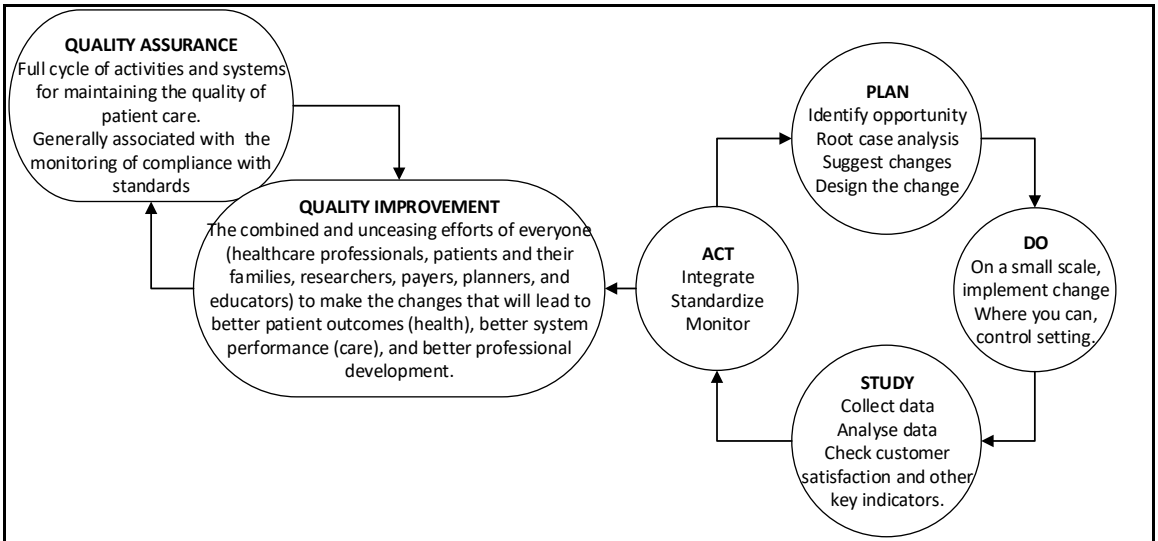

Figure1: Relationship between Site implementation and monitoring System, Quality Assurance and Quality Improvement

Source: PEPFAR's best practices for voluntary medical male circumcision site operations. A service guide for site operations https://aidsfree.usaid.gov/resources/pepfars-best-practices-vmmc-site-operations-0, 2016

Figure 1: Relationship between SIMS, Quality Assurance and Quality Improvement.

1.3.7 Plan-Do-Study-Act (PDSA): A Model for VMMC site evaluation

The PDSA is a methodology that can be used to develop VMMC objectives and to identify problems and measures of success (41). It enables systematic testing of programme activities in cycles (41). The PDSA cycle is actively applied together with routine quality assessments at VMMC facilities (36). Routine assessments are continuous and ongoing activities for ensuring that any deviations from the expected level of quality are identified and quickly remedied (11,35,36). They involve comprehensive baseline and follow-up assessments that will be conducted periodically using standardised CQI tools (11).

Results from the routine assessments lead to the development of action plans that may include technical support, staff training, mentoring and assistance in developing quality improvement plans (35). Training helps staff to test the changes in service quality improvement using the PDSA cycle (32). Research shows that training improves staff competencies in the interpretation of VMMC quality standards (11). Literature also indicate that procedure related negative outcomes have decreased from 8.6% to 4.5% after CQI training in Malawi (42). In addition, a research by the *'Good Health at Low Cost project'* provided evidence that adequately trained and motivated healthcare providers, can provide a high quality of service even under conditions of limited resources (43). Failure to provide good quality of service is often as a result of employees lacking the required skills and experience which must be continuously learned (44). Hence, site re-assessments are conducted on a regular basis to check for improvements and effectiveness of the training interventions. This is further evidence for the need to assess the changes in quality of service after CQI support for quality improvement planning.

In addition to the PDSA cycle, other models that were proved to deliver healthcare service quality include the lean, six sigma and the Malcom Baldrige National Quality Award (MBNQA) (34,45). The 'Lean approach' is useful in simplifying overcomplicated processes and it alleviates overburden and inconsistency in processes by eliminating waste and unnecessary efforts (41). Six-Sigma is also a strategy tailored to improve efficiency by identifying and removing the causes of defects (errors) and minimizing variability in internal processes (10). It combines statistical analysis with quality management methods (41). Six-Sigma relies on the ability to obtain data on process and outcome measures. Quality of service has been achieved through the application of six sigma and lean strategies at the same time, they simultaneously eliminate wastes and minimising errors (10). A CQI initiative using Six

Sigma adheres to five principles of (DMAIC) and these are Define, Measure, Analyse, Improve and Control.

1.3.8 VMMC quality standards

The World Health Organisation(WHO), the United Nations Programme on HIV and AIDS (UNAIDS) and the United States President's Emergency Plan for AIDS Relief (PEPFAR) have created a list of core essential elements as a set of minimum quality standards to address service quality gaps for VMMC programs (11,16,35). These elements include; individual counselling and HIV Testing for VMMC Clients (8 Sub-standards), management systems (8 Sub-standards), male circumcision surgical procedure (9 Sub-standards), supplies, equipment and environment (8 Sub-standards), monitoring and evaluation (4 Sub-standards), registration, group education and IEC (4 Sub-standards), infection prevention (14 Sub-standards), leadership and planning (2 Sub-standards) (35,36,46).

Recent literature shows that the successful implementation of VMMC programmes requires good waste management, infection control and availability of supplies and equipment (12). Findings from most of the VMMC priority countries indicate that poor quality of service was as a result of inadequate patient information, clinical supplies and equipment (13). Research also indicate that infection prevention and device displacements for VMMC can be managed if there is enough patient information through good education and counselling messages (47).

Therefore, continuous monitoring and evaluation of these quality standards help to identify trends, progress and opportunities for quality improvement. For instance, the expectations and needs of clients depend on communication (7,48,49). Research shows that medical errors, increased hospital admissions, lack of patient follow-up and other negative health outcomes are partly due to poor communication with the healthcare provider (50). It has also been observed that bleeding and damage to penis is as a result of poorly performed medical male circumcision (23). Management is therefore encouraged to invest in resources that support operational activities and internal processes in order to improve quality of service (12,51).

Recent literature also indicate an association between management systems and positive clinical outcomes (52). CQI assessments are therefore key strategies to assess quality of service, to ensure that VMMC programs adhere to the specified standards, and this include management systems (53). It is important to determine VMMC sites compliance to all the quality standards in relation to the South African settings for CQI planning purposes.

1.3.9 CQI assessment toolkits for VMMC sites

The CQI assessment toolkits are based on the minimum set of VMMC quality standards. The assessment tool in Uganda comprises of seven quality standard elements (9,36). In South Africa, the assessment toolkit have an additional eighth standard for 'Leadership and Planning'(9). This was added in order to understand leadership commitment in addressing service quality gaps at district and provincial levels. Kenya was successful in implementing VMMC programmes as a result of management commitment and this involve leadership and planning (12). Research shows that quality initiatives are effectively implemented in the presence of strong and consistent leadership (32).

The CQI assessments are conducted through direct observation of facility procedures and activities; staff interviews; review of material resource inventories; review of policies, client registers and records (54). During the assessments, a scale ranging from 0 to 100 is used (52). A score below 50% will indicate "poor" service quality; scores from 50% to below 80% indicate "fair" service quality; and scores of 80% and above indicate "good" service quality (36,55).

Quality of service is therefore determined from continuous quality assessment findings which are site-specific reports. The findings help to identify barriers to demand creation and delivery of quality service. Interventions to solve site-specific challenges will be developed based on the findings (36). For instance, high staff turnover was reported in Zimbabwe and almost all trained doctors for VMMC programs have resigned (56). This has created the need for external and internal quality improvement assessments to identify sites that required re-training of new healthcare professionals. Therefore, measuring changes in quality of service is necessary for identification of service quality gaps and to determine the effectiveness of the CQI support intervention strategies.

1.3.10 VMMC quality of service in South Africa

Medical male circumcision was introduced in South Africa as one of the prevention methods for HIV transmission in 2010 (21). In 2014, the highest rates of medical male circumcision were in the Western Cape and lowest in Gauteng (57). In 2018, more than 572,000 circumcisions were performed, compared to 485,500 in 2015 (21). This is evidence of positive developments in the scaling up of VMMC programmes in South Africa.

However, evidence from research findings shows that a significant proportion of sites in South Africa were operating with inadequate VMMC supplies and equipment, and also without guideline documents (13). This has a negative impact for VMMC quality of service. More studies have also identified quality of service gaps for VMMC programs in South Africa (7,14). Literature shows that 72% of VMMC facilities in South Africa were operating without the required basic life support equipment in 2012 (13). Furthermore, the South Africa 2016 reference report on HIV and TB investment case showed inefficiencies in the supply chain for the healthcare sector in South Africa and the Eastern Cape was the most seriously affected province (8). In addition, 86% of the WHO VMMC priority countries were operating with inadequate supplies and equipment in 2012 (12). Further declines in quality of service were also reported in South Africa for counselling, infection control, monitoring and evaluation (32).

However, there is limited information relating to changes in quality of service after CQI support to address the quality of service gaps in South Africa. This is a demonstration of the need to continuously assess VMMC quality of service in South Africa and to determine the changes in service quality after CQI support. It helps to identify gaps in quality of service and to improve the existing systems for CQI support strategies.

Recent literature indicate low baseline average scores for CQI assessments across service quality standards in most countries (58,59). In Malawi, low-quality scores were associated with several quality gaps that include management systems, monitoring and evaluation, infection prevention services, and client follow-up (11). The overall performance in six sites that were assessed in Lesotho only improved from an average of 79.8% at baseline to 91.3% after CQI intervention strategies (7). Therefore, CQI assessments are necessary in South Africa, in order to determine the level of quality improvement support required, and also to measure the changes in quality of service after CQI support.

1.3.11 VMMC facility structures and types of service delivery

Sites for VMMC services are determined by demand, accessibility, the prevalence of HIV and male circumcisions (11). In addition, the type of facility structure is determined by the geographical site and type of service delivery (15). Based on these determinants, they are three possible types of facility structures for VMMC programs and these are fixed, mobile, and outreach sites (11). Fixed sites have permanent structures (60) and are recommended for areas with high VMMC demand (15). Fixed sites can be used to provide extra support to both

outreach and mobile sites (15). Outreach sites are recommended during short-term campaigns that generally create more demand (11). They provide services at health facilities that do not provide medical circumcisions at regular basis (12). Mobile structures are small facilities that follow demand to supplement existing services (15,60).

A research that was conducted in Uganda showed a significant difference in the quality of service between fixed and mobile sites (36). However, the findings were based on average quality scores and were not specific to a particular quality standard. Research have also indicated high technical efficiency at outreach facilities compared to fixed sites (61). In addition, a research that was conducted in Tanzania indicated a variation in quality of service between rural and urban facilities (62). This demonstrates the influence of geographical location on quality of service, urban facilities tend to provide better service quality (62).

Under VMMC programs they are two types of service delivery (i.e., routine and campaign). Routine service delivery ensures the continuous availability of VMMC services at existing health care facilities (15,63) Campaign service delivery provides VMMC services in high volume for short periods and this requires demand creation through community sensitization (12,64). The campaign service delivery approach is generally designed to target specific populations (15).

The association between quality of service and facility characteristics such as type of facility structure has not been extensively explored among the VMMC sites in South Africa. Recent literature shows that quality of service varies within and between countries (65). In addition, variations also exist within and between health-care systems (32). Therefore, it is important to evaluate changes in quality of service after CQI support intervention strategies, by province and other facility characteristics, to determine site specific challenges.

1.4 Statement of the research problem

WHO VMMC quality standards are measurement tools used to assess quality of service (47). However, this information has not been extensively applied to identify quality of service gaps at VMMC sites in South Africa. In addition, less has been focused on the changes in quality of service across all the quality standard parameters after CQI support. Quality of service has a bearing on the willingness of males to undergo medical male circumcision. ‘Poorly performed

male circumcision can lead to bleeding and damage to the penis' (23). This is an indication that poor quality of service can result in medical complications and other negative health outcomes, and these will act as barriers for demand creation (66). In addition, the perceptions and needs of the target population play a significant role in VMMC program success (16). Poor quality of service creates a negative perception from clients. Healthcare service providers need to have a proper understanding of the needs and expectations of their clients, in order to deliver the best quality of service (32). Therefore, quality of service for VMMC sites in South Africa requires continuous quality assessment in order to meet the needs and expectations of clients. It is also equally important, to understand the changes in quality of service after CQI support, in order to improve and strengthen the current intervention strategies. In addition, challenges experienced by sites differ and these should be regularly identified to maintain a high quality of service at all VMMC sites.

1.5 Justification for the study

Improving quality of service rendered will result in client satisfaction. The study will help to increase demand creation since service-related quality gaps and challenges will be identified and addressed. The South African VMMC health guidelines may further be improved based on the study findings and recommendations. VMMC surgical complications have resulted from inadequate provider competence and training, poor clinical infrastructure, and limited patient information and follow-up (13). The study will help to determine if the VMMC service provision is in compliance with WHO and South Africa National Department of Health (NDOH) quality standards. Barriers to service efficiency and demand creation will also be identified.

1.6 Purpose of the study

The purpose of this study was to determine changes in the quality of voluntary medical male circumcision services in selected districts of Mpumalanga, Eastern Cape, Free State and North West provinces of South Africa, after implementation of a continuous quality improvement programme.

1.6.1 Research question

Does continuous quality improvement intervention at voluntary medical male circumcision sites makes a difference in quality of service.

1.6.2 Main objective

To determine if continuous quality improvement intervention makes a difference in quality of service at voluntary medical male circumcision sites.

1.6.2.1 Specific objectives

1.6.2.1.1 To compare quality of service at baseline (pre-intervention) and follow-up re-assessment time-points (post intervention) from July 2018 to October 2019.

1.6.2.1.2 To determine changes in quality of service by type of service delivery and facility structure from July 2018 to October 2019.

CHAPTER TWO

RESEARCH METHODOLOGY

2.1 Chapter overview

This chapter describes the study design, data collection process, management and analysis. In addition, the chapter also described the inclusion and exclusion criteria for the main characteristics of the study population of interest.

2.2 Study design

This study was a pre-post design intervention study based on secondary data collected as part of Right to Care (RTC) program for VMMC sites in South Africa. This was done through the CQI and SIMS approach.

Below was the study design for VMMC sites assessment.

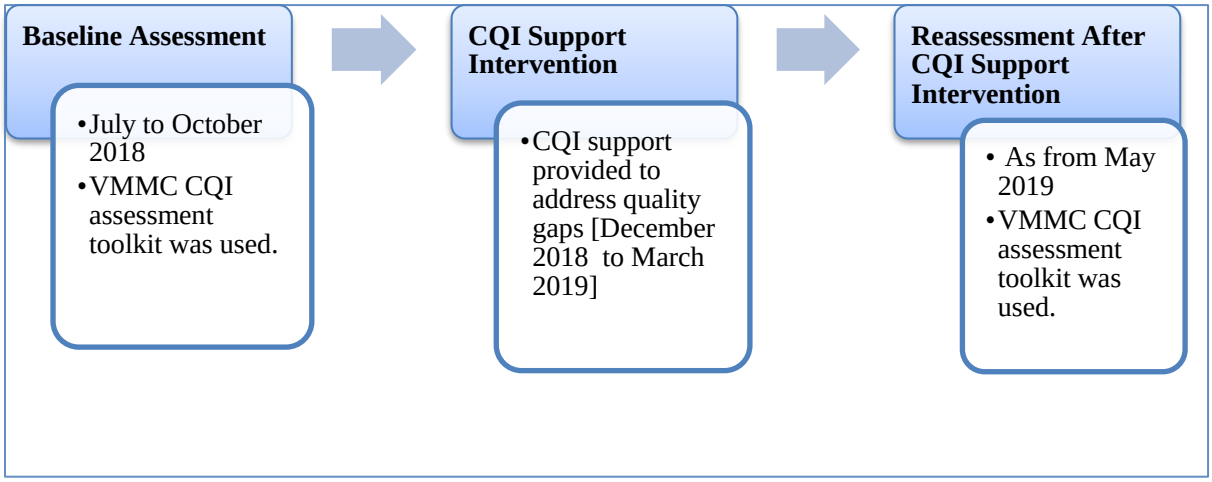

Figure 2: Study design for VMMC sites assessment.

2.3 Study sites

The VMMC sites were situated in the selected districts of the North West, Mpumalanga, Eastern Cape and Free State provinces of South Africa (Annex W).

2.4 Study population

The study was based on sites that were assessed for continuous quality improvement from July 2018 to October 2019, in the selected districts of the North West, Mpumalanga, Eastern Cape, and Free State provinces of South Africa.

2.4.1 Inclusion criteria

The inclusion criteria describes the main characteristics of the population of interest (67). In this study, the inclusion criteria were all VMMC sites supported by Right to Care VMMC program, in the selected districts of the North West [Dr Kenneth Kaunda, Ngaka Modiri Molema]; Mpumalanga [Nkangala]; Eastern Cape [Amathole, Alfred Nzo and O R Tambo] and Free State

[Thabo Mofutsanyane] provinces of South Africa. All mobile, outreach and fixed VMMC sites provided with continuous quality improvement support in these districts were considered for analysis.

2.4.2 Exclusion criteria

Sites with a single assessment time point or none at all were excluded from the analysis since they were going to contribute no information about the changes in quality of service.

2.4.3 Sampling

In this study, all VMMC health facilities under the Right to Care program that satisfied the inclusion criteria were considered for analysis.

2.5 Description of primary data collection

Data was collected using a standardized VMMC CQI assessment tool (see Annexure T). It was developed by the National Department of Health (NDOH) and approved by PEPFAR to assess quality of services in all facilities within the districts of agreement. The same tool was used for both baseline and subsequent re-assessments to provide an objective and consistent measure of quality improvement. This assessment tool has elements of the WHO-defined quality standards for VMMC service provision. The quality standard elements of focus during assessments were leadership and planning, management systems; monitoring and evaluation; group counselling, registration and communication; individual counselling and HIV testing; supplies, equipment, environment and emergency; male circumcision surgical procedure, and infection prevention.

The assessments were conducted through staff interviews, checklists and direct observation of all the facility processes and activities in line with the NDOH and WHO VMMC quality guidelines (15). Facility level registers and client files (client intake forms, consent forms and identification documents) were also reviewed during the assessments. Quality of service assessment scores were recorded as percentages during the assessments (see Annexure T). The scores were categorized into three groups: below 50% was an indication of “poor” service quality; 50% -80% reflected “fair” service quality; and greater than 80% indicated “good” service quality (36,55). Data was

collected using password protected and encrypted electronic devices (Tablets, Laptops) to maximize protection during and after the assessment visits.

2.5.1 Validity and reliability of data collection tool

VMMC assessment tool was evaluated for validity by experts from the National Department of Health (NDOH) and PEPFAR. The tool was also based on quality standards that were developed by experts from the WHO.

The reliability of the VMMC assessment tool was enhanced through the use of professionally trained team members. In addition, the same tool was used for both baseline and subsequent re-assessments in order to provide an objective and consistent measure of quality improvement.

2.6 Site quality improvement support

CQI support was provided from December 2018 to March 2019 through a combination of on-site staff training, mentorship, coaching, providing standard operating procedures and guidelines, and assistance in developing quality improvement plans. CQI support was provided to sites based on their baseline assessment scores as from December 2018 to March 2019. Sites with quality scores of less than 50% were visited quarterly for intensive CQI support. In addition, sites with 50% to 79% quality scores were visited three times annually for light CQI support, and collaborative support was provided bi-annually to sites with quality scores of 80% and above. In addition, CQI support teams were formed to implement quality improvement objectives that were in line with the action plans. The objectives included tracking quality of service performance at site, district and provincial level using the Plan-Do-Study-Act (PDSA) cycle, time series charts, run charts and indicator monitoring. Each CQI team was made-up of a clinical associate mentor, professional nurse mentor, enrolled nurse mentor, counsellor mentor and a data quality mentor. CQI focal persons were identified at each VMMC site and these were assigned with responsibilities to focus on quality improvement requirements. Stakeholders for the VMMC program were also invited to share their success stories and barriers to program implementation as part of CQI support intervention. Following CQI implementation, another assessment was performed in May 2019 to evaluate the effectiveness of the intervention.

2.7 Variables description

2.7.1 The primary outcome

The primary outcome in this study was *quality of service* for each quality standard element. Since the quality of service scores were recorded as percentages, the outcome was therefore classified as a continuous variable. The quality standard variables of focus were leadership and planning, management systems; monitoring and evaluation; group counselling, registration and communication; individual counselling and HIV testing; supplies, equipment, environment and emergency; male circumcision surgical procedure, and infection prevention. These were the agreed set of standards between the NDOH and PEPFAR.

2.7.2 Primary outcome measurement

Quality of service was measured by checking compliance of sites to the agreed NDOH and PEPFAR quality standards based on a VMMC CQI assessment tool, (see Annexure T). The scores were measured for each quality standard, at baseline and after CQI support visits and were recorded as percentages. A score below 50% was an indication of "poor" service quality; scores from 50% to below 80% reflected "fair" service quality; and scores of 80% and above indicated "good" service quality. However, in this study, quality of service was not categorised, the variable was considered as a continuous variable as stated above.

2.7.3 Other explanatory variables

In addition to the quality standard variables, other independent variables that were used in this study include type of service delivery, rural-urban classification, facility structure, province, and assessment occasion. Type of service delivery was expressed as routine or campaign; facility structure as fixed or outreach; province was expressed as Eastern Cape, North West, Mpumalanga and Free State. Assessment occasion was the time variable and this was the main exposure expressed as T0 for baseline assessment and T1 for post-test re-assessment period. Coding and further description of the variables is as shown on Annexure D.

2.8 Data management

Stata IC version 15 (Stata Corporation, College Station, TX) was used for data management. It was used for creating, labelling and renaming variables. Outliers, duplicates and missing variables were identified and managed using Stata SE version 15. A subset of the dataset was created for data cleaning and coding in preparation for analysis. Both original dataset and the subset of data were password protected, anonymised and stored in Google drive to maximize prevention of data loss.

2.8.1 Missing data

Analysis through frequency tables were done to determine the number of missing values for the outcome at each assessment time-point (T0, T1) (Annexure O). Sites with one quality assessment or none at all, were excluded for analysis, since these were going to contribute no information about the changes in quality of service. List-wise deletion was applied to deal with missing data, it is more preferred for repeated measures (68).

2.8.2 Outliers

Box plots were used to check for significant outliers in the dataset (Annexure F-N). Outliers were detected using the differences between the baseline and after CQI support intervention assessments (69). The non-parametric Wilcoxon's Signed Rank Test was applied in situations where outliers that affected results were detected. The Wilcoxon Signed Rank Test is recommended when paired t-test assumptions are violated (70).

2.9 Data analysis

Data was cleaned, coded, restructured and analysed using STATA SE ver.15 statistical software package. Statistical significance was based on a p-value of less than 0.05 and the 95% confidence intervals (two-sided tests).

2.9.1 Descriptive statistics

Univariate descriptive analyses were performed to describe the various characteristics of the study sites. Normally distributed continuous variables were described using the quality of service mean scores and standard deviation. The median and interquartile range (IQR) was used for data not

normally distributed. Frequency and percentage distributions were applied for categorical variables.

2.9.2 Bivariate correlation

Bivariate correlation was computed to quantify the association between baseline and after CQI support intervention. Repeated measures on the same subject overtime are not independent and time points closer together are more highly correlated than those further apart (71). Therefore, observations on the same subject overtime violate the assumption for the two-sample t-test of independence. Research shows that the paired t-test is more powerful when correlation is at least 0.25 and it was applied in this study (70).

2.9.3 Paired samples t-test

Paired samples t-test was applied to compare the quality of service scores between baseline assessment and after CQI support intervention by quality standard. It is ideal when the two groups under comparison are dependent on each other (72). The paired sample t-test helps to determine if there was an improvement in performance as a result of an intervention, hence it is more applicable for pre-test and post-test study designs (73). Research shows that the paired t-test is applicable for extremely small samples, particularly when the within-pair correlation coefficient is high (74,75).

Paired Sample t-test statistics $(\mathrm{t}) = \frac{\mathrm{n}\sum \mathrm{D}}{\sqrt{\frac{\mathrm{n}\sum \mathrm{D}^2 - (\sum \mathrm{D})^2}{\mathrm{n}-1}}}$

Where;

$\sum \mathrm{D}$ = sum of the differences between the paired observations

$\sum \mathrm{D}^2$ = sum of the squared differences

n = number of paired observations(72).

2.9.4 Tests of Assumptions

The Shapiro-Wilk test was applied for normality tests (Annexure E). The non-parametric Wilcoxon's signed rank test was applied in cases where the assumption of normality for the paired t-test was violated (76). The Wilcoxon test provides bigger power, however the t-test is robust and more powerful for symmetric distributions (70).

2.9.5 Multivariate analysis

Multivariate analysis was applied to determine changes in quality of service by type of service delivery and facility structure from July 2018 to October 2019. Linear mixed modelling (LMM) that can model repeated measures designs with options to control for clustering were applied using the average quality of service scores across quality standards. Repeated measurements of a variable over time within sites and from the same province are likely to be similar (77). LMM help to account for the data hierarchy and the differences across provinces, facility structures and type of service delivery. In addition, LMM provides intra-class correlation coefficient for variability attributed to differences within entities (77,78). They allow the coefficients to vary across groups by estimating the between-group variance and covariance. Model goodness of fit was carried out using the Akaike's information criterion (AIC). Akaike's information criterion (AIC) is a tool for assessing model fit (79). A model with a smaller AIC value indicates a "better" model (80).

$AIC = -2 \times L + 2\,p$; where L is the (ML or REML) log-likelihood and p depends on the type of likelihood selected (80). Data was converted from wide form to long format in preparation for analysis using LMM. This is in line with Stata requirements for analysis of linear mixed models (81).

2.10 Ethical approval

This study was approved by the Witwatersrand Human Research Ethics Committee (HREC), South Africa (annexure B, Ethics clearance number M200415). Permission for data access to implement the research objectives was granted by the Right to Care organisation (annexure V). Data was treated as confidential and the names of health facilities were anonymised during the analysis. Good clinical practice and research ethics principles were followed during all stages of the research report development.

2.11 Budget and Milestones

The costs associated with the project's financial and material requirements were self-funded. The costs included transport and communication (see Annex P for budget details). The time-frame for the research project development and implementation was as from July 2019 to October 2020 (see Annex Q for details).

CHAPTER THREE

RESULTS

3.0 Chapter overview

Chapter 3 provides descriptive statistics for the distribution of quality of service mean scores at baseline and after CQI support intervention. The statistics were based on the eight (8) key quality standards for VMMC assessment in South Africa. The chapter also provides results of the paired samples t-tests comparing the quality of service mean scores between baseline and after CQI support intervention by quality standard. Multivariate analysis results using linear mixed modelling that can model repeated measures and with options to control for clustering were also presented.

3.1 Descriptive Statistics

During the period July 2018 to October 2019, there were 96 sites offering VMMC services, 16 in the Eastern Cape, 19 in Free State, 19 in Mpumalanga and 42 in the North West province (Figure 3). Out of these, 40 sites were assessed at both baseline and pre-post period and 13 were from Mpumalanga, 6 from Free State and 21 from the North West provinces (Figure 3). At the time the present study was implemented, all sites from the Eastern Cape were not yet re-assessed. Therefore, they were not included in the final analysis as per the requirements of the repeated measures t-test (68). The reasons for no re-assessment include facility closure, suspension and instruction from the NDoH to stop all VMMC services and focus on Customary Male Circumcision.

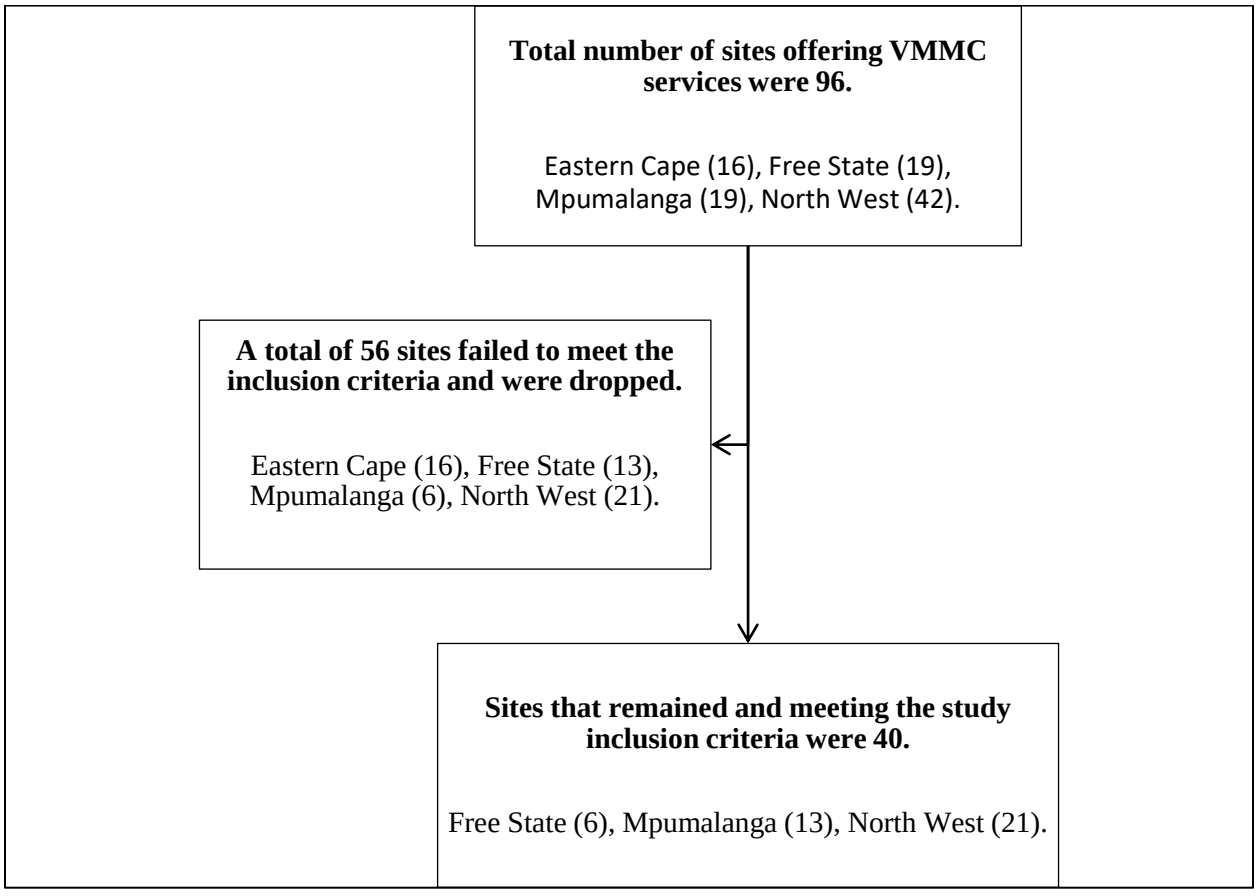

Figure 3: Flow diagram indicating sites excluded in analysis and those that remained.

3.1.1 Quality of Service

3.1.1.1 Type of facilities

Of the total number of sites that remained, 80% were fixed VMMC sites and 20% were outreach facilities (Table 1). Outreach sites recorded the highest overall quality of service mean scores ± standard deviation of 69.72 ± 4.47% and 81.40 ± 7.13% at both the baseline and after CQI support intervention respectively compared to fixed sites (Table 1).

3.1.1.2 Type of service delivery

A total of 85% of the sites offered routine type of service delivery and 15% were campaign. The campaign mode of service delivery recorded the highest overall quality of service mean score at the post-test assessment of 81.71 ± 8.52% compared to routine (78.96% ± 8.85%) (Table 1).

3.1.1.3 Rural – Urban classification

Of the total number of sites, 22.5% were rural and 77.5% were urban. The urban VMMC sites had the highest overall quality of service mean scores (81.10 ± 7.92%) compared to rural facilities (71.57 ± 8.21%) after CQI support intervention (Table 1).

Table 1: Descriptive statistics for the overall quality of service mean scores before and after CQI support intervention by facility characteristics.

Site Characteristic	**Overall quality of service mean scores**			
	T0		**T1**	
	N (%)	Mean ± SD	N (%)	Mean ± SD
Type of facility Structure				
Outreach	8 (20%)	69.72 ± 4.47	8 (20%)	81.40 ± 7.13
Fixed	32 (80%)	59.03 ± 13.00	32 (80%)	78.35 ± 9.23
Rural-Urban				
Rural	9 (22.5%)	55.45 ± 15.44	9 (22.5%)	71.57 ± 8.21
Urban	31 (77.5%)	62.82 ± 11.29	31 (77.5%)	81.10 ± 7.92
Type of Service Delivery				
Routine	34 (85%)	61.17 ± 12.51	34 (85%)	78.96 ± 8.85
Campaign	6 (15%)	60.63 ± 15.96	6 (15%)	81.71 ± 8.52
NB; All mean values are in %				
T0 = Baseline, T1 = Reassessment after CQI support intervention				

3.1.2 Overall quality of service by quality standard

Results were reported as means ± standard deviation for normally distributed variables and as medians and interquartile range [p50(p25-p75)] for variables not normally distributed or with outliers. Table 2 provides the descriptive statistics for the quality of service mean scores at baseline and after CQI support intervention disaggregated by quality standards. At baseline, the overall quality of service scores across quality standards ranged from 34.98±24.09% [leadership and planning] to 79.50(53-89.50%) [group counselling and registration]. The baseline overall quality of service scores for infection prevention; monitoring and evaluation; and management systems were 65.85±18.30%, 43.65±18.21% and 50.10±15.42% respectively (Table 2).

Similarly, after CQI support intervention, the overall quality of service scores ranged from 61.58±23.97% [leadership and planning] to 88(73.50-95.50%) [Group counselling, registration and communication]. The overall quality of service scores for male circumcision surgical procedure; supplies, equipment, environment and emergency; and individual counselling and HIV testing after CQI support intervention were 85.08±7.58%, 83.90±9.26% and 81.78±18.15% respectively (Table 2).

The overall quality of service performance was measured as the average quality of service across all quality standards and this was 61.17±12.51% at baseline and 78.96±8.85% after CQI support intervention (Table 2). Quality standards with the highest overall quality of service after CQI support intervention across provinces were male circumcision surgical procedure; and supplies, equipment, environment and emergency with mean scores of 85.08±7.58% and 83.90±9.26% respectively (Table 2 and Figure 4).

The overall quality of service scores shows that sites across provinces were performing below standards before CQI support intervention for monitoring and evaluation (43.65±18.21), management systems (50,10±15,42%) and leadership and planning (34,98±24,09%) as illustrated by the baseline scores (Table 2). In addition, leadership and planning had the lowest (61.58±23.97%) overall quality of service scores across provinces after CQI support intervention (Table 2, Figure 4).

3.1.2 Quality of service by province

The baseline quality of service scores across quality standards in the North West ranged from 34.62±27.33% [leadership and planning] to 80.71±12.34% [Supplies, equipment, environment and emergency] (Table 2). In addition, the North West baseline quality of service scores were 38.90±18.65%, 50.57±12.23% and 74.48±16.70% for monitoring and evaluation, management systems, and male circumcision surgical procedure respectively. After CQI support intervention, the quality of service scores in the North West ranged from 69.05±25.42% [Leadership and planning] to 91(87-95%) [Group counselling, registration and communication]. Furthermore, the overall quality of service performance score was 63.25(59.25-67.38%) at baseline and 82.63(79.50-85.25%) after CQI support intervention in the North West province (Table 2).

In Mpumalanga province, the baseline quality of service scores across quality standards ranged from 33(33-50%) [leadership and planning] to 83(43-91%) [group counselling, registration and communication]. After CQI support intervention, the quality of service scores ranged from 50(33-50%) [leadership and planning] to 86.31±6.85% [supplies, equipment, environment and emergency]. In addition, the overall quality of service performance score was 61.31±15.91% at baseline and 75.92±10.02% after CQI support intervention in Mpumalanga province (Table 2).

The overall quality of service performance score in the Free State province was 58.92±15.54% at baseline and 76.17±10.61% after CQI support intervention (Table 2). Furthermore, the baseline scores across quality standards in the Free State province ranged from 30.17±26.74% [leadership and management] to 76.67±13.08% [male circumcision surgical procedure]. Similarly, after CQI support intervention, the quality of service scores ranged from 63.83±19.48% [leadership and planning] to 87.33±7.94% [male circumcision surgical procedure] (Table 2).

Table 2: Descriptive statistics for quality of service mean scores at baseline and after CQI support intervention disaggregated by quality standards.

Province / Time point	Overall, all provinces (N=40)		North West (N=21)		Mpumalanga (N==13)		Free State (N=6)	
	T0	T1	T0	T1	T0	T1	T0	T1
Quality Standard	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**	**Mean ± SD**
Management systems	50.10±15.42	78.75±11.56	50.57±12.23	78.81±12.48	49.00±18.55	79.62±11.59	50.83±20.62	76.67±9.46
Monitoring and Evaluation	43.65±18.21	78.73±14.23	38.90±18.65	82.57±10.76	ǂ 55(39-59)	75(68-78)	ǂ 57(44-62)	84(73-90)
Group counselling, registration and communication	ǂ 79.50(53-89.50)	88(73.50-95.50)	ǂ 79(67-88)	91(87-95)	ǂ 83(43-91)	85(66-96)	60.50±29.71	71.00±19.89
Individual counselling and HIV testing	68.22±25.36	81.78±18.15	76.26±13.51	87.68±8.51	62.92±32.53	77.92±21.13	53.33±32.65	70.83±28.60
Supplies, equipment, environment and emergency	78.80±11.76	83.90±9.26	80.71±12.34	83.62±9.58	77.46±12.86	86.31±6.85	ǂ 75.50(71-79)	83(79-88)
Male circumcision surgical procedure	76.80±16.62	85.08±7.58	74.48±16.70	85.29±6.41	80.62±18.34	83.69±9.35	76.67±13.08	87.33±7.94
Infection prevention	65.85±18.30	77.73±11.70	64.38±13.54	76.52±10.00	ǂ 79(54-80)	85(75-87)	71.66±19.14	77.17±6.71
Leadership and planning	34.98±24.09	61.58±23.97	34.62±27.33	69.05±25.42	ǂ 33(33-50)	50(33-50)	30.17±26.74	63.83±19.48
Overall performance	61.17±12.51	78.96±8.85	ǂ 63.25(59.25-67.38)	82.63(79.50-85.25)	61.31±15.91	75.92±10.02	58.92±15.54	76.17±10.61

NB; All values are as %

T0 = Baseline assessment, T1 = Reassessment after CQI support intervention

ǂ = median values and interquartile range used p50(p25-p75), paired t-test assumptions violated.

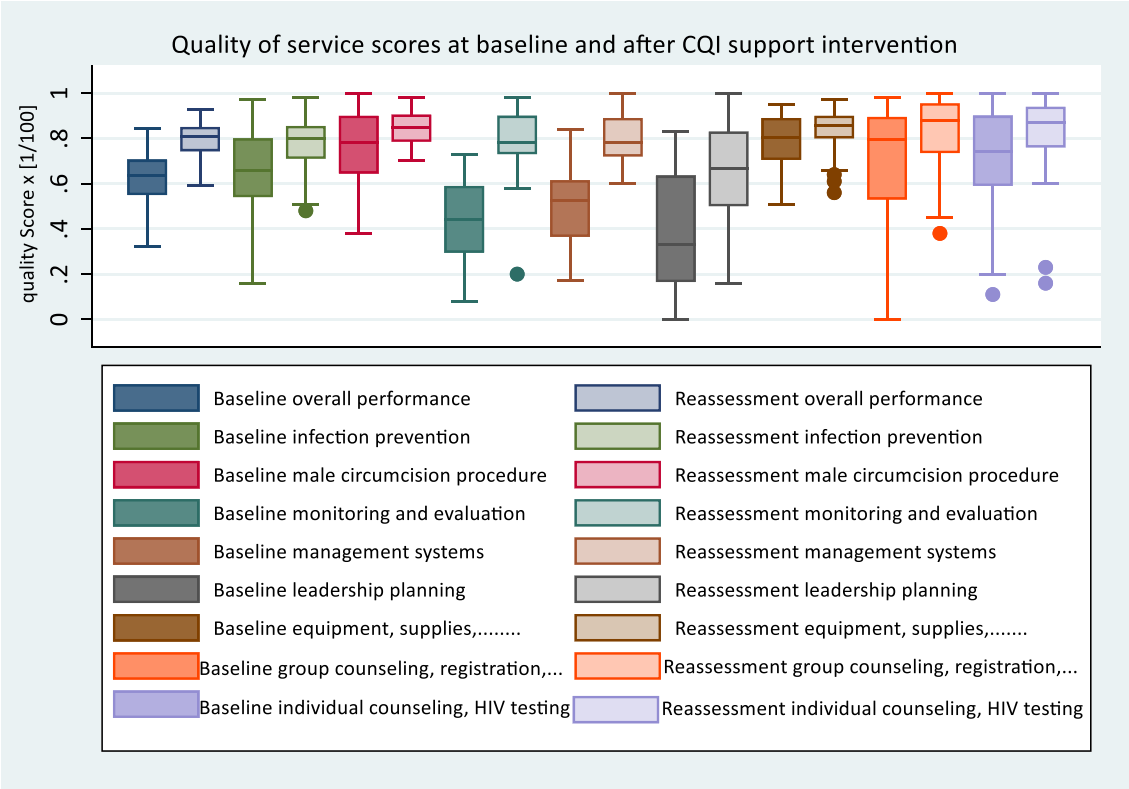

Figure 4: Comparing the overall quality of service mean scores across provinces after CQI support intervention.

3.2 Correlation between pre and post quality of service scores.

A simple bivariate correlation was computed for each quality standard between baseline and after CQI support intervention. **Table 3** shows significant positive correlation across provinces for group counselling, registration and communication ($r = 0.62$, $p<0.001$), individual counselling and HIV testing ($r = 0.63$, $p<0.001$), male circumcision surgical procedure ($r = 0.35$, $p<0.05$), infection prevention ($r = 0.47$, $p<0.01$) and for the overall performance ($r = 0.35$, $p<0.05$). Results also shows significant positive correlation for group counselling, registration and communication in the North West ($r = 0.61$, $p<0.01$) and Mpumalanga ($r = 0.74$, $p<0.01$). Mpumalanga province was also positively correlated for individual counselling and HIV testing ($r = 0.72$, $p<0.01$), male circumcision surgical procedure ($r = 0.65$, $p<0.05$), infection prevention ($r = 0.76$, $p<0.01$) and for the overall performance ($r = 0.72$, $p<0.01$). Monitoring and evaluation was positively correlated for the pre and post scores in the Free State province ($r = 0.93$, $p<0.01$). Other quality standards

were positively correlated between the pre and post quality of service scores, however they did not reach statistical significance.

Table 3: Paired samples correlations between pre and post quality of service scores.

Quality Standard	Overall, all provinces		North West		Mpumalanga		Free State	
	Correlation	p-value	Correlation	p-value	Correlation	p-value	Correlation	p-value
Management systems	-0.065	0.689	-0.334	0.139	0.004	0.990	0.591	0.217
Monitoring and Evaluation	0.096	0.558	0.101	0.664	0.241	0.451	0.934	*
Group counselling, registration and communication	0.621	***	0.609	**	0.737	**	0.584	0.224
Individual counselling and HIV testing	0.627	***	-0.118	0.630	0.721	**	0.656	0.157
Supplies, equipment, environment and emergency	0.305	0.056	0.397	0.075	0.276	0.362	0.063	0.906
Male circumcision surgical procedure	0.346	*	0.018	0.937	0.651	*	0.775	0.070
Infection prevention	0.466	**	0.274	0.230	0.762	**	0.046	0.932
Leadership and planning	-0.014	0.934	-0.180	0.434	0.368	0.216	0.509	0.303
Overall performance	0.503	***	0.347	0.134	0.719	**	0.699	0.122
*significant, p<0.05 (95% confidence)								
**significant, p<0.01 (99% confidence)								
***significant, p<0.001								

3.3 Changes in quality of service by quality standard

Table 4 shows changes in quality of service that were computed by quality standard using paired samples t-tests and the Wilcoxon Sign rank test in situations where the paired t-test assumptions were violated. This was applied to compare changes in quality of service mean scores at baseline and after CQI support intervention for the separate eight (8) standards used for evaluation of VMMC facilities. Hence, in this study the paired t-tests were computed to test the hypothesis of eight (8) quality standards and for the overall performance. The null hypotheses tested were as follows; [H_0: $T\mu_0 = T\mu_1$]

H1: there is no difference in the pre and post-quality of service mean scores for leadership and planning

H2: there is no difference in the pre and post-quality of service mean scores for management systems

H3: there is no difference in the pre and post-quality of service mean scores for monitoring and evaluation

H4: there is no difference in the pre and post-quality of service mean scores for group counselling, registration and communication

H5: there is no difference in the pre and post-quality of service mean scores for individual counselling and HIV testing

H6: there is no difference in the pre and post-quality of service mean scores for supplies, equipment, environment and emergency

H7: there is no difference in the pre and post-quality of service mean scores for male circumcision surgical procedure

H8: there is no difference in the pre and post-quality of service mean scores for infection prevention

H9: there is no difference in the pre and post-quality of service mean scores for overall performance

Table 4: Paired samples t-test (2-tailed) comparing the change in quality of service mean scores before and after CQI support intervention by province.

	North West					Mpumalanga					Free State				
Quality Standard	*T0*	*T1*	Δ	*p-value*	*95% CI*	*T0*	*T1*	Δ	*p-value*	*95% CI*	*T0*	*T1*	Δ	*p-value*	*95% CI*
Leadership and planning	34.62	69.05	34.43	***	15.97 - 52.88	33.00	50.00	17.00	0.061	ǂ z = - 1.869	30.17	63.83	33.67	*	8.73 - 58.60
Management systems	50.57	78.81	28.24	***	19.90 - 38.70	49.00	79.62	30.62	***	17.42 - 43.81	50.83	76.67	25.83	*	8.14 - 43.52
Monitoring and Evaluation	38.90	82.57	43.67	***	33.34 - 52.96	55.00	75.00	20.00	**	ǂ z = 2.621	57.00	84.00	27.00	*	ǂ z = 1.992
Group counselling, registration and communication	91.00	79.00	12.00	***	ǂ z = 3.601	83.00	85.00	2.00	0.196	ǂ z = 1.293	60.50	71.00	10.50	0.338	14.96 - 35.96
Individual counselling and HIV testing	76.26	87.68	11.42	**	3.32 - 19.52	62.92	77.92	15.00	*	0.60 - 29.40	53.33	70.83	17.50	0.156	9.42 - 44.43
Supplies, equipment, environment and emergency	80.71	83.61	2.90	0.291	2.68 - 8.49	77.46	86.31	8.85	*	1.12 - 16.58	75.50	83.00	7.50	0.249	ǂ z = 1.153
Male circumcision surgical procedure	74.48	85.29	10.81	*	2.83 - 19.77	80.62	83.69	3.08	0.448	5.48 - 11.63	76.67	87.33	10.67	*	1.70 - 19.64
Infection prevention	64.38	76.52	12.14	***	5.48 - 19.32	79.00	85.00	6.00	*	ǂ z = 2.310	71.67	77.17	5.50	0.530	15.49 - 26.49
Overall performance	63.25	82.63	19.38	***	ǂ z = 4.015	61.31	75.92	14.61	***	7.87 - 21.35	58.92	76.17	17.25	*	5.59 - 28.91

*significant, p<0.05 (95% confidence)

**significant, p<0.01 (99% confidence)

***significant, p<0.001

Δ = T1 – T0, Change in quality-of-service score

ǂ = median values for Wilcoxon sign rank test were compared and z - values recorded.

T0 = Baseline mean quality score, T1 = Mean quality score after CQI support intervention

3.3.1 Leadership and Management

Figure 5 shows an increase in the overall quality of service for leadership and planning across provinces after CQI support intervention, and this increase was highest in the North West. Results of the paired samples t-test shows that this increase in overall leadership and planning quality scores across provinces of 23.00% (95%CI: 12.85%; 33.88%) was statistically significant, t (39) = 28.08, p<0.001 (Table 5). Similarly, there was a statistically significant increase for leadership and planning quality scores of 34.43% in the North West Province [(95%CI: 15.97%; 52.88%), t(20) = 3.89, p<0.001] and 33.67% in the Free State Province [(95%CI: 8.73%; 58.60%), t(5) = 3.47, p=0.0178<0.05] after CQI support intervention (Table 4). In addition, the Wilcoxon Sign rank test showed a marginally significant increase of 17% in Mpumalanga (z = -1.87, p = 0.061) after CQI support intervention (Table 4).

Figure 5: Mean quality scores for leadership and management at baseline and after CQI support intervention by province and across provinces.

There were sharp increases in quality of service for leadership and planning across all provinces, however it was below 70% in all the provinces.

3.3.2 Individual Counselling and HIV Testing

Results from Table 2 and Figure 6 shows an increase in the overall quality of service mean scores across provinces after CQI support intervention for individual counselling and HIV testing from 68.22±25.36% at baseline to 81.78±18.15%. Results of the paired samples t-test showed that this increase of 13.56% after CQI support intervention was statistically significant [(95%CI: 6.94%; 20.19%), t(36) = 4.15; p<0.001] (Table 5). In addition, results showed statistically significant increase in quality of service scores for individual counselling and HIV testing in the North West Province of 11.42%, [(95%CI: 3.33%; 19.52%), t(18) = 2.96, p=0.0083<0.01] and 15%, [(95% CI, 0.60%; 29.40%), t(11) = 2.29, p<0.05] in Mpumalanga province after CQI support intervention (Table 4, Figure 6). However, the increase in quality of service in the Free State for individual counselling and HIV testing did not reach statistical significance (p=0.156>0.05) (Table 4).

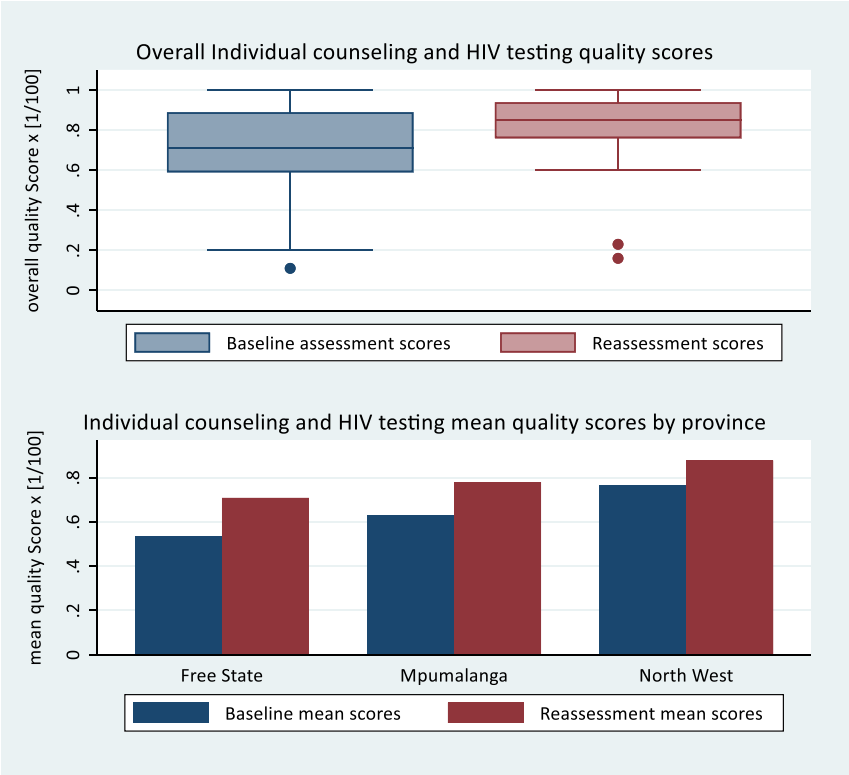

Figure 6: Mean quality scores for individual counselling and HIV testing at baseline and after CQI support intervention by province and across provinces.

There was a general increase in quality of service for individual counselling and HIV testing across all provinces.

Table 5: Paired samples t-test for overall changes in quality of service mean scores after CQI support intervention by quality standard across provinces.

Quality Standard indicator	Paired differences (%)	df	t-value	95% CI	Sig. (2-tailed)
Leadership and planning	23.00	39	28.08	12.85 - 33.88	***
Management systems	28.65	39	9.12	22.30 - 35.00	***
Monitoring and Evaluation	35.08	39	10.08	28.03 - 42.12	***
Group counselling, registration and communication	ǂ 8.50	ǂ 39	ǂ **z** = 3.529	ǂ	***
Individual counselling and HIV testing	13.56	36	4.15	6.94 - 20.19	***
Supplies, equipment, environment and emergency	5.10	39	2.57	1.09 - 9.11	**
Male circumcision surgical procedure	8.28	39	3.33	3.25 - 13.30	**
Infection prevention	11.89	39	4.55	6.60 - 17.15	***
Overall performance	17.79	39	10.13	14.24 - 21.34	***
T0 = Baseline assessment, T1 = Reassessment after CQI support intervention ǂ = Wilcoxon sign rank test used, median values were compared and z - values recorded.					
*significant, p<0.05					
**significant, p<0.01					
***significant, p<0.001					

Table 5 shows that at 5% level of significance, all the null hypotheses for the eight (8) quality standards and for the overall performance are rejected for quality of service assessment across provinces. Therefore, it can be concluded that there was a statistically significant change in the overall quality of service between baseline and after CQI support intervention. This implies that the CQI support intervention was effective across provinces.

3.3.3 Management Systems

Figure 7 shows a sharp increase in the overall quality of service scores for management systems across provinces. Additionally, results of the paired samples t-test showed a statistically significant increase in the overall quality of service across provinces for management systems of 28.65% [(95%CI: 22.30%; 35.00%), t(39) = 9.12, p<0.001] after CQI support intervention (Table 5). Results of the repeated measures paired t-test further showed a statistically significant increase for management systems quality of service mean scores in North West Province of 28.24% [(95%CI: 19.05%; 37.42%), t(20) = 6.41, p<0.001]; 30.62% in Mpumalanga [(95%CI: 17.42%; 43.81%), t(12) = 5.06, p<0.001] and 25.83% in the Free State province [(95%CI: 8.14%; 43.52%), t(5) = 3.75, p<0.05] (Table 4).

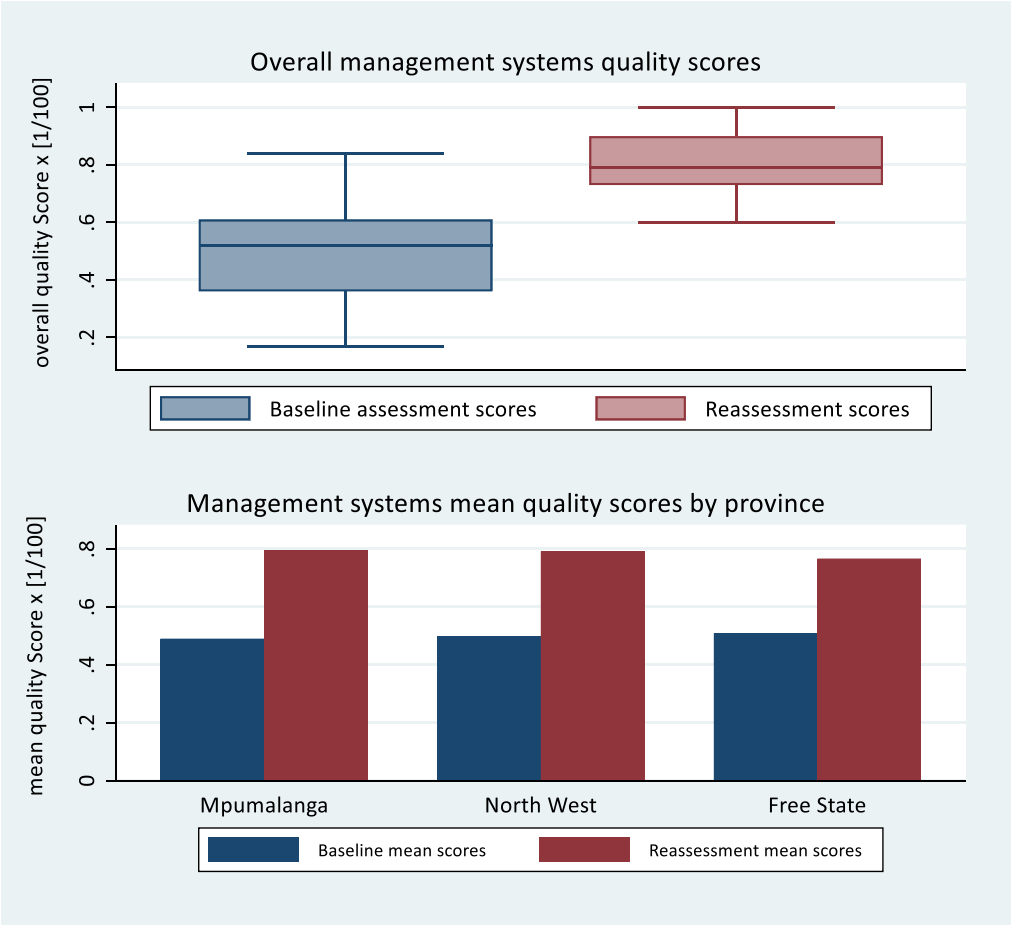

Figure 7: Mean quality scores for management systems at baseline and after CQI support intervention by province and across provinces.

There were sharp increases in quality of service for management systems across all provinces.

3.3.4 Supplies, Equipment, Environment and Emergency

There was an increase in the overall quality of service scores for supplies, equipment, environment and emergency across provinces (Figure 8). The increase was from 78.80±11.76% at baseline to 83.90±9.26% after CQI support intervention (Table 2). Paired samples t-test showed that this increase of 5.10% was statistically significant [(95%CI: 1.09%; 9.11%), t(39) = 2.57, p<0.0141] (Table 5). In addition, the increase in quality of service mean scores for supplies, equipment, environment and emergency in Mpumalanga province of 8.85% [(95% CI: 1.12%; 16.58%), t(12) = 2.49, p=0.0283<0.05] (Table 4). However, the increase in quality of service scores for supplies, equipment, environment and emergency did not reach statistical significant in the North West [t(20) = 1.09, p=0.2906>0.05] and in the Free State (z = 1.153, p = 0.249>0.05) (Table 4).

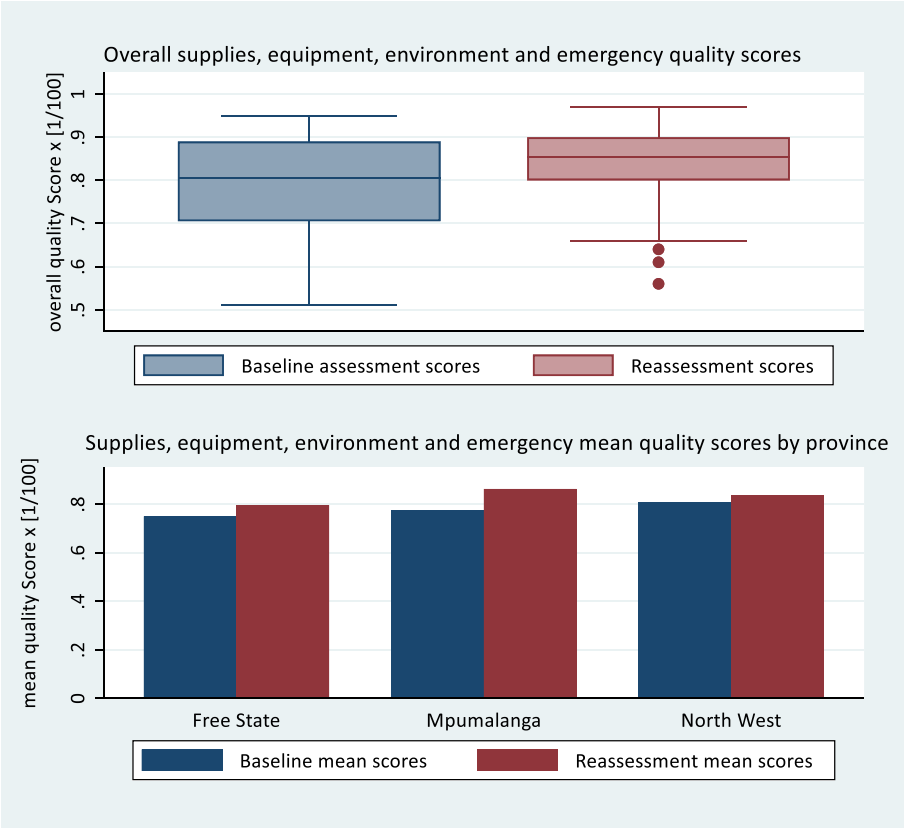

Figure 8: Mean quality scores for supplies, equipment, environment and emergency at baseline and after CQI support intervention by province and across provinces.

There was a general increase in quality of service for supplies, equipment, environment and emergency across all provinces; however, the increases in the North West were very small.

3.3.5 Group Counselling, Registration and Communication

Figure 9 shows an increase in the overall group counselling, registration and communication quality of service scores and this was from 79.5% at baseline to 88% after CQI support intervention (Table 2). Results of the Wilcoxon Sign rank test showed that this increase of 8.5% was statistically significant (z = 3.529, p<0.001) (Table 5). In addition, the increase of 12% after CQI support intervention in the North West province for group counselling, registration and communication quality of service median score was statistically significant (z = 3.601, p<0.001) (Table 4). Results of the Wilcoxon Sign rank test failed to reach statistical significance in Mpumalanga (z=1.293, p=0.196>0.05). Similarly, the paired samples t-test failed to reach statistical significance for the increase in quality of service in the Free State [t(5) = 1.06, p=0.3376>0.05] after CQI support intervention(Table 4).

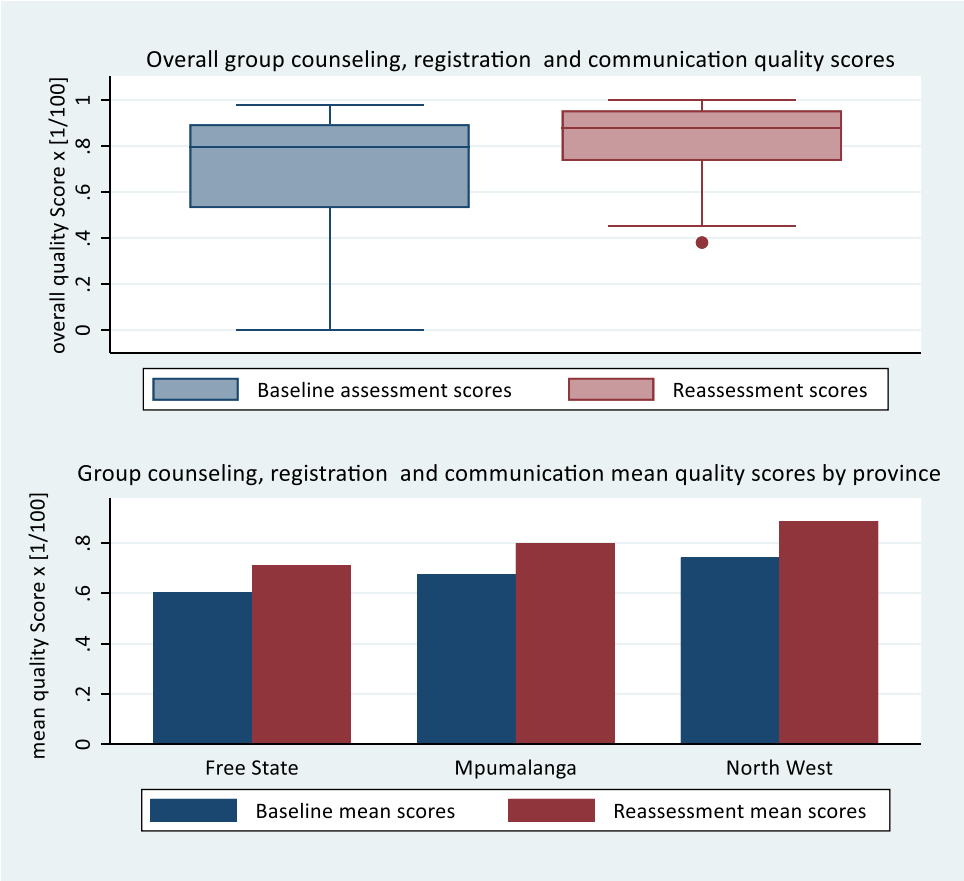

Figure 9: Mean quality scores for group counselling, registration and communication at baseline and after CQI support intervention by province and across provinces.

There was a general increase in quality of service for group counselling, registration and communication across all provinces.

3.3.6 Monitoring and Evaluation

There was a sharp increase in the overall monitoring and evaluation quality of service scores across provinces after CQI support intervention (Figure 10). Results in Table 2 shows that this increase was from 43.65±18.21% at baseline to 78.73±14.23% after CQI support intervention. Additionally, results of the paired samples t-test showed a statistically significant increase in the overall monitoring and evaluation quality of service score of 35.06% [(95%CI: 28.03%; 42.12%), t(39) = 10.08, p<0.001] after CQI support intervention (Table 5). Similarly, results showed statistically significant increases in quality of service mean scores for monitoring and evaluation of 43.67% in the North West [(95%CI: 34.30%; 53.03%), t(20) = 9.73, p<0.001]. The Wilcoxon sign rank test also showed statistically significant increases in quality of service median scores for monitoring and evaluation of 20% in Mpumalanga (z=2.621, p<0.01) and 27% in the Free State (z=1.992, p<0.05) after CQI support intervention (Table 4).

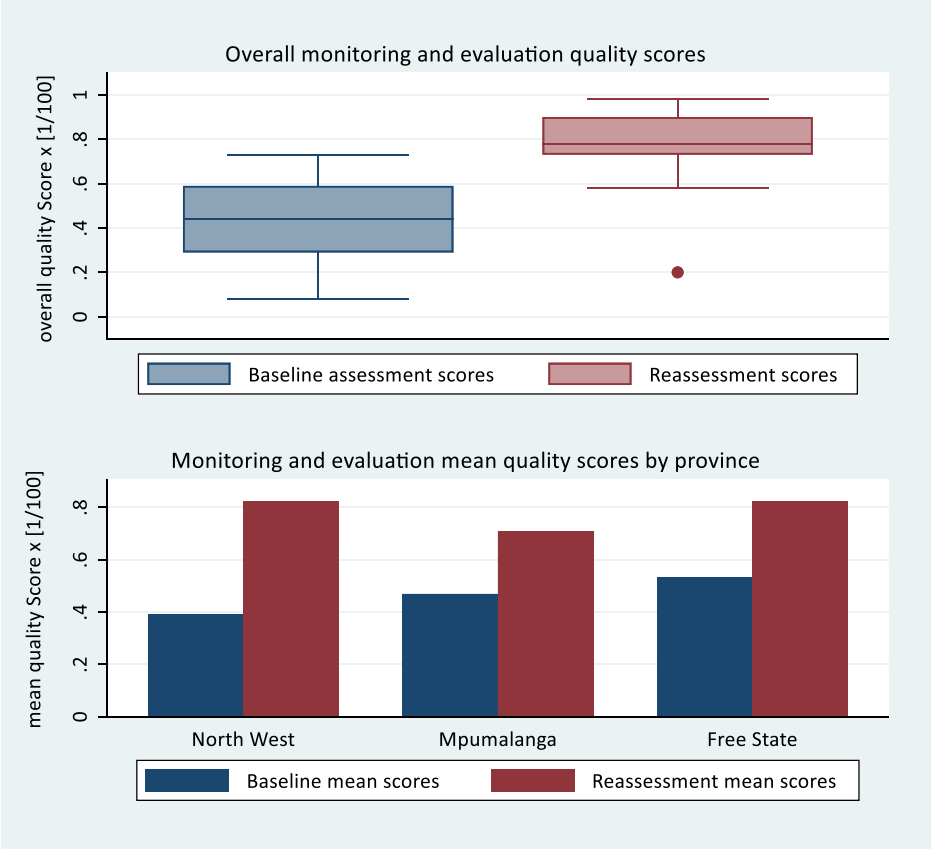

Figure 10: Mean quality scores for monitoring and evaluation at baseline and after CQI support intervention by province and across provinces.

There were sharp increases in quality of service for monitoring and evaluation across all provinces.

3.3.7 Male Circumcision Surgical Procedure

Results of the repeated measures paired t-test showed a statistically significant increase in the quality of service for the overall male circumcision surgical procedure of 8.28% [(95%CI; 3.25%; 13.30%), t (39) = 3.33, p=0.0019<0.01] after CQI support intervention (Table 5). The results of the paired samples t-test further showed a statistically significant increase for male circumcision surgical procedure quality of service mean scores in the North West province of 10.81% [(95%CI; 2.72%; 18.90%), t(20) = 2.79, p<0.05] and 10.67% [(95%CI: 1.70%; 19.64%) t(5) = 3.06, p<0.05] in the Free State province after CQI support intervention (Table 4, Figure 11). However, the increase of 3.08% in Mpumalanga province was not statistically significant [(95%CI: -5.48%; 11.63%) t(12) = 0.784, p=0.448>0.05] (Table 4).

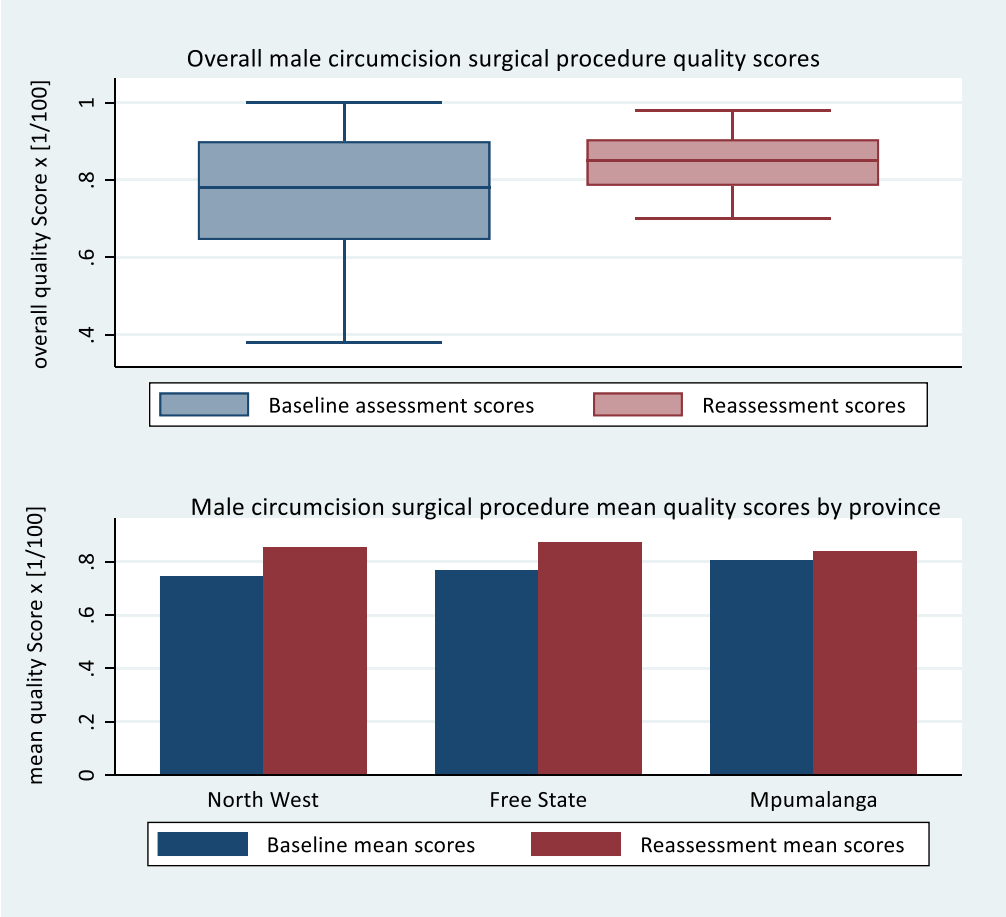

Figure 11: Mean quality scores for male circumcision surgical procedure at baseline and after CQI support intervention by province and across provinces.

There was a general increase in quality of service for male circumcision surgical procedures across all provinces; however, the increases in Mpumalanga province were very small.

3.3.8 Infection Prevention

Results showed a statistically significant increase in the overall quality of service mean scores across provinces for infection prevention of 11.89% [(95%CI: 6.60%; 17.15%), t (39) = 4.55, p<0.001] after CQI support intervention (Table 5, Figure 12). Similarly, there was a statistically significant increase for infection prevention quality of service mean scores in the North West province of 12.14% [(95%CI: 5.56%; 18.73%), t(20) = 3.85, p<0.001]. In addition, the Wilcoxon sign rank test showed a significant increase in quality of service median scores of 6% (z=2.310, p<0.05] in Mpumalanga province (Table 4). The Free State province had the highest quality of service scores at baseline; however, there was slight increase after CQI support intervention (Figure 12). Additionally, results of the repeated measures paired t-test further showed that this increase of 5.50% after CQI support intervention in the Free State province was not statistically significant [t(5) = 0.674, p=0.5304>0.05] (Table 4).

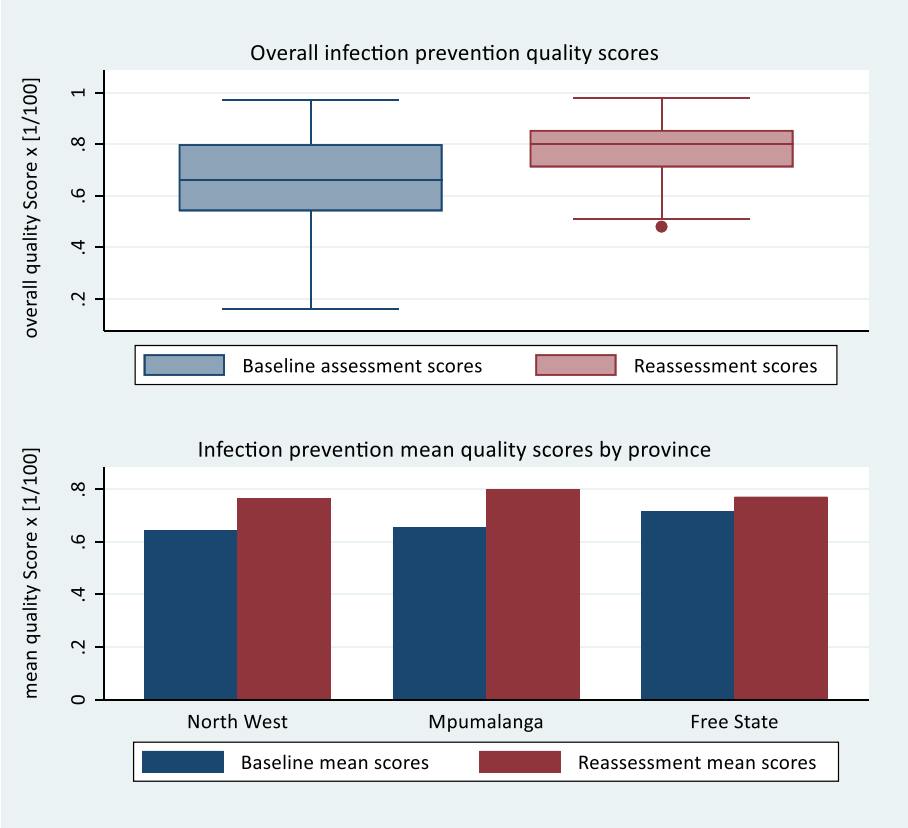

Figure 12: Mean quality scores for infection prevention at baseline and after CQI support intervention by province and across provinces.

There was a general increase in quality of service for infection prevention across all provinces.

3.3.9 Overall quality of service performance

Results of the paired samples t-test revealed statistically significant increase in the overall quality of service performance across provinces of 17.79% [(95%CI: 14.24%; 21.35%), t(39) = 10.13, p<0.001] after CQI support intervention (Table 5). In addition, results showed statistically significant increases for the overall quality of service performance in Mpumalanga province of 14.61% [(95%CI: 7.87%; 21.35%), t(12) = 4.73, p<0.001] and 17.25% in the Free State province [(95%CI: 5.59%; 28.91%), t(5) = 3.80, p<0.05] after CQI support intervention (Table 4, Figure 13). In addition, the Wilcoxon Sign rank test showed a significant increase in the overall quality of service the North West province of 19.38% (z = 4.015, p < 0.001).

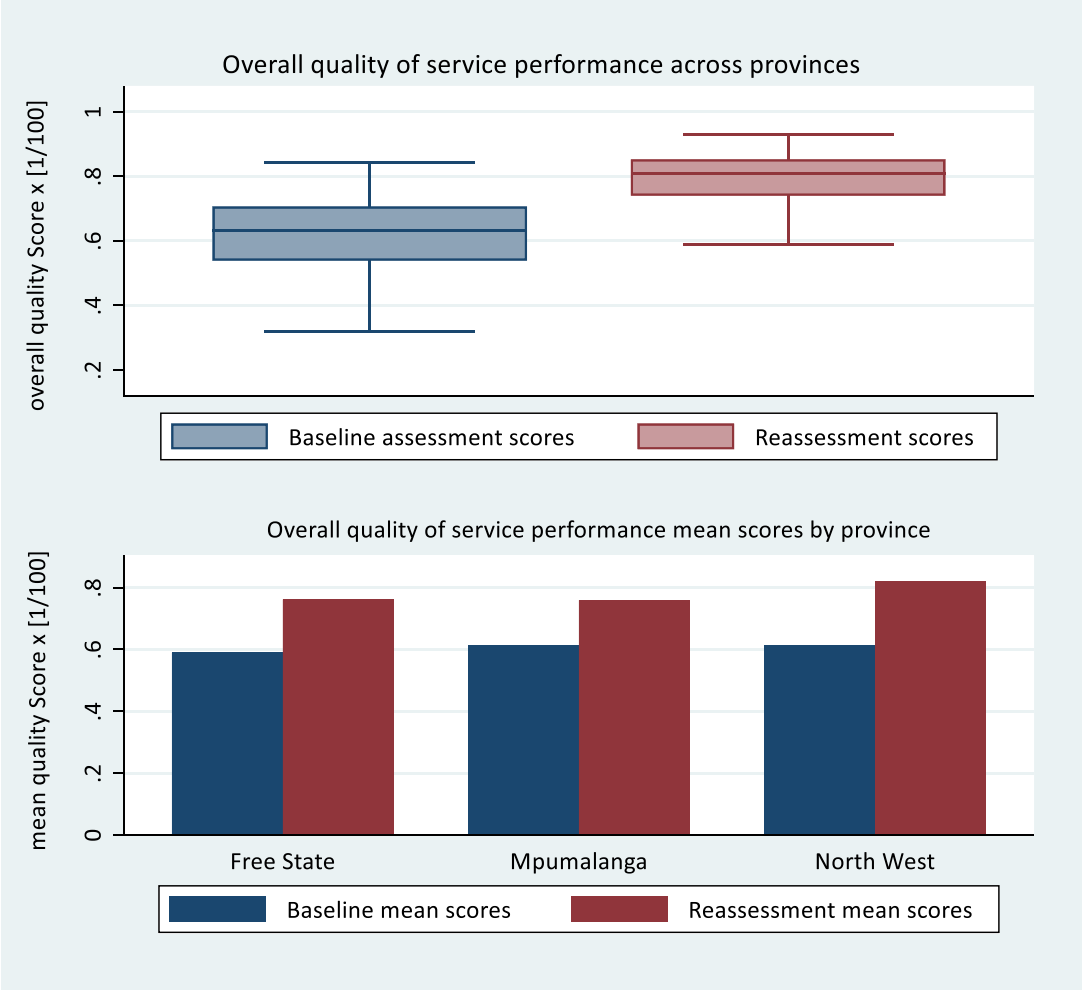

Figure 13: Mean quality scores for overall performance across quality standards at baseline and after CQI support intervention by province and across provinces.

There was a general increase in quality of service for the overall quality of service across all provinces.

3.3.10 Changes in quality of service by type of service delivery and facility structure

This study also focused on the changes in quality of service scores by type of service delivery and facility structure. The analysis was computed through linear mixed modelling. Both random and fixed models were applied and then compared for best fit. In this regard, the Hausman test was computed to compare the fixed and random effects models and the results were in favour of the random model analysis ($p>0.05$). Further tests were carried out for random effects using the Breusch and Pagan Lagrangian multiplier (LM) to test for the hypothesis that variances across panels is zero. The results were furthermore in favour of the random effects model ($p<0.05$) indicating evidence of differences across VMMC sites. Therefore, the random effects model was a good fit compared to the simple OLS model. However, the random effects model was applied in this study under the maximum likelihood estimation (MLE) option, for reporting of the final results.

Results from Modell II, revealed marginally significant interaction between assessment occasion and facility structure ($p = 0.07$) (Table 6). Further analysis through Akaike's information criterion (AIC), showed model fit improvement on introducing the marginally significant interaction term (Model II; AIC: -143.50) compared to Model I, with no interaction; (Model I; AIC: -142.27), (Table 6).

Results from the best model fit with the lowest AIC (Model II), showed a significant increase in the overall quality of service performance of 19.32% after CQI support intervention (95%CI: 15.67 – 22.97%; $p<0.001$) on adjustment to type of facility structure and rural-urban classification (Table 6). However, there were no significant differences in the overall quality of service between types of service delivery (campaign and routine). Furthermore, no significant differences in overall quality of service performance were observed between provinces (Annexure S). In contrary, the overall quality of service in outreach facilities was 12.56% higher, compared to fixed facility structures (95%CI: 5.21% - 19.91%; $p<0.001$). However, the effect of CQI support intervention on the overall quality of service was 7.64% less in outreach facilities compared to fixed facilities (95%CI: 0.52% - 15.80%; $p=0.067$), (Table 6). Therefore, after CQI support intervention, the overall quality of service in outreach facilities was 4.92% [12.56% - 7.64%] higher compared to fixed facility structures. Hence, there was a decline in overall quality of service gap between fixed and outreach facilities after CQI support intervention from 12.56% to 4.92% (Figure 1, Table 4). On the other hand, the overall quality of service performance was 9.9% higher in urban facilities compared to rural

facilities (95%CI: 4.10 - 15.81%; p<0.001), (Table 6). However, the gap in overall quality of service performance between rural and urban facilities was constant from baseline to the post-test assessment period (Figure 14). This shows that the effect of CQI support was equally effective by rural-urban classification; change in quality of service was similar. In addition, 36.9% of the variation in the overall quality of service after adjustment to type of facility structure and urban-rural classification was attributed to differences between VMMC sites (ICC: 36.90%; (95%CI: 14.82 – 64.62%; p<0.01), (Table 6).

Table 6: Results from linear mixed modelling comparing the overall quality of service performance from baseline to the post-test assessment by facility characteristics.

Site Characteristic	**Model I with no interaction**				**Model II with interaction**			
	Coef.	**Std. Err**	**p-value**	**95% CI**	**Coef.**	**Std. Err**	**p-value**	**95% CI**
Assessment occasion								
Baseline	*reference*				*reference*			
Reassessment	17.79%	1.73%	***	14.39%; 21.19%	19.32%	1.86%	***	15.67%; 22.97%
Urban-rural classification								
Rural	*reference*				*reference*			
Urban	9.95%	2.99%	***	4.10%; 15.81%	9.95%	2.99%	***	4.10%; 15.81%
Facility Structure								
Fixed	*reference*				*reference*			
Outreach	*8.74%*	3.12%	**	2.63%; 14.85%	*12.56%*	3.75%	***	5.21%; 19.91%
Facility structure # Assessment occasion								
Outreach # Reassessment					-7.64%	4.16%	0.07	-15.80%; 0.52%
ICC	33.36% (95%CI: 11.76%; 62.82%)				36.90% (95%CI: 14.82%; 64.62%)			
AIC	-142.27				-143.50			
Hausman test					p>0.05			
Breusch-Pagan LM					**			
Model fitness	***				***			
LR test	**				**			
**significant, p<0.05*								
***significant, p<0.01*								
****significant, p<0.001*								

Figure 14 below shows that the overall quality of service performance scores at both baseline and after CQI support intervention was higher in outreach facilities compared to fixed facility structures. Figure 14 further demonstrates that, although the outreach facilities had the highest

overall quality of service performance, the change in quality of service had substantially increased at fixed facilities. This substantial increase in quality of service from baseline to the post-test assessment at fixed facilities reflects the variability in the change on quality of service by facility structure in response to CQI support intervention (non-parallel slopes). Likewise, urban facilities had a higher overall quality of service compared to rural facilities, however there were no differences in the overall change on quality of service from baseline to the post-test assessment (parallel slopes), (Figure 14).

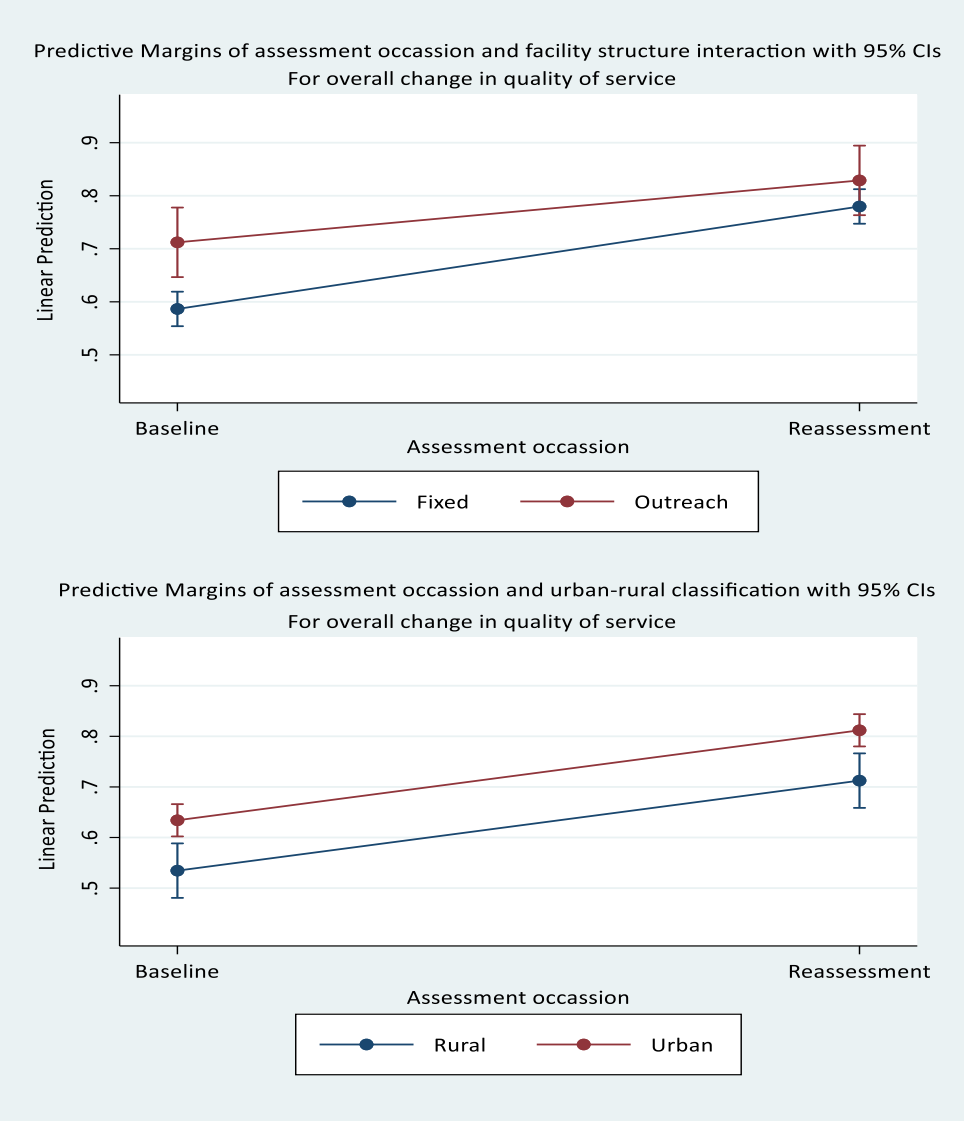

Figure 14: Overall change in quality of service scores across quality standards by type of facility structure and type of service delivery.

CHAPTER FOUR

DISCUSSION

4.1 Chapter overview

The main aim of this study was to determine if continuous quality improvement intervention makes a difference in quality of service at voluntary medical male circumcision sites. The analysis was done across eight (8) quality standards used in VMMC programs for site evaluation. In this chapter I discuss the results and the changes in quality of service by province, quality standard and facility characteristics.

4.2 Overall changes in quality of service

Results showed an overall significant increase in the quality of service across all provinces of 17.79% (from 61.17% at baseline to 78.96% after CQI support intervention). This implies that all-inclusively, the CQI support intervention program was effective to bring positive changes for quality of service at VMMC facilities. The results resonate with findings from six sites that were assessed in Lesotho that improved from an average of 79.8% at baseline to 91.3% after CQI support intervention(7). Similarly, the findings also concur with the studies that were conducted in Zimbabwe and Uganda, where positive outcomes for VMMC program were demonstrated through CQI support intervention programs (9,13,36). Studies focusing on changes in quality of service at VMMC sites in South Africa were limited at the time this study was conducted.

4.2.1 Changes in quality of service across quality standards

There were significant increases in quality of service across all quality standards from baseline to post-test assessment. Supplies, equipment, environment and emergency had the lowest change in quality of service of 5.1%, followed by male circumcision surgical procedure (8.28%). The small increases could have been as a result of the already highest baseline values compared to other quality standards. In other contexts, the overall performances for the two quality standards at baseline were already close to the satisfactory category of 80% and above; [Supplies, equipment, environment and emergency (78.80±11.76%), and male circumcision surgical procedure (76.80±16.62%)]. Male circumcision surgical procedure and supplies, equipment, environment and emergency had also the highest post-test assessment quality of service performances of 85.08±7.58% and 83.90±9.26% respectively.

Monitoring and evaluation, management systems, and leadership and planning recorded the highest significant changes in quality of service of 35.08%, 28.65% and 23% respectively. These were major achievements that demonstrate the effectiveness of the CQI support intervention. The high changes in quality of service for the three quality standards were partly attributed to their very low baseline values that were already in the poor category of 50% and below. Hence their changes in quality of service were significantly higher compared to other quality standards that were near the satisfactory category of 80% and above at baseline.

However, although there was a significant overall increase in quality of service for leadership and planning across provinces, the post-test assessment quality of service was lowest compared to other quality standards. This implies that more CQI support intervention programs were required to further improve quality of service for leadership and planning in all provinces, particularly in Mpumalanga province with a post-test assessment quality of service median score of 50%.

Literature shows that Kenya was successful in implementing VMMC programs as a result of strong and consistent leadership (12). Therefore, findings from this study reflect the need to further strengthen the CQI strategies for leadership and planning.

4.2.2 Changes in quality of service in the North West Province

Results showed significant increases in the North West province for infection prevention; male circumcision surgical procedure; individual counselling and HIV testing; group counselling, registration and communication; monitoring and evaluation; management systems and leadership and planning. The results demonstrate the combined positive effect of SIMS and the PDSA to develop and implement action plans. This is in-line with the recent studies that support implementation of CQI programs through the PDSA cycle and SIMS (38). However, no significant improvements were observed in the North West province for supplies, equipment, environment and emergency. The findings for supplies, equipment, environment and emergency were similar to previous studies that were carried out in South Africa, where gaps were consistently identified for VMMC supplies and equipment (7,14). In addition, the South Africa 2016 reference report on HIV and TB investment case also showed inefficiencies in the supply chain for the healthcare sector (8). Therefore, findings from previous research and the results from this study, shows that more support with effective action plans is required to further improve supplies, equipment, environment and emergency for VMMC facilities particularly in the North West province.

4.2.3 Changes in quality of service in Mpumalanga Province

Mpumalanga province showed positive significant increases for infection prevention; supplies, equipment, environment and emergency; individual counselling and HIV testing; monitoring and evaluation; management systems; and leadership and planning. The results were consistent with findings from previous studies, where CQI quality improvement

strategies resulted in positive quality improvement outcomes and this was demonstrated in Uganda (9,36). In contrary, male circumcision surgical procedure, and group counselling, registration and communication did not yield positive results in Mpumalanga province. Research shows that communication with clients is critical and if poorly managed can result in medical errors and increased hospital admissions (82). Additionally, previous findings shows that bleeding and damage to penis is as a result of poorly performed medical male circumcision (23). Hence, there is need for further improvement for male circumcision surgical procedures, infection prevention and group counselling, registration and communication in the Mpumalanga province. Procedure related negative outcomes were reduced from 8.6% to 4.5% in Malawi after CQI training (42). Similar improvements can be achieved if CQI support is effectively provided in Mpumalanga provinces.

4.2.4 Changes in quality of service in the Free State Province

The Free State Province results revealed significant improvements for the majority of quality standards, except for group counselling, registration and communication; infection prevention; and individual counselling and HIV testing. The province has also the highest quality of service performance compared to other provinces for monitoring and evaluation and male circumcision surgical procedure. This study was limited to CQI support intervention strategies; however, more research could be carried out to understand other factors that could have attributed to the high increase in quality of service in the Free State province for monitoring and evaluation and male circumcision surgical procedure.

4.3 Changes in Quality of Service by type of facility and service delivery

In this study, changes in quality of service were assessed to determine if they were differences by type of service delivery and facility structure. It was therefore, determined that, they were no significant differences in the overall quality of service between campaign and routine service delivery from baseline to the post-test assessment period. In contrary, the overall quality of service in outreach facilities was 12.56% higher, compared to fixed facilities. However, after CQI support intervention, the gap in overall quality of service between outreach and fixed facilities was reduced from 12.56% to 4.92%. Therefore, the gap in overall quality of service between fixed and outreach facilities can be reduced if more CQI support intervention is provided. Results from this study resonate with findings from previous studies in Uganda, where significant differences in the quality of service were observed between fixed

and mobile sites (36). However, studies focusing on the association between changes in quality of service and type of service delivery were highly limited at the time when this study was conducted.

In relation to urban-rural classification, the overall quality of service performance was 9.9% higher in urban compared to rural facilities. The results concurred with findings from Tanzania that showed differences in the quality of service between rural and urban facilities (62). However, further analysis in this study, showed no differences on the overall change in quality of service performance from baseline to the post-test assessment period between urban and rural VMMC sites. In other contexts, this may be an indication that, the impact of the CQI support program was equally effective at both urban and rural VMMC sites. However, VMMC sites in the rural areas still requires more CQI support to match the high quality of service reflected in urban facilities. Sharing of experiences through challenges and successes can be vital to further improve quality of service at sites that are struggling to meet the required quality standards. The study also revealed that 36.9% of the variability in overall quality of service from baseline to the post-test assessment period was attributed to differences between sites.

4.4 Limitations

This study did not include the experience and level of education of the health care personnel teams that were assessed at the facilities. These factors may have influenced the change in quality of service after CQI support intervention. Furthermore, the researcher was not involved in the primary data collection process. This implies lack of control on data quality issues and knowledge on how the data was collected (83–85). However, the researcher utilized documentation from program data and also consulted with the primary researchers from Right to Care. In addition, direct observations of staff surgical procedures and other activities introduce hawthorn bias. People change behaviour if they are under observation (86).

4.5 Conclusion

Results from this study showed that CQI support intervention strategies through PDSA and SIMS have resulted in a positive impact on quality of service at VMMC facilities in South Africa. The overall performance for changes in quality of service across provinces significantly improved after CQI support intervention program at VMMC sites. However, provinces showed lack of positive improvement for specific quality standards. For instance, no improvement was observed in the North West province for supplies, equipment, environment and emergency. Similarly, the Free State and Mpumalanga provinces revealed no significant improvement for group counselling, registration and communication. Results also showed that, outreach facilities and VMMC sites in urban areas had the highest overall quality of service compared to fixed and rural facilities respectively. In addition, results from this study did not find any significant differences between routine and campaign mode of service delivery on the changes in quality of service. Similarly, no significant differences were observed between provinces.

4.6 Recommendations

In this study, there were no significant changes in the North West province for supplies, equipment, environment and emergency. Findings from previous studies have showed evidence, that the use of mobile technology and logistics management information system (LMIS) help to improve quality of service for the supply chain management system(8). They enable uninterrupted availability of material resources, medicines and equipment requirements at sites. Hence, these technologies can also be incorporated in the action plans for continuous quality improvement at VMMC sites. In addition to the PDSA cycle and SIMS, the CQI program can also employ other quality improvement initiatives at VMMC sites that will be struggling to meet the expected quality requirements. Such initiatives may include MBQA, six-sigma and the lean approach. These are strategies that have been demonstrated to improve efficiency (41). On the other hand, the effect of volume of weekly medical circumcisions per site, staff designation and age on the change in quality of service after CQI support intervention was not evaluated in this study. Further studies can be designed focusing on the effect of these factors. In addition, the findings suggest the need for regular VMMC site assessments to identify quality of service gaps. Challenges experienced by sites differ, therefore action plans should be designed based on site specific challenges. Collaborative support is recommended to maintain good quality of service for sites in the satisfactory category for quality of service. Regular visits and intensive CQI support are required for sites

with low performance in CQI standards. Furthermore, sharing of success stories and barriers to program implementation are critical to support the CQI intervention action plans.

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APPENDICES

ANNEX A: Plagiarism Declaration

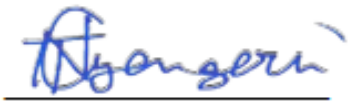
PLAGIARISM DECLARATION TO BE SIGNED BY ALL HIGHER DEGREE STUDENTS

SENATE PLAGIARISM POLICY: APPENDIX ONE

I Tawanda Nyengerai (Student number: 1129343) am a student registered for the degree of MSc Epidemiology & Biostatistics in the academic year 2021.

I hereby declare the following:

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

Signature:  Date: 15 February 2021

ANNEX B: Ethics Clearance Certificate

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

R14/49 Mr T Nyengerai

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
CLEARANCE CERTIFICATE NO. M200415

NAME: (Principal Investigator)	Mr T Nyengerai
DEPARTMENT:	School of Public Health Division of Epidemiology and Biostatistics Medical School University
PROJECT TITLE:	Changes in the quality of voluntary medical male circumcision services in selected districts of the Mpumalanga, Eastern Cape, Free State and North West Provinces of South Africa
DATE CONSIDERED:	2020/04/24
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Professor C Chasela and Ms M Phohole
APPROVED BY:	Dr CB Penny, Chairperson, HREC (Medical)
DATE OF APPROVAL:	2020/08/19

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and ONE COPY returned to the Research Office Secretary on the 3rd Floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.
I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **April** and will therefore reports and re-certification will be due early in the month of **April** each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

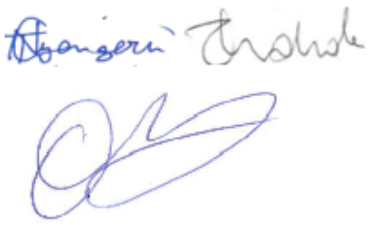
2020/08/23
Date

ANNEX C: Turnitin Plagiarism Report

1129343:T._Nyengerai_Final_Research_Report,_7_Dec_2020.docx

by Tawanda Nyengerai

Submission date: 07-Dec-2020 10:55PM (UTC+0200)
Submission ID: 1467857817
File name: c2d3ed4fd18b_T._Nyengerai_Final_Research_Report,_7_Dec_2020.docx (363.3K)
Word count: 13104
Character count: 75137



1129343:T._Nyengerai_Final_Research_Report,_7_Dec_2020.d

ORIGINALITY REPORT

11%	10%	5%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	aidsfree.usaid.gov Internet Source	1%
2	repository-tnmgrmu.ac.in Internet Source	1%
3	1pdf.net Internet Source	1%
4	www.usaidassist.org Internet Source	1%
5	sutir.sut.ac.th:8080 Internet Source	<1%
6	www.intechopen.com Internet Source	<1%
7	repository.nwu.ac.za Internet Source	<1%
8	inba.info Internet Source	<1%

ANNEX D: Variables description

Variable name	Type	Description
NAME OF SITE	Continuous	Renamed Site_ID, Site unique identifier (coded 1, 2, . . ., 97)
Assessment occasion	Time variable	Time variable expressed as T0, T1; the time-points are as defined under section 6.5.1. (coded T0 = 1, T1 = 1)
Overall performance at T0	Continuous	Renamed Overall_performance0; expressed as a % on a scale of 0 - 100
Overall performance at T1	Continuous	Renamed Overall_performance1; expressed as a % on a scale of 0 - 100
Infection prevention at T0	Continuous	Renamed Infection_prevention0; expressed as a % on a scale of 0 - 100
Infection prevention at T1	Continuous	Renamed Infection_prevention1; expressed as a % on a scale of 0 - 100
Management systems at T0	Continuous	Renamed Management_systems0; expressed as a % on a scale of 0 - 100
Management systems at T1	Continuous	Renamed Management_systems1; expressed as a % on a scale of 0 - 100
Individual counselling and HIV testing for MMC clients at T0	Continuous	Renamed Indiv_counsel_hivtest0; expressed as a % on a scale of 0 - 100
Individual counselling and HIV testing for MMC clients at T1	Continuous	Renamed Indiv_counsel_hivtest1; expressed as a % on a scale of 0 - 100
Leadership and Planning at T0	Continuous	Renamed leadership_planning0; expressed as a % on a scale of 0 - 100
Leadership and Planning at T1	Continuous	Renamed leadership_planning1; expressed as a % on a scale of 0 - 100
Supplies, equipment, environment, and emergency at T0	Continuous	Renamed Supplies_equip_environ0; expressed as a % on a scale of 0 - 100
Supplies, equipment, environment, and emergency at T1	Continuous	Renamed Supplies_equip_environ1; expressed as a % on a scale of 0 - 100
Group counselling, registration and communication at T0	Continuous	Renamed Group_counsel_regist0; expressed as a % on a scale of 0 - 100
Group counselling, registration and communication at T1	Continuous	Renamed Group_counsel_regist1; expressed as a % on a scale of 0 - 100

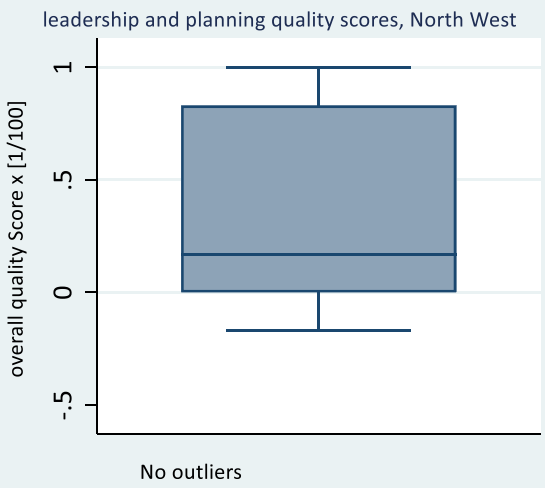
Monitoring and evaluation at T0	Continuous	Renamed Monitoring_evaluation0; expressed as a % on a scale of 0 - 100
Monitoring and evaluation at T1	Continuous	Renamed Monitoring_evaluation1; expressed as a % on a scale of 0 - 100
Male circumcision surgical procedure at T0	Continuous	Renamed Male_circumc_procedure0; expressed as a % on a scale of 0 - 100
Male circumcision surgical procedure at T1	Continuous	Renamed Male_circumc_procedure1; expressed as a % on a scale of 0 - 100
Type of service delivery	Binary	Expressed as routine, campaign (coded; 2=routine, 1=campaign)
Type of facility structure	Categorical	Expressed as; fixed, outreach (coded; 1=fixed, 2=outreach)
Province	Categorical	Expressed as Mpumalanga, Free State and North West (coded; 1=Free State, 2=Mpumalanga, 3= North West) Eastern Cape sites failed to meet inclusion criteria and hence the province was dropped from dataset.
District	Categorical	Expressed as Alfred Nzo, Amathole, Dr Kenneth Kaunda, Ehlanzeni, Ngaka Modiri Molema, Nkangala, OR Tambo, Thabo Mofutsanyana. (coded; 1=Alfred Nzo, 2=Amathole, 3=Dr Kenneth Kaunda, 4= Ehlanzeni, 5=Ngaka Modiri Molema, 6= Nkangala, 7=OR Tambo, 8=Thabo Mofutsanyana)
Rural urban classification	Categorical	Expressed as Rural, Urban (coded; 1=Rural, 2=Urban)
Assessment Occassion	Time variable (Categorical)	Expressed as 0=T0_Baseline, and 1=T1_reassessment

ANNEX E: Normality tests using the Shapiro-Wilk analysis for the eight (8) quality standards and the overall performance.

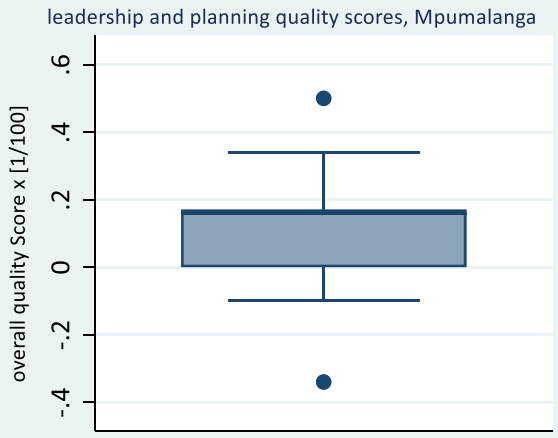
Quality Standard	Overall, all provinces		North West		Mpumalanga		Free State	
	Statistic(w)	p-value	Statistic(w)	p-value	Statistic(w)	p-value	Statistic(w)	p-value
Management systems	0.979	0.661	0.959	0.490	0.966	0.845	0.916	0.479
Monitoring and Evaluation	0.990	0.977	0.983	0.961	0.956	0.723	0.985	0.960
Group counselling, registration and communication	0.956	0.156	0.945	0.319	0.967	0.855	0.828	0.102
Individual counselling and HIV testing	0.948	0.083	0.967	0.711	0.936	0.453	0.800	0.059
Supplies, equipment, environment and emergency	0.980	0.684	0.925	0.110	0.940	0.459	0.927	0.555
Male circumcision surgical procedure	0.984	0.834	0.978	0.900	0.931	0.346	0.894	0.339
Infection prevention	0.984	0.837	0.968	0.691	0.875	0.115	0.964	0.850
Leadership and planning	0.959	0.161	0.926	0.113	0.952	0.631	0.984	0.970
Overall performance	0.966	0.286	0.958	0.504	0.952	0.637	0.961	0.824
*significant, p<0.05								
**significant, p<0.01								
***significant, p<0.001								

ANNEX F: Leadership and planning outliers identification

No outliers



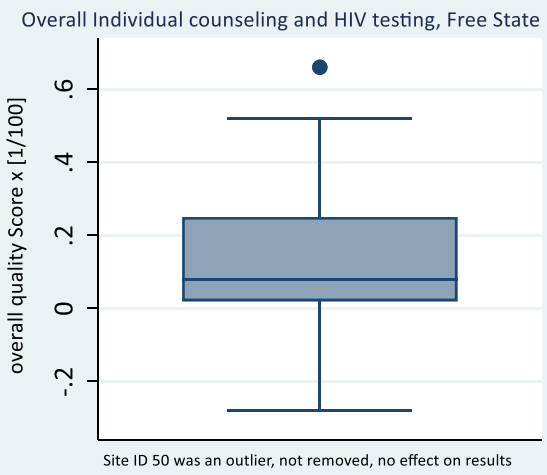
No outliers

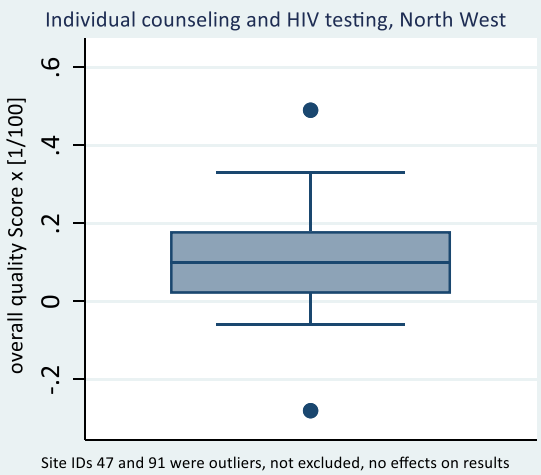


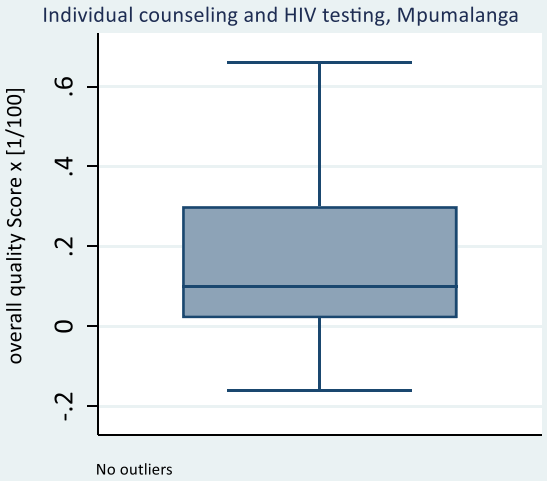
Outliers were Site IDs 15 and 63, Wilcoxon analysis used

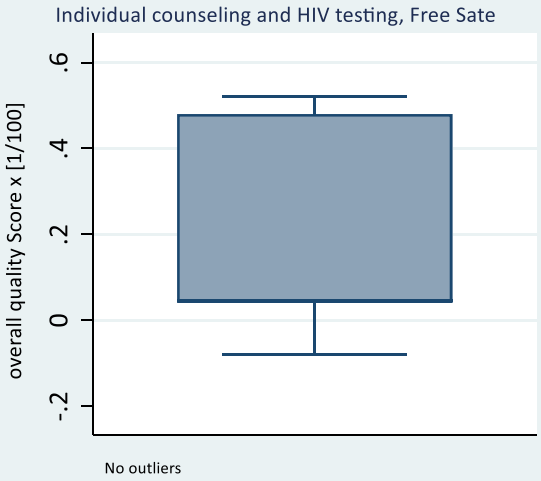
No outliers

ANNEX G: Individual counselling and HIV testing, outliers identification

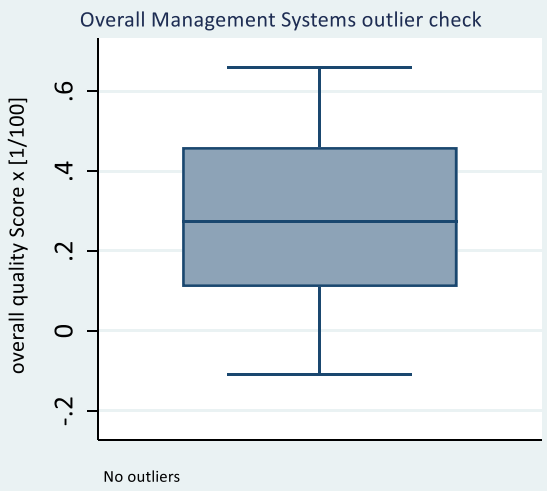


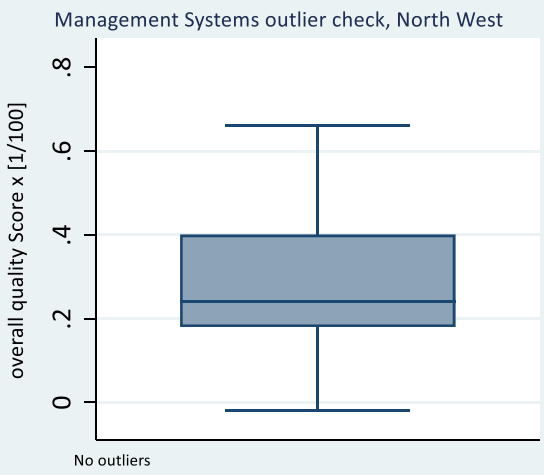


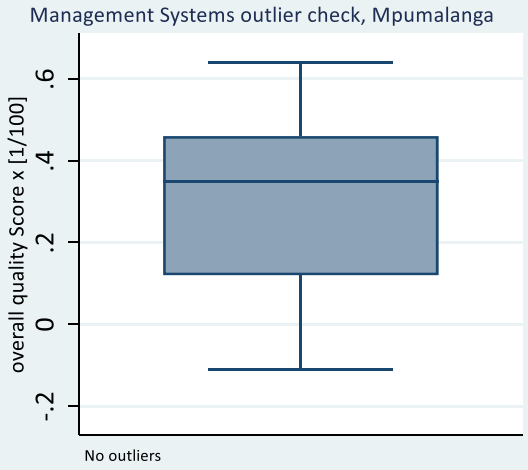


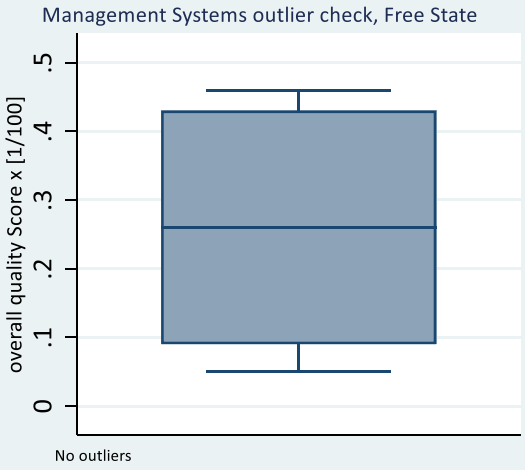


ANNEX H: Management systems outliers identification

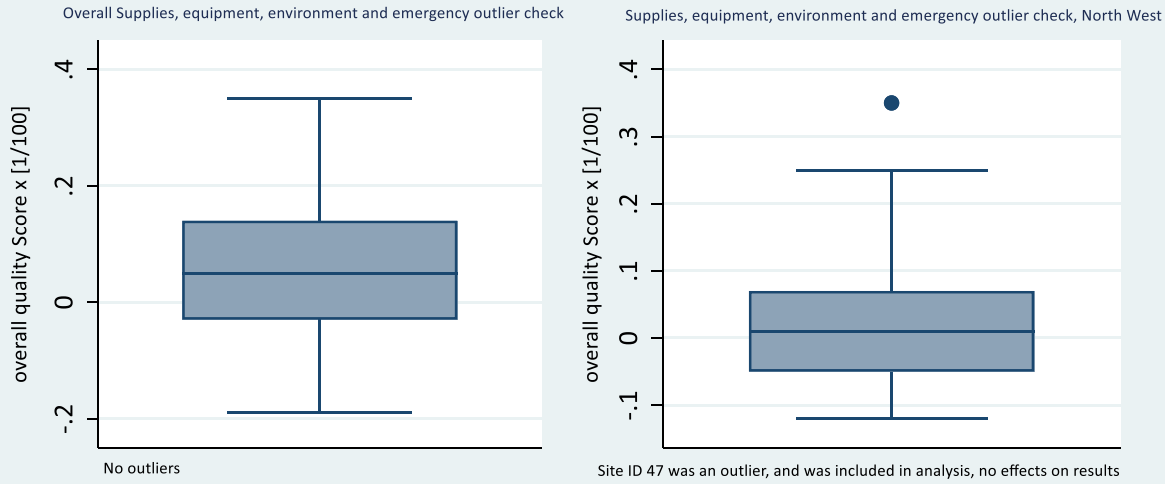


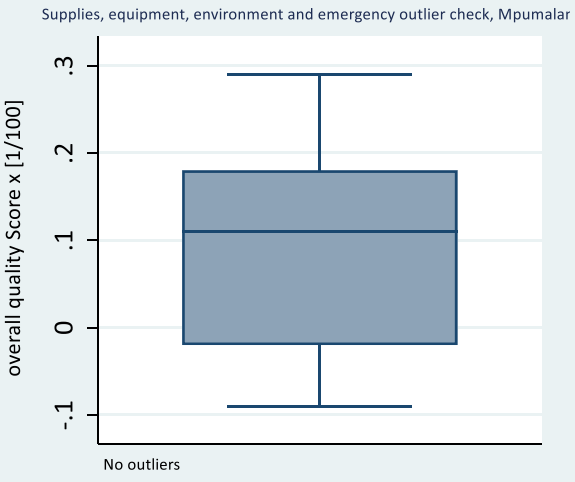


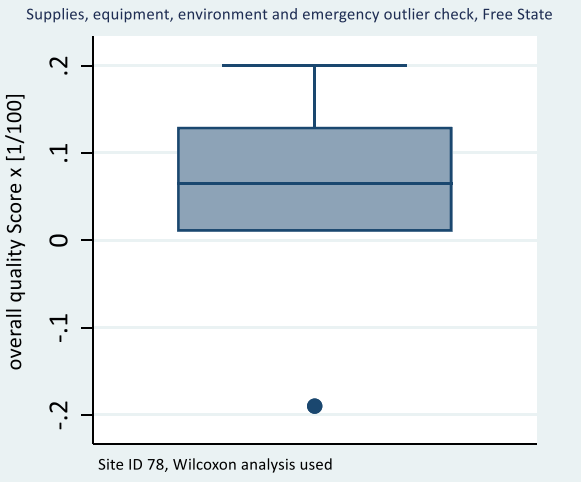




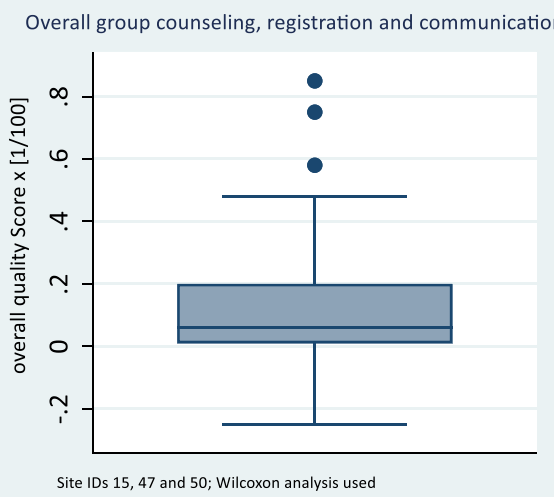
ANNEX I: Supplies, equipment, environment and emergency, outliers identification



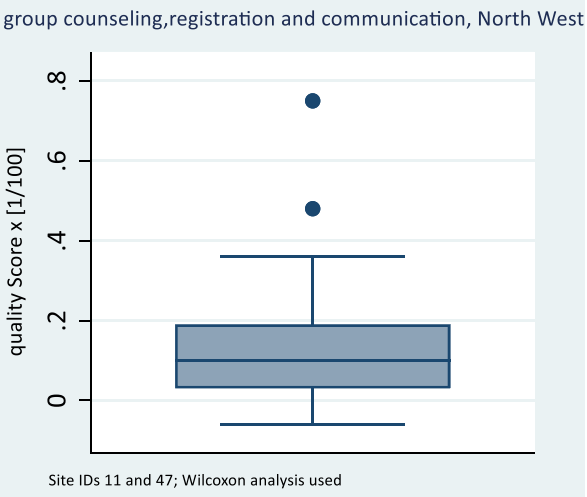




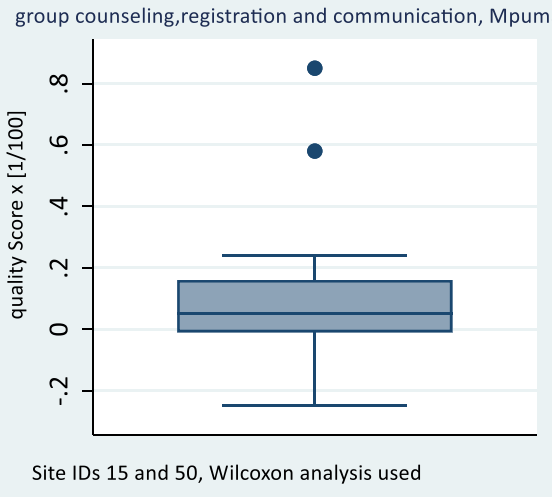
ANNEX J: Group counselling, registration and communication, outliers identification



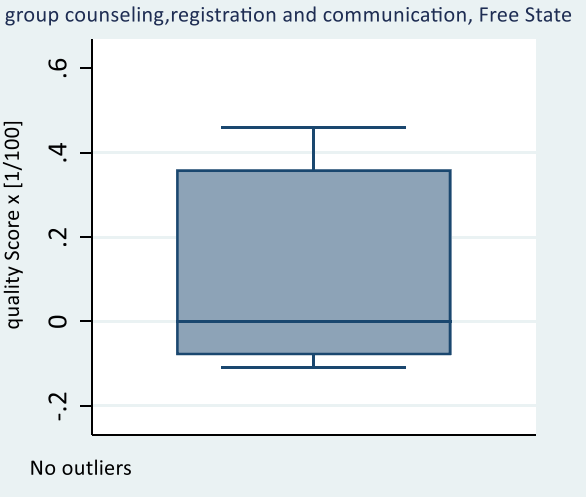
Site IDs 15, 47 and 50; Wilcoxon analysis used



Site IDs 11 and 47; Wilcoxon analysis used

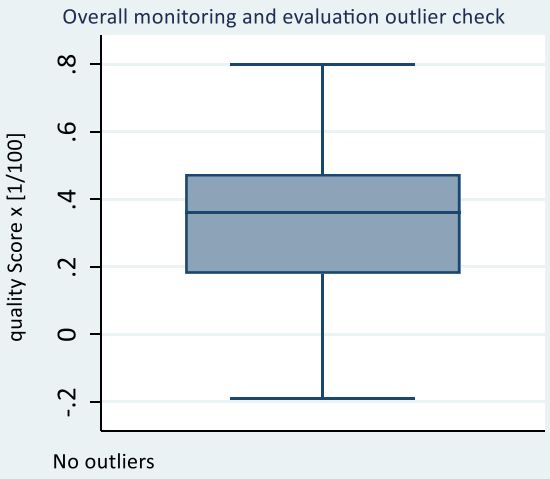


Site IDs 15 and 50, Wilcoxon analysis used

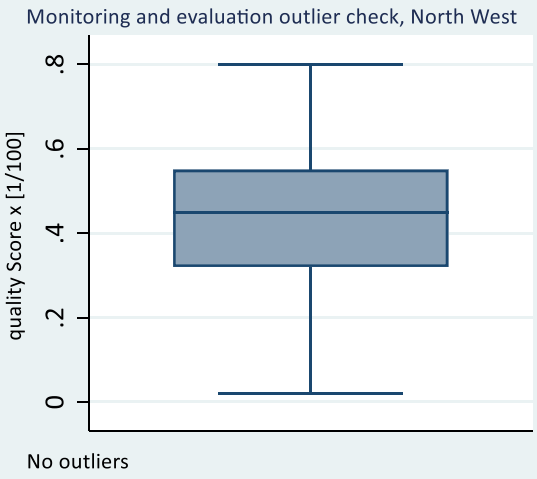


No outliers

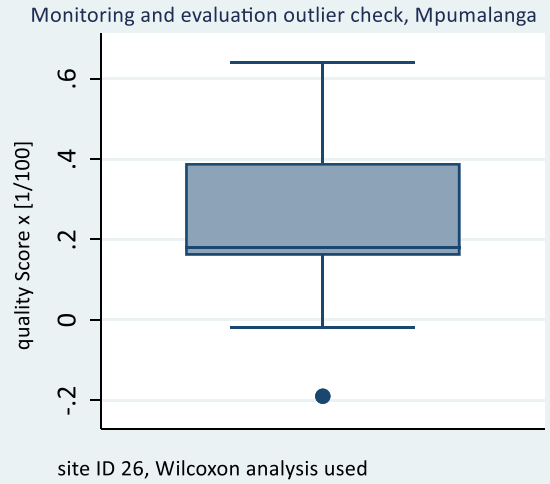
ANNEX K: Monitoring and Evaluation outliers identification



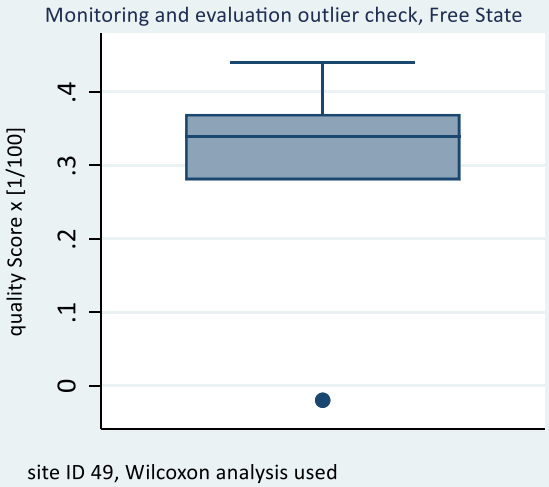
No outliers



No outliers

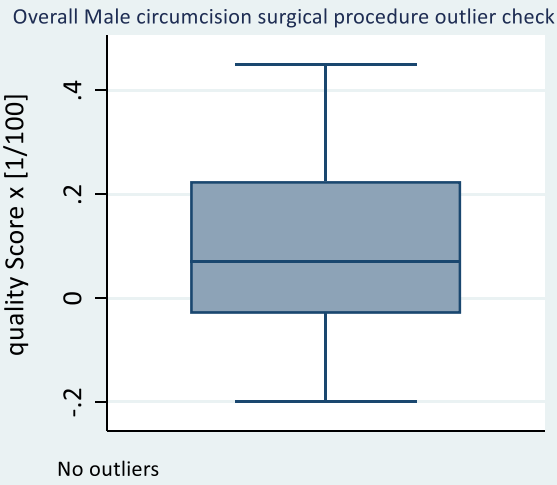


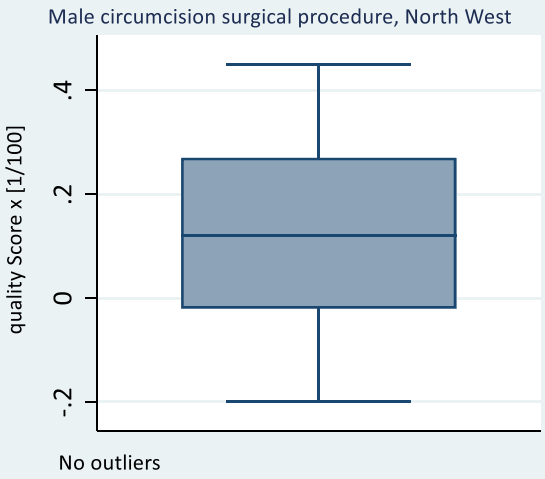
site ID 26, Wilcoxon analysis used

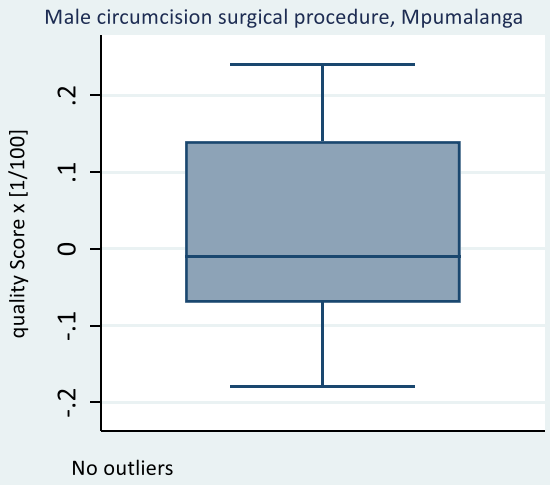


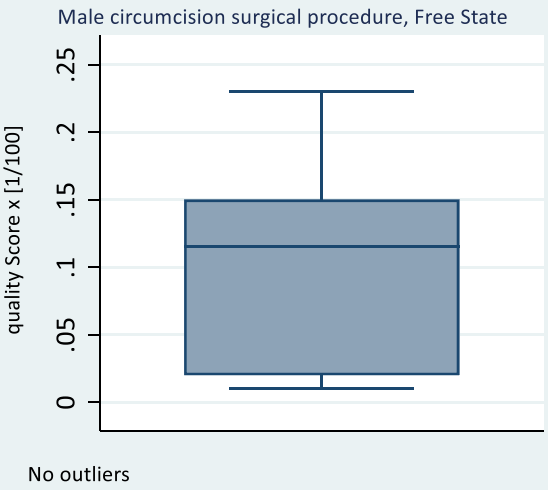
site ID 49, Wilcoxon analysis used

ANNEX L: Male medical circumcision outliers identification

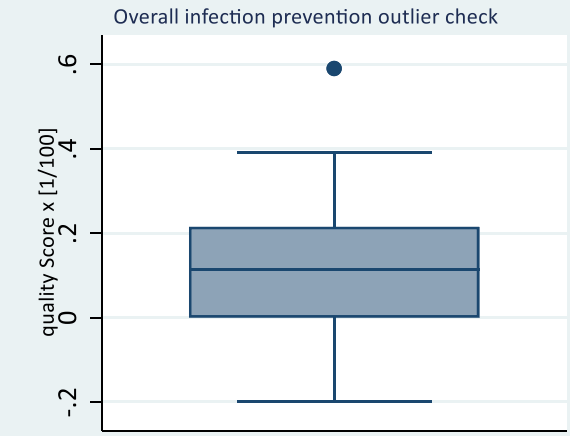




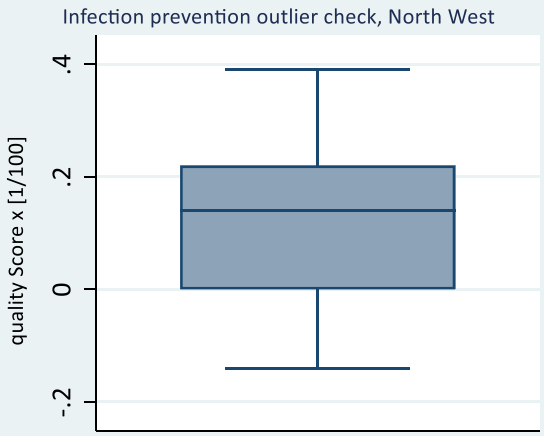




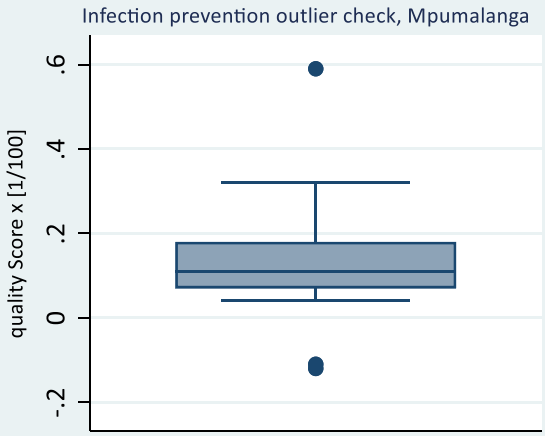
ANNEX M: Infection prevention outliers identification



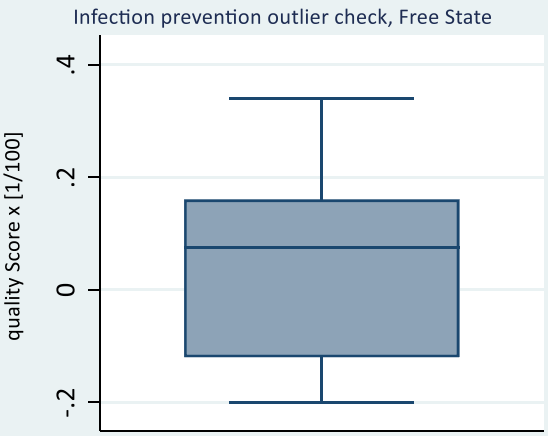
site ID 17 was an outlier, included in analysis no effect on results



no outliers

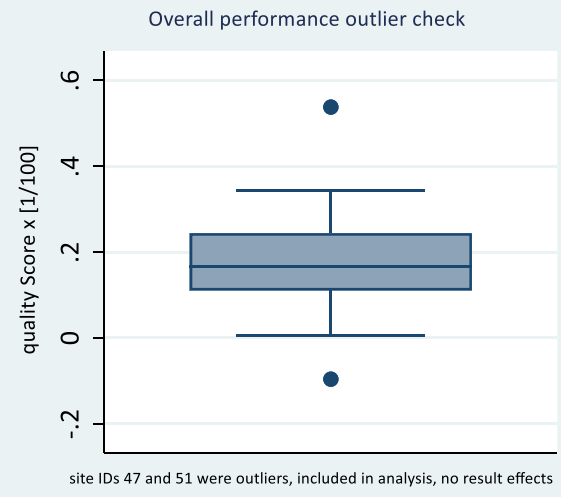


site IDS were 17, 39 and 51; Wilcoxon analyis used

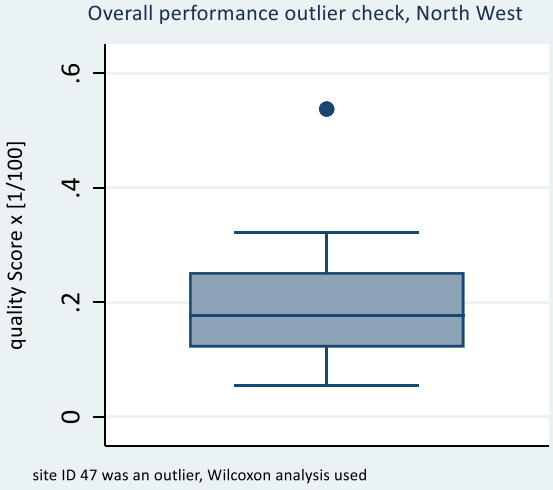


No outliers identified

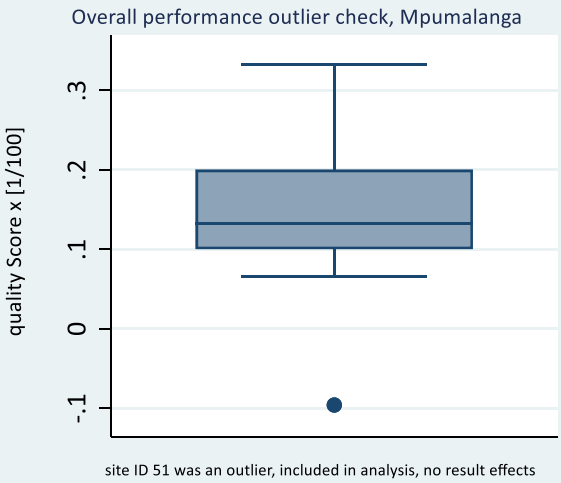
ANNEX N: Overall performance outliers identification



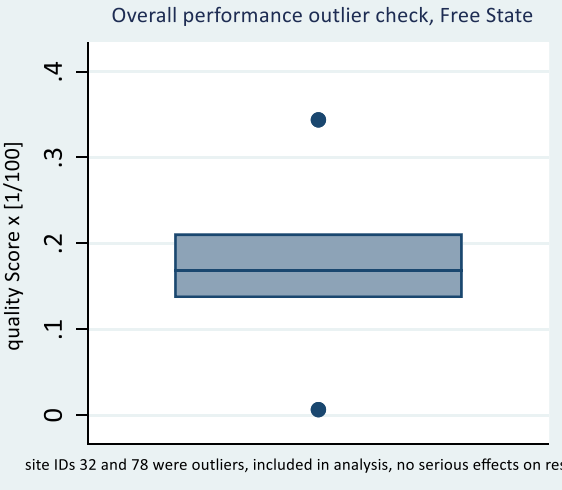
site IDs 47 and 51 were outliers, included in analysis, no result effects



site ID 47 was an outlier, Wilcoxon analysis used



site ID 51 was an outlier, included in analysis, no result effects



site IDs 32 and 78 were outliers, included in analysis, no serious effects on results

ANNEX O: Missing data and sites assessed

Description	Number of sites
Total number of sites	96
Total assessed at baseline	95
Maximum assessed after CQI support intervention	40
Sites Missing at baseline	1
Sites Missing after CQI support intervention	56
NB; One site from the North West was not assessed at baseline and this was dropped from the dataset, not meeting inclusion criteria.	
All 16 sites from the Eastern Cape province were excluded in the analysis since VMMC campaigns were suspended from this province after baseline assessment. The sites did not meet inclusion criteria.	
Sites were not assessed after baseline assessment due to VMMC suspension or contract termination. Other sites were not yet reassessed during the time of this study.	

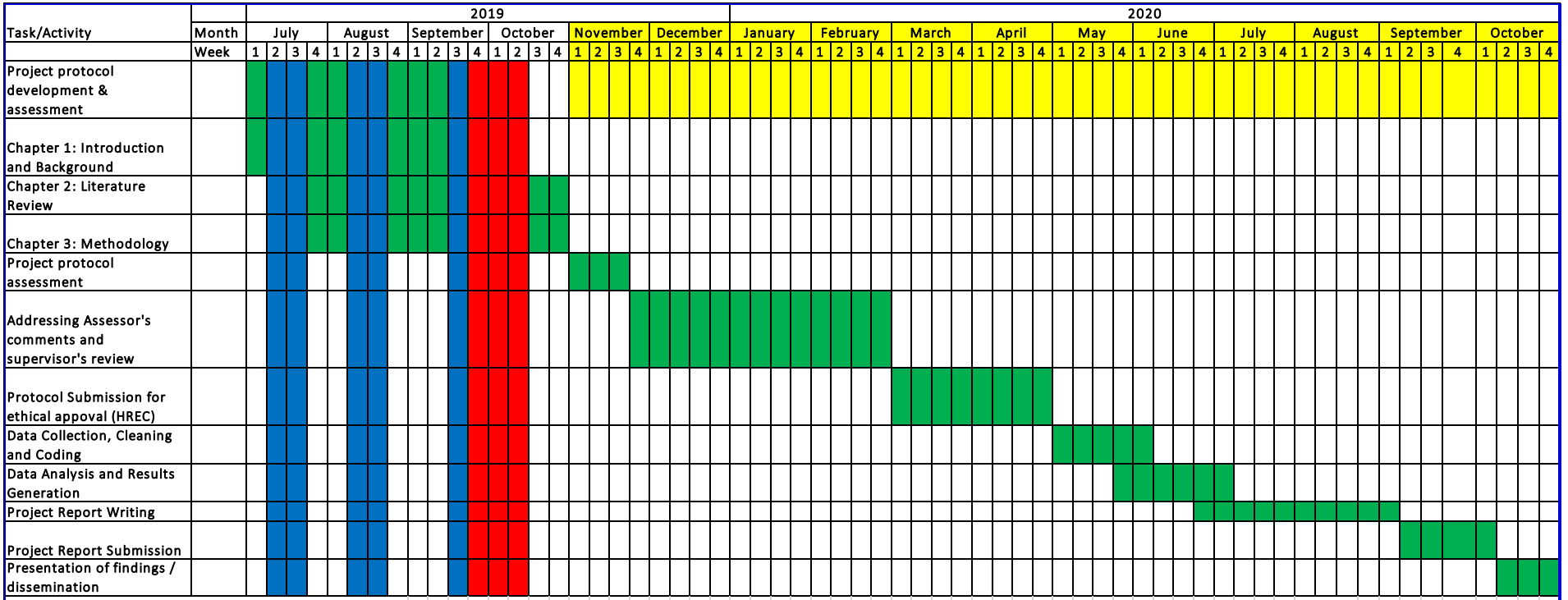
Sites remaining after dropping one site from the North West with no baseline assessment

Province	VMMC stopped/suspended/contract terminated	Reassessed at the post test assessment	Sites not re-assessed at the post test assessment during the study period	Total
Eastern Cape	16	0	0	16
Free State	5	6	8	19
Mpumalanga	2	13	4	19
North West	7	21	13	41
Total	30	40	25	95

ANNEX P: Project Research Budget - Self Funded.

Project Research Budget - Self Funded				
item description	**Quantity**	**unit cost (ZAR)**	**total cost (ZAR)**	**Justification**
Research proposal printing for assessment submission	3 copies, 28 pages each	11.20	33.60	Printing @ R0.40 per page.
Research proposal printing for ethics submission	2 copies, 28 pages each	11.20	22.40	Printing @ R0.40 per page.
Transport for project activities (Uber taxi)	10 trips	130.00	1300.00	transport @ R130 total (to and from Pretoria, Centurion @ least once a month) - local travel for meeting with supervisors
Airtime for communication project related issues	10 months	13.00	130.00	communication @ R13 for 30 minutes per month
Thesis final report printing and binding	3 copies	150.00	450.00	Printing @ R40 per page
Publication	1 publication	3000	3000	Publication fees
Grant Total		**3340.40**	**4936**	

ANNEX Q: Research project time frame (Gantt chart)

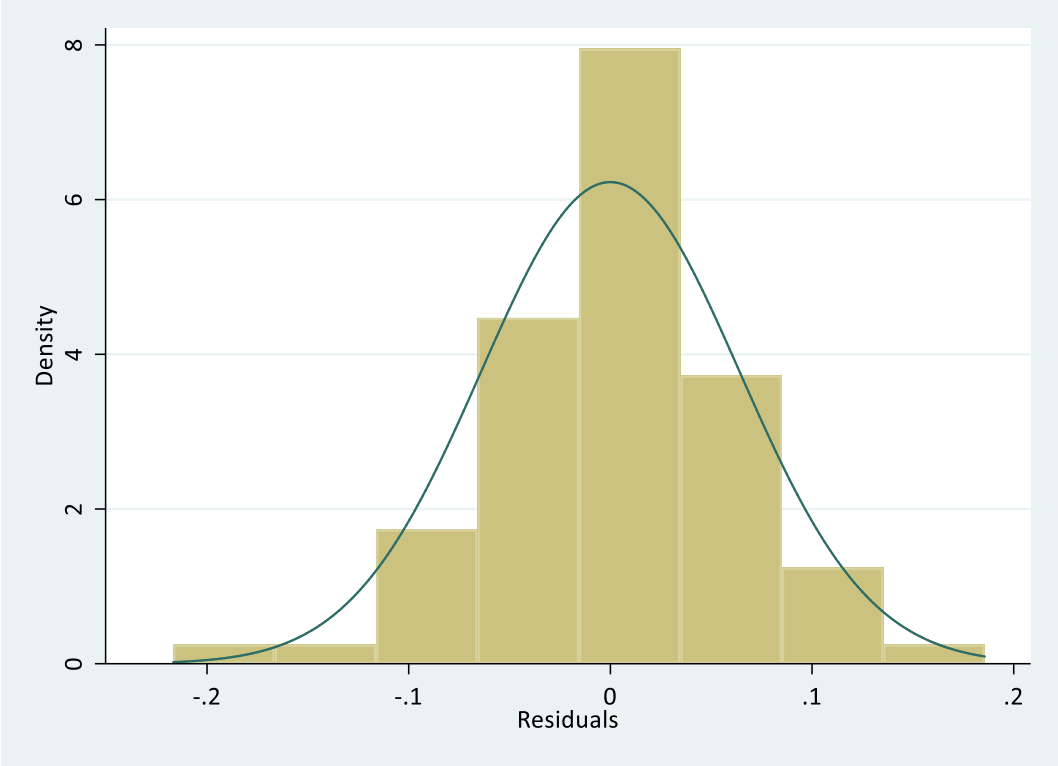


Key:	
	Research implementation
	Lecture periods
	Exams period

Assessment dates	Assessor Group Meeting Dates
26, August 2019	18, September 2019
30, September 2019	23, October 2019
28, October 2019	20, November 2019
29, January 2019	20, February 2020 tbc

Ethics dates to SPH Coordinator	HREC Submission Dates
31, August 2019	6, September 2019
29, September 2019	7, October 2019
31, October 2019	7, November 2019
13, December 2019 tbc	7, January 2019 tbc

ANNEX R: Distribution of residuals for linear mixed model



Shapiro wilk test: W = 0.98123 (p = 0.289>0.05), normally distributed.

ANNEX S: Null Model for the main effects results from linear mixed modelling comparing the overall quality of service performance from baseline to the post-test assessment by facility characteristics.

Site Characteristic	**Main effects results**			
	Coef.	**Std. Err**	**p-value**	**95% CI**
Assessment occasion				
Baseline	*reference*			
Reassessment	17.79%	1.73%	***	14.39% - 21.19%
Urban-rural classification				
Rural	*reference*			
Urban	11.64%	3.84%	**	4.12% - 19.16%
Facility Structure				
Fixed	*reference*			
Outreach	8.02%	3.57%	*	10.27% - 15.00%
Service delivery				
Campaign	*reference*			
Routine	0.67%	3.98%	0.865	-7.12% - 8.47%
Province				
Free State	reference			
Mpumalanga	5.36%	4.64%	0.248	-3.73% - 14.45%
North West	3.61%	3.57%	0.311	-3.38% - 10.60%
**significant, p<0.05*				
***significant, p<0.01*				
****significant, p<0.001*				

Annex T: NDOH CQI Assessment tool questionnaire hyperlink

Hyperlink to NDOH CQI Assessment tool questionnaire	https://www.knowledgehub.org.za/content/medical-male-circumcision

Annex U: Letter requesting Data Access

Right to Care
1006 Lenchen Ave North
Centurion

08 March 2020

Dear Sir/Madam

I am a student at the University of Witwatersrand in the School of Public Health. I am expected to carry out a research project as part of the requirements for the MSc in Epidemiology and Biostatistics. My research title is "Changes in the quality of voluntary medical male circumcision services in selected districts of the Mpumalanga, Eastern Cape, Free State and North West provinces of South Africa".

The research is aimed at evaluating changes in healthcare service quality for continuous quality improvement planning. The study will help in the identification of gaps and challenges associated with healthcare service quality in VMMC programs. Improving quality of service increases demand creation and client satisfaction.

I am therefore requesting for permission to carry out the study using Right to Care secondary data collected from 2018 to 2019. Both baseline and follow-up assessments data for program performance would be required to ensure successful implementation of the research project. Names of the health facilities shall be anonymised and data shall strictly be confidential and password protected.

Yours Sincerely

Tawanda Nyengerai
Email: tnyengerai@gmail.com
1129343@students.wits.ac.za
Mobile: 0658167237

Annex V: Letter Authorising Data Access

Treating Health Seriously

CONFIDENTIALITY AGREEMENT

The Right to Care Voluntary Medical Male Circumcision (VMMC) provides an essential and valuable services that adheres to Department of Health and donor's highest quality of care to men 10 years and older seeking male circumcision in selected districts in South Africa. RTC initiatives are data driven and as such has a strong research agenda, to assess program progress, identify bottlenecks and use data for planning and decision making. Any research can be conducted internally or by an external service provider. While engaging in these functions, researchers collect and/or may have access to program data which may entail personal and privileged information concerning individuals/ service providers associated with the Company. This requires a commitment to confidentiality to protect privacy. Unless there is a proper and appropriate request, including a request from the affected individual, unauthorised disclosure or access of this information could create a legal liability of confidence in the Company and VMMC program.

Accordingly, I, _____ **Tawanda Nyengerai**_____, hereby agree to treat the VMMC data with outmost confidentiality, not misuse, misinterpret such confidential and privileged information. Neither will I publish such information as a report or publication without proper authorisation from Chief of Party of VMMC.

I further agree that I will not release or discuss:

1. Any information from site quality assessments or other types of files or documents. Under no circumstances shallhealth facility names or scores, including the assessments or diagnosis, be released to other parties for further research.
2. The contents of discussions and conversations with VMMC personnel concerning quality of care standards assessments and results.
3. Copies of any of the above listed information or documents without an appropriate request from a Company official.

I am aware that I must manage the data, materials and records to which I may have access in a professional and confidential manner.

I fully understand that an intentional disclosure by myself of personnel records or personally identifiable information to any unauthorised person could subject me to penalties by Right to Care.

I understand that all persons (sites and service providers) have a right to privacy and will treat all sources and records as privileged. I understand that a violation of this agreement subjects me to disciplinary action, up to and including immediate termination of access to data provided.

ACCEPTANCE

Signed at (place) Centurion on this the 22 (date) day of June (month) in the presence of the undersigned witnesses:

Company Representative	Dr Khumbulani Moyo							
Signature								
Date	2	2	0	6	2	0	2	0

Witness	Motshana Phohole							
Signature								
Date	D	D	M	M	Y	Y	Y	Y

Signed at (place) 16 1st St, Vrededorp, Johannesburg on this the 17th (date) day of June, 2020 (month) in the presence of the undersigned witnesses:

Researcher	Tawanda Nyengerai							
Signature								
Date	1	7	0	6	2	0	2	0

Witness	Darlington S Mapiye							
Signature								
Date	1	7	0	6	2	0	2	0

Annex W: Map showing provinces with VMMC sites assessed.