Evaluating the Process and Output indicators for Maternal, Newborn and Child survival in South Africa:
A comparative study of PMTCT information systems in KwaZulu-Natal and the Western Cape

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Declaration

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

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Abstract

The prevention of mother-to-child transmission (PMTCT) of HIV is a key maternal and child health intervention in the context of the HIV/AIDS pandemic in South Africa. Accordingly, the PMTCT programme has been incorporated in the District Health Management Information System (DHMIS) that collects monthly facility-based data to support the management of public health services. To date, there has not been a comprehensive evaluation of the PMTCT information system. By comparing the experiences in two health districts, using the Performance of Routine Information System Management (PRISM) framework and tools, this study seeks to evaluate the availability, quality and use of process and output indicators for monitoring PMTCT interventions.

A comparative analytical and observational study was undertaken using a multi-method approach which included: a self-administered survey of health information personnel to assess confidence and competence levels for routine health information system (RHIS) tasks, an assessment of the routine PMTCT data for quality, completeness, accuracy, and data use; and a facility survey of RHIS processes and resources. In addition, in-depth interviews with 22 key informants and observations in health facilities were conducted. Data were collected from 57 health facilities in a convenience sample of two health districts, and also from 182 health information personnel in the 57 health facilities, three sub-districts, and two district offices. Descriptive statistics, χ^2-test, correlation and multiple regression analyses were conducted using STATA$^®$ Version 13. A general inductive approach was also used to analyse the qualitative data, which was used for triangulation.

The study revealed considerable data quality concerns for the PMTCT information with an average accuracy between the register and routine monthly report of 51% and between the routine monthly reports and DHMIS database of 84% suggesting that the primary point of departure for accurate transfer of data is during the collation process. The importance of human factors was emphasised by the observation that the average confidence level for performing RHIS-related tasks (69%) was not commensurate with the average competence levels (30%). Education was found to be associated with competence, implying that levels of education may be associated with the level at which RHIS competencies are acquired; and that three years or more of post-matriculation education is necessary. Motivation, on the other hand was not associated

with competence. The study observed the absence of processes such as data-quality checks and data-analysis in place in facilities. There was a general absence of a culture of information use, as a result of lack of trust in the data, and the inability of programme and facility managers to analyse, interpret and use information. We observed differences in the data accuracy by organisational authority, and multivariate analysis and qualitative information suggested that feedback may be an essential process to ensure quality.

Although the PRISM framework has been developed from a multi-disciplinary evidence base, this study has been able to validate some of the internal assumptions but has also found some aspects that were not supported such as motivation and data display. Data collected from a larger number of facilities will be required to investigate this further.

Institutional capacity to improve RHIS processes, ensure core competencies for RHIS-related tasks are needed, and in the longer term, measures to tackle problems associated with low pass rates in numeracy subjects among high school learners are needed. Further exploration of the possible factors that may influence data accuracy, such as supervision, training and leadership are needed as well as investigating the relationships between human and institutional agency-related aspects, in particular, how individual actions can bring about changes in institutional routines. Further study is needed to determine how decision for planning and evaluating key programmes such as PMTCT are made, and what informs such decisions if not routine data.

Opsomming

In die lig van Suid Afrika se MIV/VIGS-pandemie kan 'n ingryping op gesondheidsvlak 'n belangrike rol speel om moeder-na-kind-oordrag (beter bekend as PMTCT) van MIV te voorkom. 'n Inligtingstelsel vir distriksgesondheidsbestuur – die DHMIS – was ontwerp vir die invordering van maandelikse fasiliteitsdata, wat gebruik kan word om die bestuur van openbare gesondheidsdienste en -programme te ondersteun. Die inligtingstelsel self was nog nie omvattend evalueer nie. Hierdie studie het die ervarings van twee gesondheidsdistrikte vergelyk met behulp van die PRISM- (Performance of Routine Information System) raamwerk en -instrumente. Derhalwe het hierdie studie die beskikbaarheid, gehalte en gebruik van proses- en uitsetaanwysers probeer bepaal om die PMTCT-ingrypings te monitor.

'n Vergelykende analitiese en waarnemingstudie is onderneem met behulp van 'n veelvuldige benadering. Die verskillende metodes het 'n selfopname onder gesondheidsinligtingspersoneel ingesluit om hul selfvertroue en bevoegdheid in roetinegesondheidsinligtingstelsel (RHIS)-take te evalueer. Daar was ook 'n assessering van die PMTCT-roetinedata om datagehalte, -volledigheid, -akkuraatheid en -gebruik te beoordeel. 'n Fasiliteitsopname oor RHIS-prosesse en –hulpbronne was ook gedoen. Ander navorsingsmetodes het diepte-onderhoude met 22 sleutelpersone ingesluit, sowel as waarnemings in gesondheidsfasiliteite. Data is van 182 gesondheidsinligtingpersoneel van die 57 gesondheidsfasiliteite in 'n geriefsteekproef van twee gesondheidsdistrikte ingesamel. Deskriptiewe statistiek, $\chi 2$-toetsing, korrelasie en veelvoudige regressie is met behulp van STATA® weergawe 13 ontleed. 'n Algemene induktiewe benadering is ook gevolg om die kwalitatiewe data te ontleed.

Die studie toon dat menslike faktore 'n impak op datagehalte en -inligting kan hê, met 'n gemiddelde akkuraatheidsyfer van 51% van beide die register en roetine maandelikse verslae. Die akkuraatheid van die maandelikse verslae en RHIS databasis is 84%, wat aandui dat akkuraatheid slegs toegepas word indien inligting uit die staanspoor korrek aangeteken word. Die impak van menslike hulpbronafaktore was beklemtoon toe daar bevind was dat hoewel 69% van RHIS-dataverwerkers vertroue getoon het in die gebruik van RHIS-verwante take, slegs 30% wel bevoeg was om die werk te doen. Opvoeding was grootliks geassosieer met bevoegdheid, wat moontlik voorstel dat sekere vlakke van opvoeding benodig word vir spesifieke RHIS-bevoegdhede. Minsten drie jaar tersiêre opleiding word aanbebeel. Motivering was nie met

bevoegdheid geklassifeer nie. Die studie het bevind dat daar te min aandag aan datagehalte en – analise gegee word in fasiliteite. Oor die algemeen was daar nie 'n ordentlike kultuur van inligtinggebruik nie, a.g.v. die feit dat daar nie vertroue in die data was nie. Terselftertyd was program- en fasiliteitbestuurders nie bevoeg om inligting te analiseer en ontleed nie. Ons het verskille in die akkuraatheid van data opgetel wat deur organisasie-hoofde gedoen was. Meervoudige analise en kwalitatiewe informasie stel voor dat terugvoering 'n belangrike deel van die proses moet wees om kwaliteit te verseker.

Hoewel die PRISM-raamwerk saamgestel was uit 'n multi-dissiplinêre bewyslewering, kon hierdie studie sommige van die interne voorneme valideer, maar daar was aspekte wat nie gestaaf kon word nie. Inligting van 'n groter aantal fasiliteite sal benodig word om verder hierna ondersoek in te stel.

Institusionele kapasiteit word benodig om RHIS-prosesses te verbeter en basiese vaardighede vir RHIS-verwante take te verseker. Op langtermynvlak moet daar ook gekyk word na probleme wat lei tot laë slaagsyfers in syfervaardighede in hoërskoolleerders. Verdere ondersoek moet ingestel word om vas te stel watter faktore moontlik akkurate data teweeg kan bring. Dit sluit toesig, opleiding en leierskap, asook die verhoudings tussen menslike en agentskap-verwante aspekte in. Die feit dat optrede op individuele vlak veranderings in institusionele roetines kan aanbring, moet spesifiek na gekyk word. Verdere studies kan help om vas te stel hoe besluite vir beplanning en evaluaring vir hoofprogramme soos PMTCT gemaak word – asook hoe die besluite gemaak word indien hulle nie roetine voorafgaan nie.

Dedication

To my God, my lovely wife Jeannine, and the Okutinyangs:

You have always been my support and a source of inspiration. Thank you.

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List of Acronyms and abbreviations

3TC	Lamivudine
AIDS	Acquired Immunodeficiency Syndrome
ANC	Ante-natal clinics
APP	Annual performance plan
ART	Antiretroviral therapy
AZT	Zidovudine, *Retrovir*
BANC	Basic antenatal care
BBA	Birth before arrival
BE	Benefit evaluation
CD4	Cluster of differentiation 4
CDC	Community Day Centre
CDSS	Clinical decision support system
CEO	Chief Executive Officer
CHC	Community Health Centre
CHEATS	Clinical, human, educational, administrative, technical and social
CHIS	Computerised hospital information system
CNP	Clinical Nurse Practitioners
CoCT	City of Cape Town
CPOE	Computerised physician order entry
CRADLE	Central Reporting of all Delivery Data on Local Establishment
CREAM	Clear Relevant Economic Adequate and Monitorable
DC	Data capturer
DDIU	Data demand and information use
DEAT	Data Entry and Analysis Tool
DFID	Department for International Development
DHMIS	District Health Management Information System
DHIS	District Health Information System
DIO	District Information Officer
DM	District Manager
D&M	DeLone and McLean
DNA	Deoxyribonucleic acid
DoH	Department of Health
DoRA	Division of Revenue Act

DQA	Data Quality Assessment
EFV	Efavirenz
EPI	Expanded programme on immunisation
EPR	Electronic patient record
ESI	Enhancing Strategic Information
FIO	Facility Information Officer
FM	Facility Manager
FTC	Emtricitabine
GAMET	Global monitoring and evaluation team
GWME	Government-wide M&E system
HAART	Highly active antiretroviral therapy
HAST	HIV/AIDS, STIs and TB
HBC	Home-Based Care
HCT	HIV counselling and testing
HIO	Health Information Officer
HIS	Health Information System
HISP	Health Information System Programme
HIV	Human Immunodeficiency Virus
HIV+	Human Immunodeficiency Virus positive
HMN	Health Metrics Network
HOT-fit	Human, organisation and technology-fit
ICT	Information communication technology
IM	Information Management
IO	Information Officer
IS	Information System
IT	Information technology
KESS	Khayelitsha Eastern Sub-Structure
KZN	KwaZulu-Natal
LPV/RTV	Lopinavir/Ritonavir
MAT	Management Assessment Tool
MCH	Maternal and Child Health
MCWH	Maternal, Child and Women's Health
MERG	M&E Reference Group
MDG	Millennium Development Goals
MDHS	Metro District Health Services

M&E	Monitoring and Evaluation
MIS	Management information systems
MNCWH	Maternal, New Born, Child and Women's Health
MOU	Midwife Obstetric Unit
MS	Microsoft
MSM	Men having sex with men
MTCT	Mother-To-Child Transmission of HIV
NAP	National AIDS Programme
NDoH	National Department of Health
NGO	Non-governmental organisation
NHI	National Health Insurance
NHIS	National health information system
NHISSA	National health information system of South Africa
NIDS	National Indicator Data Set
NSDA	Negotiated Service Delivery Agreement
NSP	National Strategic Plan
NVP	Nevirapine prophylaxis
OBAT	Organisational and behavioural tool
OM	Operation manager
OTE	Opportunities for transcribing error
PCR	Polymerase Chain Reaction
PEP	Pathway for Evidence-Based Planning
PEPFAR	President's Emergency Plan for AIDS Relief
PGWC	Provincial Government of the Western Cape
PHC	Primary Health Care
PHCIS	Primary Health Computerised Information System
PIDS	Provincial Indicator Data Sets
PIO	Provincial Information Officer
PLWH	People living with HIV
PM	Programme Manager
PMTCT	Prevention of Mother-To-Child Transmission of HIV
PREHMIS	Patient Record and Health Management Information System
PRISM	Performance of Routine Information Systems Management
RC	Reference category
RHIS	Routine Health Information System

RMR	Routine monthly report
SD	Sub-district
SDM	Sub-district manager
SOP	Standard operating procedures
SS	Sub-structures
STI	Sexually Transmitted Infections
SW	Sex Workers
TB	Tuberculosis
TDF	Tenofovir disoproxil fumarate
TPC	Technology-to-Performance Chain
U5MR	Under 5 years mortality rate
UNAIDS	Joint United Nations Programme on HIV/AIDS
UNGASS	UN General Assembly Special Session on HIV/AIDS
VCT	Voluntary Counselling and Testing
VL	Visceral leishmaniasis
WC	Western Cape
WHO	World Health Organization

Glossary

Behavioural factors are important determinants of the routine health information systems (RHIS) that influence the quality of the information generated by the system. They refer to the knowledge, skills, attitudes, values, and motivation of the people who collect and use data.

Competence levels in RHIS tasks refer to a cluster of RHIS-related abilities, commitments, knowledge, and skills that enable a person to act effectively in RHIS-related tasks.

Confidence levels for RHIS tasks refer to one's perception of being certain about performing RHIS-related tasks.

Culture of information use is the capacity and control to promote values and beliefs among members of an organisation by collecting, analysing and using information to accomplish the organisation's goals and mission.

Data quality refers to the degree to which data or statistics measure what was intended to be measured when the data collection system was designed. Data is said to be of good quality if it is accurate, complete, timely, valid, consistent, and relevant.

Data accuracy is the degree to which data correctly reflects the real world object OR an event being described.

Data completeness is the extent to which the expected attributes of data are provided.

Data timeliness refers to the degree to which data represents reality from the required point in time.

Management functions refer to the presence of mechanisms for effectively managing RHIS functions and resources for better performance, and include indicators such as RHIS governance, use of quality performance standards, planning, training, availability of finance, and supervision.

MDG 4 – Reduce child mortality
Target A: Reduce by two-thirds, between 1990 and 2015, the under-five mortality rate.

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MDG 5 – Improve maternal health

Target A: Reduce by three-quarters, between 1990 and 2015, the maternal mortality rate

Target B: Achieve, by 2015, universal access to reproductive health.

MDG 6 – Combat HIV/AIDS, malaria and other diseases

Target A: Have halted by 2015 and begun to reverse the spread of HIV/AIDS

Target B: Achieve, by 2010, universal access to treatment for HIV/AIDS for all those who need it.

Motivation refers to the desire to carry out RHIS-related tasks, and is defined as the process that initiates, guides, and maintains goal-oriented behaviours.

Multicollinearity is a statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated, meaning that one can be linearly predicted from the others with a non-trivial degree of accuracy.

Organisational factors include the promotion of a culture of information, such as emphasis on data quality; use of information; evidence-based decision making; feedback from staff and community; a sense of responsibility, empowerment and accountability; promoting problem solving; and perceived reward from the Department of Health. They also include management functions at the facility level, such as RHIS governance, use of quality performance standards, planning, training, availability of finance, and supervision.

Output indicators refer to the immediate results obtained by programmes through the execution of activities.

Process indicators refer to the multiple activities that are carried out to achieve a programme's objectives.

RHIS governance is a management function that includes the display of the RHIS mission statement and the availability of an organisational chart showing functions related to RHIS/health information at the facility level.

RHIS finance was assessed by measuring the presence of any RHIS-related expense register, and monthly/quarterly financial report.

RHIS supervision involves the availability of any RHIS supervisory checklist, a schedule for supervisory visits, and supervisory reports at the facility level.

RHIS planning is the presence of any RHIS situation analysis report, and RHIS targets at the facility level.

RHIS training refers to the presence of a training manual and a training schedule for planned training.

Use of information refers to the analysis, synthesis, interpretation and review of data as part of decision-making processes, regardless of the source of data.

Use of quality/performance standard refers to the presence of a copy of RHIS Standard Operating Protocol: Performance Improvement Tools.

Chapter 1

Introduction

1.1   Background

1.1.1   Prevention of mother-to-child transmission of HIV programme in South Africa

South Africa has an extensive AIDS pandemic and HIV prevalence is highest among women of reproductive age (17.4%),[1] putting their unborn babies at risk of being infected; as a result, a high proportion of babies born to HIV-infected women is infected daily (about 25% to 40%).[2] A study has shown that in the absence of intervention, about 15% to 25% of transmissions of HIV will occur during pregnancy, 35% to 40% of transmissions during labour and delivery, and 5% to 20% during early and late breastfeeding.[2,3] This perinatal transmission of HIV can be significantly reduced through identifying women who are infected and providing them with a cocktail of a single dose of nevirapine (NVP), emtricitabine (FTC), efavirenz (EFV), tenofovir disoproxil fumarate (TDF), and zidovudine, *Retrovir* (AZT) before and after delivery, and the infant with nevirapine prophylaxis at birth and up to six weeks after birth. A Prevention of Mother-to-Child-Transmission (PMTCT) programme has been nationally available in South Africa since 2002,[4] and has been a component of the 2007–2011 HIV and AIDS national strategic plans (NSP).[5] The plan focuses on four priority areas, emphasising actions to scale up coverage of voluntary counselling and testing, improving the quality of prevention of mother-to-child transmission services, addressing issues relating to human rights, and setting up monitoring and evaluation systems to support the NSP. In addition, the latest strategic plan for 2012–2016 sets targets to reduce the rate of mother-to-child transmission (MTCT) of HIV to less than 2% at six weeks after birth and less than 5% at 18 months of age by 2016.[6]

More than a decade after the implementation of the PMTCT programme, estimates for 2012 report that 98% of women attending antenatal clinics had an HIV test,[7] indicating some progress in the coverage of PMTCT interventions. However, only 74% of children are tested for HIV;[8] 75% of HIV positive antenatal clients and 54% of identified HIV-exposed babies under 18 months were initiated on Highly Active Antiretroviral Therapy (HAART).[7] A recent survey evaluating the PMTCT programme concludes that despite universal coverage of infant HIV testing services in primary health care facilities, not all infants who are at risk of HIV benefit

from the programme.[9] Although there has been an increase in the uptake, the introduction of the B+ option (the latest WHO treatment regimen for managing PMTCT) requires that all HIV-infected pregnant women be put on HAART for life.[10] This has implications for the need for a proper health information system (HIS) to monitor drug toxicities, prescription adherence and drug resistance. Recent reviews of the PMTCT programme in South Africa[11,12] have highlighted some challenges with the implementation of the programme, such as the lack of data to monitor progress across the PMTCT cascade, and the fact that an important indicator (the MTCT rate at 18 months) to evaluate the currently NSP is unavailable.[11] Other challenges which may hinder monitoring of policy changes include issues relating to the alignment of the new PMTCT guideline with data collection tools such as registers and tally sheets, and lack of mentoring and inadequate supervisory support systems to facilitate the use of information at the facility level.[13]

In 1998, free health care for mothers and children was introduced by the South African government. The public sector caters for the majority of the population (about 80%) and will be the focus of this study.

1.1.2   Monitoring and evaluation of PMTCT programme in South Africa

Monitoring of the PMTCT programme is essential and must be supported by a robust information system. Despite investments made by several stakeholders and donor agencies such as the US President's Emergency Plan for AIDS Relief (PEPFAR) in information systems to support various components of HIV prevention and care in South Africa,[14] routine quality data still remains a cause for concern.[12,15,16] The South African National Department of Health (NDoH) has implemented a district-based information system; however, there are indications that the system is not providing the information required to manage the PMTCT and other priority programmes.

To improve programmes aimed at scaling up coverage of PMTCT interventions, it is necessary to understand how well these programmes are implemented, to what extent planned activities are being realised, and whether the programmes are making progress towards achieving their initial targets.[17] These activities will enable policy makers and PMTCT programme managers to make necessary changes within the programmes' components and enable them to identify determinants of successes or failures of implemented programmes.[18] Studies have highlighted the importance of process[19,20,21,22,23,24] and output[25] indicators for monitoring programmes. The advantages of process indicators over outcome indicators is that process indicators are easy to

interpret, and are more sensitive to differences in the quality of care. The NDoH is putting more emphasis on outcome indicators; nonetheless to improve performance on outcome indicators, it is appropriate to evaluate the process and output indicators to ensure that activities set out to improve outcomes are carried out as planned; hence improvement in process and output indicators will in turn impact on the outcome indicators. Therefore evaluating the *process indicators* (the multiple activities that are carried out to achieve a programme's objectives) and the *output indicators* (the immediate results obtained by the programme through the execution of activities) will help identify where there are problems with the implementation of the PMTCT policy guidelines and programmes aimed at scaling up coverage of interventions.

1.1.3   The District Health management Information System

The South African national Department of Health has adopted the district health information system (DHIS), a free and open source software developed by the Health Information System Programme (HISP)[26,27] and used widely in several low- and middle-income countries, to collect monthly facility-based data from the public sector primary health services and district hospitals.[28] It provides information for all levels of the healthcare system in relation to planning, budgeting, health services management, monitoring and evaluation. The system, which was introduced in South Africa in 1996, and rolled out in all nine provinces by 2001, has become synonymous with the District Health Management Information System (DHMIS),[29] and is considered a management information system, where financial and personnel data can be incorporated.[30] The District Health Information System is now a central component of the South African Health Management Information System,[28] and is an important tool for the delivery of the Negotiated Service Delivery Agreement (NSDA) of the health sector. An updated version of this system has been developed; the DHIS2[31] builds on the earlier version and incorporates an integrated web-based open-source platform for data collection, management and analysis. However, the DHIS2 still requires manual collection of data at the facility level, the source of data entry into the system, which is used in more than 46 countries in four continents, including Africa and Asia.

1.2   Statement of the problem

The *Every Death Counts* report[32] and subsequent studies[33,34] highlight the impact of HIV/AIDS on South Africa's mortality trends and have stressed the need to strengthen and improve the programmes directed at maternal, new-born and child survival, as well as gaps in the continuum

of care and the incompleteness in coverage of some programmes. Systems have been put in place to scale up coverage of interventions that have been proved to be effective in reducing maternal, new-born and child survival in low- and medium-income countries.[35] Unfortunately, these interventions are not reaching those vulnerable mothers and their children who are in desperate need of them.[36,37] Yet, tracking coverage of these interventions is challenging, owing to a lack of accurate and reliable data needed by managers and policy makers at the district and provincial levels for planning and management purposes.[38,39] For example, the lack of national or provincial data on the proportion of children receiving co-trimoxazole prophylaxis or children 0–14 years receiving ART, makes it difficult to say for certain which province or district needs to be strengthened in terms of the rollout of the interventions. Furthermore, an attempt to assess trends in coverage of key high-impact maternal, new-born and child survival interventions identified in the *Countdown to 2015* initiative,[36] has identified several data gaps as well as data quality issues.[16] Another study conducted in 2009 also found that the PMTCT routine statistics from three large, high-HIV-prevalence districts were neither complete nor accurate.[15] The authors of this study concluded that the routine data were not a viable means to track process performance or outcomes for PMTCT.

South Africa, through the 2007–2011 HIV/AIDS and STI National Strategic Plan,[5] has set out targets in four priority areas, emphasising 'actions to scale up coverage, improve the quality of prevention of mother-to-child transmission services', and set up monitoring and evaluation systems to support the NSP. However, relevant data for monitoring PMTCT programmes which may also be a generic issue to other programmes, and in other countries has been shown to be inaccurate, incomplete, or of poor quality.[15,16,40] An attempt to assess trends in coverage of key high-impact maternal, new-born and child survival interventions (immunization, PMTCT, and nutrition) with a view to identifying key policy and programmatic areas in each province, identified discrepancies observed between routinely collected data and survey data that were ascribed to data quality issues.[16]

Several studies[32,34,41] have highlighted the importance of maternal and child health interventions as essential to meet the millennium development goals (MDGs) 4, 5, and 6. However, there are challenges in monitoring these interventions due to inaccurate and unreliable statistics.[15,16,38,39,42,43] Despite the South African national Department of Health's emphasis on outcome indicators for tracking progress of maternal and child health programmes, the importance of process and output indicators for improving the quality of PMTCT care cannot be over emphasised. There is an urgent need for reliable data and process and output indicators to

monitor PMTCT interventions in maternal, new-born and child health to assess whether the activities outlined in the national strategic plan to scale up these interventions are being implemented as planned.

1.3   Rationale for the study

Process and output indicators are usually obtained from routine health information system (RHIS), and are needed to ensure that activities set out to improve outcomes are carried out as planned. Improvement in process and output indicators will in turn impact on the outcome indicators. The NDoH has outlined ambitious targets in the 2012–2016 HIV/AIDS, STI and TB National Strategic Plan.[6] It is not clear whether appropriate process and output indicators have been identified and whether the information systems in the health services will provide quality data. Furthermore, the NDoH is in the process of piloting the National Health Insurance (NHI) scheme; to ensure a successful implementation of the NSDA and the NHI, there is a need to evaluate and improve the health information component of the health system, specifically addressing the issues surrounding the lack of accurate and reliable data that are needed to monitor PMTCT programmes.

Audits of the human resources[44,45,46] and equipment[47,48,49] to support the DHMIS in South Africa have been undertaken, and have highlighted the challenges faced by facilities with inadequate resources such as functional computers, printers, limited availability of data collection tools, and registers. Issues around staff shortages and inadequate skills for collecting and processing information were also highlighted. Despite findings from these studies, there has not been a comprehensive evaluation of the DHMIS implementation as at the time of this study (2012).

Most studies on the evaluation of health information systems' (HIS) performance primarily focus on technical and organisational issues or clinical processes[50,51,52,53] and generally fail to explain the determinants of HIS successes or failures in different settings. Very few studies have examined the 'people' aspect of HIS, and these only focus on the availability of human resources[44,45,46,49] and not on competence and motivation, nor use of data for decision making and improving services. In spite of the demands for quality data, routine health information systems (RHIS) in many resource-limited settings continue to perform below expectations, and are often not used for their intended purposes of generating accurate and reliable data; where data is generated, the information is not sufficiently used for planning and management purposes.

One of the challenges of routine health information systems (RHIS) in low- and middle- income countries in particular, revolves around nurses, who are faced with the dilemma of seeing patients and compiling monthly statistics due to the lack of human resources. A major concern is that clinic personnel, such as nurses, have multiple responsibilities, including primary clinical responsibilities, which may interfere with the time they allocate to data collection.[45] Clinic staff may value the care of patients over data collection; hence data collection may be completed many days after the event has occurred,[91,92,150,151] and this time lag may impact on the quality of the statistics nurses produce.

Another concern is that at the facility level, there are numerous registers and tally sheets that need to be collated, summarised and sent to the sub-district level.[48] Training is not usually provided for clinic staff involved in data-collection processes, who frequently have very limited data quality checking skills and do not understand the value of the data being collected, as such data captured into the RHIS may be of low quality. Studies have shown that data from the RHIS are inaccurate, and data collection methods are not complete.[15,16,39,54,55] In the case of the district health information system (DHIS), the data are collected at the facility level in paper format and captured into electronic format (Microsoft Excel) at the sub-district level, which is then imported into the DHIS at the district level. Consequently, there are a number of opportunities for transcribing errors, particularly when these tasks are performed in unconducive environments, like the spaces the nurses work in.

Several studies have highlighted the importance of organisational factors in determining the performance of routine health information systems.[56,57,58] The performance of routine information system (PRISM) framework postulates that RHIS performance is affected directly or indirectly by organisational factors through behavioural factors, and these factors have been defined[59] (p. 221) as " all those factors that are related to organisational structure, resources, procedures, support services, and culture to develop, manage and improve RHIS processes and performance". Organisational factors include the promotion of a culture of information, such as emphasis on data quality; use of information; evidence-based decision making; feedback from staff and community; a sense of responsibility, empowerment and accountability; promoting problem solving; and perceived reward from the Department of Health. They also include management functions at the facility level, such as RHIS governance, use of quality performance standards, planning, training, availability of finance, and supervision.

The NDoH has identified 18 priority districts and sub-districts classified as the most deprived, having the highest burden of HIV, with the poorest health status, and poor access to health care and health service delivery. This comparative study therefore focuses on two health districts, each incorporating one of the eighteen priority sub-districts identified by the NDOH. By comparing the experience in a health district in KwaZulu-Natal with that in a district in the Western Cape, this project seeks to evaluate the availability, quality and use of process and output indicators for monitoring PMTCT interventions in maternal, new-born and child health, and the Routine Health Information System that supports it. It also seeks to identify the information challenges in monitoring PMTCT programmes and improve the current status of the routine health information systems.

1.4   Research questions

RHIS performance has been defined in the literature[59] (p 219) as 'improved data quality and continued use of information'. It is based on the premise that better monitoring and evaluation of maternal and child health HIV programmes will lead to improved programmes and health information systems, and in turn will improve the quality of maternal and child health. To achieve quality improvement, process and output indicators for delivering maternal and child survival are critical and need to be evaluated. This operations research seeks to address the following research questions:

1. How does the Health Management Information System at the district level function and how can it be strengthened to make it more supportive of the PMTCT programmes?

2. What can be done to improve the quality of reporting and analysis of PMTCT programme performance data at the health facility level using the DHMIS?

3. What are the main causes of lack of information for management, and why are the gaps occurring? Are these gaps structural, or a result of a breakdown in data flow from the health facilities to the districts, or a result of inaccurate and incomplete reporting, or lack of analysis of data, or limited usage by health care providers and managers?

1.5   Aims and objectives of the study

The main goal of this study is to evaluate the availability, quality and use of process and output indicators for monitoring and evaluating HIV interventions in maternal, new-born and child health, and to identify the information challenges in monitoring PMTCT programmes in KwaZulu-Natal (KZN) and the Western Cape (WC). Based on the comparison of the two districts, the overall purpose is to identify recommendations for improving the ability of health services to strengthen the information systems to monitor PMTCT programmes.

1.5.1   Specific objectives

1. To map the routine health information system in two districts (Amajuba and part of the Cape Metro/City of Cape Town), to investigate what is currently being used in monitoring progress on PMTCT programmes, and to identify information gaps at different levels.

2. To investigate use and barriers to the use of routine health information for monitoring progress on maternal and child health HIV indicators.

3. To measure the performance of the District Health Information System for PMTCT process and output indicators in terms of data quality measured in terms of data accuracy, completeness, and timeliness, at both the facility and district levels.

4. To assess the behavioural and organisational determinants affecting the performance of the District Health Management Information System.

1.5.2   Study components

The study is divided into four components that are linked to each of the research objectives (Figure 1.1).
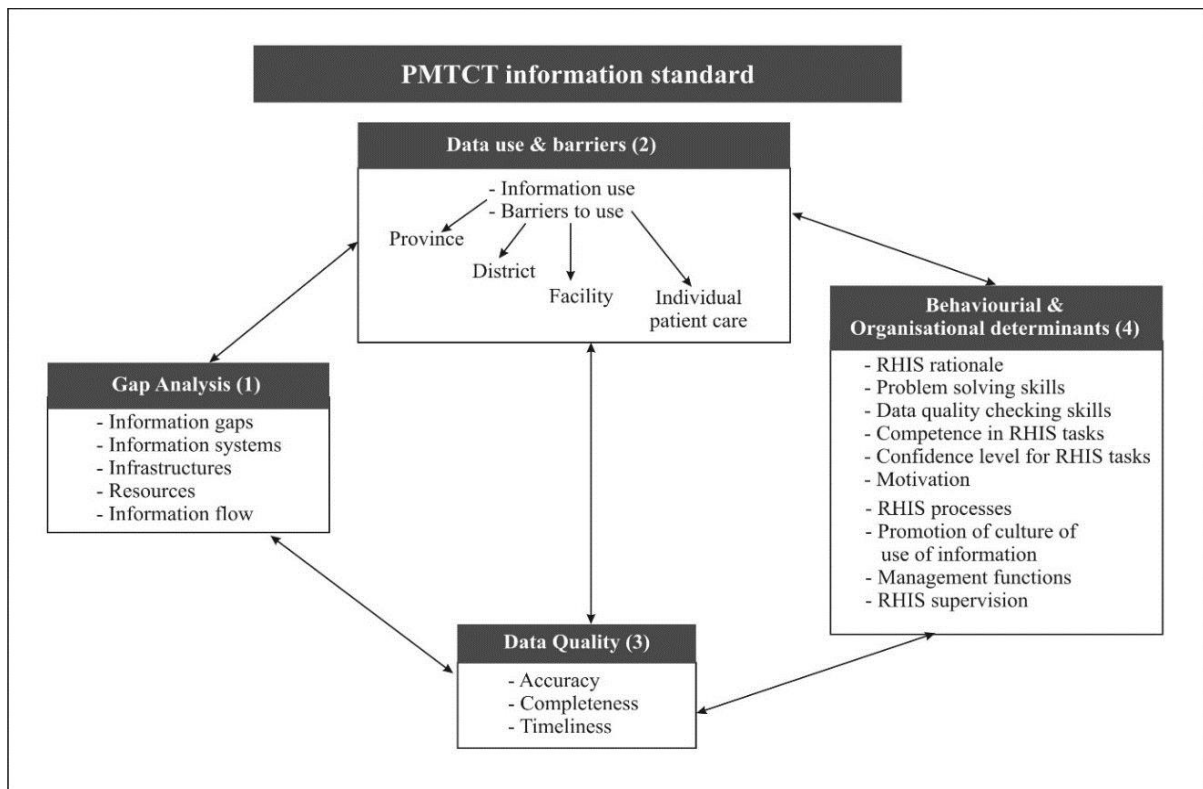
Figure 1.1: Study component for evaluating routine PMTCT information performance

1.6   Chapter outline

Following the general overview given in this chapter, which includes the introduction, problem statement, rationale, research questions, as well as the aims and objective of the this study, *Chapter 2* describes the review of literature on the PMTCT programme in South Africa, and a review of frameworks for evaluating maternal and child health HIV services. The chapter also reviews indicators, data elements and data sources for the PMTCT programme. In addition, reviews on health information system (HIS) evaluation were described. These include HIS evaluation frameworks, data quality issues, information use, HIS resources and behavioural determinants of the success of the health information system. *Chapter 2* concludes with a summary highlighting the theoretical framework that will be used in this study.

Chapter 3 describes the methodology used in this study and describes the study design, population, sample method and sample size, including the characteristics of the study sites and the facility and health personnel survey. The study will substantively draw on the PRISM tools and in-depth interviews to investigate the use of information, barriers to the use of information, the performance of the health information system, and determinants affecting the District Health Management Information System in terms of the PMTCT programme. The chapter describes the

PRISM data collection tools used in this study, which consist of four instruments: Performance Diagnostic Tool, Overview and Facility/Office Checklist, Management Assessment Tool (MAT), and the Organisational and Behavioural Assessment Tool (OBAT). The chapter also describes the data entry and the analysis processes for each of the objectives, and concludes with a section on the scope and the limitations of the study.

Findings related to objective 1 are presented in *Chapter 4* which include a map of the district health information systems in the two districts reviewed: Amajuba (KZN) and the Cape Metro/City of Cape Town (WC). It describes the different systems currently in place for monitoring progress on HIV programmes in maternal, newborn and child health, and the data flow from the facilities to the provincial level, including the registers from which the 20 PMTCT priority data elements are derived. In conclusion, information gaps at different levels of care were identified.

Chapter 5 investigates use of data and barriers to using health information for monitoring maternal and child health HIV indicators, and describes the information gaps at different levels of care, highlighting why data are not used at the district and facility levels to monitor progress in PMTCT programmes.

Chapter 6 presents the gaps in the PMTCT data and also describes the data quality issues identified in each of the three authorities at the facility and district levels. In addition, trends in the PMTCT data elements are described. Factors associated with data accuracy at the facility level were also identified. Finally, the chapter concludes with a discussion on the implications of the study results.

In *Chapter 7*, behavioural and organisational determinants of the District Management Health Information System (DMHIS) performance are presented. This includes knowledge of the rationale for the routine health information systems (RHIS), problem-solving skills, data-quality checking skills, competence in RHIS tasks, motivation, and promotion of the use of information. Organisational and management functions such as supervision, RHIS processes and barriers are also described.

Finally, *Chapter 8* gives a summary and an interpretation of major findings, including the significance of the study, the contribution to knowledge, and provides recommendations, and insights for future research.

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Chapter 2

Literature Review

2.1   Introduction

Several topics related to routinely collected process and output indicators for maternal, newborn and child survival were identified for the literature review of this study. The three major components are: 1) the provision of the prevention of mother-to-child transmission of HIV (PMTCT) programme in South Africa; 2) frameworks for evaluating maternal and child health programmes, specifically focusing on the PMTCT programme; and 3) evaluation of health information systems (HIS) in resource-constrained settings including HIS resources, behavioural and organisational aspects of HIS, data quality, information use, and HIS frameworks.

2.2   PMTCT in South Africa

Generally, there has been substantial progress towards alleviating the HIV epidemic since its emergence in the early 1980s. In Sub-Saharan Africa, there was a decline of more than 25% new infections in 22 countries between 2001 and 2009.[60] Despite this decline, South Africa remains the country with the highest HIV prevalence in the world. Facility estimates from the 2012/13 district health information system (DHIS)[8] show antenatal HIV prevalence to be 27.3% putting high proportion of unborn babies at risk of being infected. In the absence of an intervention, about 25% to 40% of infants born to HIV+ mothers will be infected.[2] Transmission occurs through different processes, with 10% to 25% occurring during early and late pregnancy, 35% to 40% of during labour and delivery, and 35% to 40% during early and late breastfeeding.[3] The perinatal transmission of HIV can be averted through identifying women who are infected with the virus and providing the mother-infant pair with a prescribed regimen of antiretroviral therapy before and after delivery.

In 1999, the first South African PMTCT intervention was implemented in the public sector in Khayelitsha, (Western Cape) and then piloted in 18 other sites in 2001 to evaluate the implementation in the local setting.[61] A court order required the scale-up of the programme in the public sector,[62] which became nationally available in March 2002.[4] From 2002 until 2013,

PMTCT interventions,[10,63] guidelines,[64,65,66] and an action framework[67] have been implemented and modified to provide better care for mothers and infants. This is based on a comprehensive and complex care programme that starts before pregnancy but has a strong focus during antenatal care and continues beyond the delivery of the baby through the period of infant feeding (*Table 2.1*). The latest programme includes 'routine HIV testing and counselling for pregnant women, dual therapy to prevent mother to child transmission of HIV, highly active antiretroviral therapy (HAART) for pregnant women with CD4 cell count ≤350 cells/µl, postnatal infant prophylaxis for HIV-positive mothers who breastfed, and intensified efforts to integrate PMTCT services into routine maternal and child health (MCH) services'.[66] As a result of recommendations to integrate the PMTCT programme into maternal and child health services, the NDoH has included in its National Action Framework for 'No child born with HIV by 2015 and Improving the Health and Wellbeing of Mothers, Partners and Babies in South Africa' plans to integrate the programmes.[67]

Table 2.1: Processes and goals of PMTCT interventions

Women in the Reproductive age group	**Antenatal Care**	**Labour & Delivery**	**Postnatal Care**
• Improve the quality of sexual and reproductive health services • Improve access to family planning services • Improve access to safer sex options • Prevent transmission of HIV infection • Improve access to HCT services to know HIV status	• Improve the quality of the mother's health and prevent mortality • Identify women who are HIV+ • Ensure all HIV+ women enter the PMTCT programme • Prevent mother-to-child transmission • Provide ART as soon as HIV positive status known, in pregnancy for maternal health and to reduce HIV transmission to the baby	• Provide HCT services to all women with unknown status • Identify HIV+ women • Provide adequate PMTCT coverage • Continuity of care with prophylactic and treatment ARV regimens • Initiate neonates born to HIV+ mothers with ARVs immediately at birth • Establish safe infant feeding practices supporting exclusive breastfeeding and kangaroo mother care for all mothers & infants	• Provide follow-up post-partum care including a postnatal visit within 3-6 days • Improve the quality of the mother's health and reduce mortality by including family planning counselling and cervical cancer screening where applicable • Provide post-exposure prophylaxis for infants • Reduce postnatal HIV transmission through breastfeeding • Identify all HIV-exposed infants • Reduce mortality in HIV-exposed infants • Identify all HIV+ infants and start HAART early

Source: Adapted from PMTCT Guidelines (2013)[66]

Another milestone of the PMTCT programme, which is in line with plans of the latest National Strategic Plan to reduce the MTCT rate 'to <2% at six weeks after birth and <5% at 18 months of age by 2016',[6 (p 40)] is the introduction of the B+ option (*Table 2.2*). This option requires that all HIV pregnant women be put on HAART for life, regardless of their CD4 count.[63, 68] One

advantage of this option is that CD4 testing will no longer be required to determine a woman's regimen eligibility; however, this has cost implications,[69] and the need for a proper health information system (HIS) to monitor service delivery, drug toxicities, prescription adherence and retention, and drug resistance. The current PMTCT treatment regimen is presented in *Appendix A*, categorised into maternal and infant regimens.

Table 2.2: WHO options for PMTCT programmes

	Woman receives:		Infant receives:
	Treatment (for CD4 count ≤350 cells/mm³)	**Prophylaxis** (for CD4 count >350 cells/mm³)	
Option A[a]	Triple ARVs starting as soon as diagnosed, *continued for life*	*Antepartum*: AZT starting as early as 14 weeks gestation *Intrapartum*: at onset of labour, sdNVP and first dose of AZT/3TC *Postpartum*: daily AZT/3TC through 7 days postpartum	Daily NVP from birth through 1 week beyond complete cessation of breastfeeding; or, if not breastfeeding or if mother is on treatment, through age 4–6 weeks
Option B[a]	*Same initial ARVs for both*[b]:		Daily NVP or AZT from birth through age 4–6 weeks regardless of infant feeding method
	Triple ARVs starting as soon as diagnosed, *continued for life*	Triple ARVs starting as early as 14 weeks gestation and *continued intrapartum and through childbirth if not breastfeeding or until 1 week after cessation of all breastfeeding*	
Option B+	*Same for treatment and prophylaxis*[b]:		Daily NVP or AZT from birth through age 4–6 weeks regardless of infant feeding method
	Regardless of CD4 count, triple ARVs starting as soon as diagnosed,[c] *continued for life*		

Note: "Triple ARVs" refers to the use of one of the recommended 3-drug fully suppressive treatment options.

[a] Recommended in WHO 2010 PMTCT guidelines

[b] True only for EFV-based first-line ART; NVP-based ART not recommended for prophylaxis (CD4 >350)

[c] Formal recommendations for Option B+ have not been made, but presumably ART would start at diagnosis.

Source: WHO[68]

It is now considered that zero HIV transmission from mother to child can be achieved if all women of childbearing age, including all pregnant women and their babies, are able to access the full cascade of the PMTCT interventions.[70,71] Ten years after the implementation of the PMTCT programme, estimates as of 2012,[7] report that in South Africa, 98% of women attending antenatal clinics had an HIV test. However, only 75% of HIV positive antenatal clients and 54% of identified HIV exposed babies under 18 months were initiated on Highly Active Antiretroviral Therapy (HAART).[7] Despite the coverage of clients initiated on HAART,

there has been a significant reduction in the national average of the MTCT rate at six weeks to <3%.[8, 9,72]

To provide the best care and save the most lives, linkages across the time periods and places for care giving are crucial.[73] A health service delivery framework based on the continuum of care, from before conception through pregnancy, childbirth, the post-natal period and childhood has been developed.[41] It includes the levels of care from community based, through primary health care facilities and hospitals. This creates a structural issue that poses a challenge for the implementation of the PMTCT intervention since clients have to move from one care provider to the other to get the full range of interventions; and where there are no follow-ups, some patients are likely to drop out of care.

Given that the PMTCT programme is implemented across several health care platforms, the supporting information system needs to accommodate the separate platforms. While it would be ideal to use a cohort register based at a single facility, the current situation is such that PMTCT information is conveyed between different care providers by means of stamps on the 'Road-to-Health Card'. This makes data transfer between facilities offering the different aspect of care difficult, creating opportunities for incomplete, duplicate and unreliable data. [74] Despite numerous challenges faced with monitoring the PMTCT programmes, studies[72,11,12,75] have indicated that the mother-to-child transmission rate in South Africa has declined to <3% nationally.

2.3   Frameworks for evaluating PMTCT programmes

2.3.1 Monitoring and evaluation

A monitoring and evaluation (M&E) system is a managerial tool used for planning purposes, for decision making, and for assessing and improving programme implementation. Many definitions of monitoring and evaluation have been found in the literature: Gage et al.[76] [(p 6)] defines monitoring as 'the routine tracking of a programme's activities by measuring on a regular, on-going basis whether planned activities are being carried out', to inform day-to-day programme management decisions. The aim of a monitoring system, according to Gage et al.[76] [(p 6)] is to inform managers, through regular feedback, to assess:

'whether programme activities are being implemented according to plan and at what cost, how well the programme is functioning at different levels, the extent to which a programme's services are being used, whether interim targets are being met, and whether key performance measures are changing.'

Evaluation, on the other hand, [77] [(p 125)] is 'the periodic assessment of the relevance and performance of a programme, and its impact'. It consists of the collection of information about the 'activities, characteristics, and outcomes of programmes to make judgements about the programme, improve programme effectiveness and/or inform decisions about future programming'.[78] [(p 10)] To achieve these, evaluation studies should be able to provide useful and reliable information about the programme. In practice, the main difference between monitoring and evaluation is that monitoring is a continuous, on-going process, which focuses on tracking performance, and answers questions such as, 'what is going on?', whereas evaluation is time bound and periodic, focusing on judgement, learning and merit. Evaluation answers questions such as, 'Why do we have the results indicated by the monitoring data?' Five types of evaluations have been identified in the literature: Formative, Summative, Process, Outcome and Impact evaluations; and these are conducted at different stages of a programme for various purposes.[79]

The Logic Model, also known as a theory of change, is a graphical representation of the causal relationships between different components of a programme. *Table 2.3* outlines the five components of a monitoring and evaluation system, which follows the Logic Model framework principles - Inputs, Processes/activities, Outputs, Outcomes, and Impacts.[79] According to this model, inputs such as resources e.g. funds and trained personnel are allocated and processes are implemented to achieve planned targets. It is logical to imply that if activities are not carried out and implemented as planned, the expected results (outcome and impact) will not be achieved. However, there are dependencies and threats involved in this model, which makes it very useful for monitoring and evaluation.

Table 2.3: Basic logic model and components of a monitoring and evaluation system

IMPLEMENTATION			RESULTS	
Input	**Activity/Process**	**Output**	**Outcome**	**Impact**
What do we need to do the work?	What are we going to do? How are activities linked in a coherent way?	And what was the first thing that happened? (Results of the activities at the programme level)	And then what happened? (What we wish to achieve).	So what? (Anticipated end result).
❖ Resources that are the basic materials for the programme. E.g. funds, staff, drugs, policies and protocols for PMTCT.	❖ It is possible to have a high level of inputs but a poorly delivered programme. E.g. number of health personnel trained to deliver PMTCT services according to national and international standards.	❖ Direct consequences of inputs such as products and services delivered. E.g. increase access to ARV treatment.	❖ Intermediate or direct consequences of output on clients. E.g. improve quality of life for PLHIV.	❖ Long-term results at the population level. E.g. reducing U5MR from HIV.

Source: Adapted from Kusek & Rist 2004[79]

PLHIV: People living with HIV; **U5MR:** Under 5 year mortality rate; **ARV:** Antiretroviral prophylaxis

2.3.2   Policy environment for PMTCT

Several national and international policy guidelines influence the PMTCT programme (*Table 2.4*). Paramount among these guidelines is the South African National Department of Health (NDoH) Clinical Guidelines[66] which build upon the 2010 and 2008 national PMTCT Policy and Guidelines.[64,65] The updated policy guideline focuses on the following World Health Organisation's (WHO) four-pronged strategy for PMTCT: [80]

- primary prevention of HIV, especially among women of child-bearing age
- preventing unintended pregnancies among women living with HIV
- preventing HIV transmission from a woman living with HIV to her infant and
- providing appropriate treatment, care, and support to women living with HIV and their children and families.

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Table 2.4: Policy environment for PMTCT monitoring and evaluation

	Policy	Relevance
	National	
1	Monitoring and Evaluation Framework for Comprehensive HIV and AIDS Care, Management and Treatment Plan for South Africa (2004)[81]	This framework aims to: • provide comprehensive care, management and treatment for people living with HIV and AIDS; and • facilitate the strengthening of the national health system in South Africa.
2	The Government Wide M&E system (GWME) (2007)[82]	This policy provides a framework for monitoring and evaluation at all levels of government.
3	Framework for Measuring Programme Performance Information (2007)[83]	These guidelines aim to: • clarify definitions and standards for performance information in support of regular audits of such information where appropriate; • improve integrated structures, systems and processes required to manage performance information; • define roles and responsibilities for managing performance information promote accountability and transparency by providing parliament, provincial legislature, municipal councils and the public with timely, accessible, accurate performance information.
4	HIV/AIDS and STI Strategic Plan for South Africa (2007-2011) 2008[5]	This plan represents SA's multi-sectoral national response to the challenge of HIV/AIDS and is managed by various structures at various levels, both inside and outside the government services. Monitoring and surveillance is one of the four priority areas identified in this plan. The PMTCT targets are to: • broaden existing mother-to-child transmission services to include other related services and target groups; and • scale up coverage and improve quality of PMTCT to reduce MTCT to less than 5%.
5	National Action Framework for 'No child born with HIV by 2015 & Improving the Health and Wellbeing of Mothers, Partners and Babies in South Africa' (2011)[67]	This framework links current policy and the implementation of PMTCT services integrated with Maternal, New Born, Child and Women's Health (MNCWH) services with a five-year target. The strategic objectives are: • Strengthening management, leadership and coordination for integrated PMTCT & MNCWH programmes; • Scaling up PMTCT coverage and improving quality to reduce MTCT to less than 2% at 6 weeks and less than 5% at 18 months; • Facilitating integration of PMTCT into PHC/MNCWH services; • Strengthening monitoring and evaluation of the programme; • Increasing awareness and community involvement in the integrated programmes.
6	National Strategic Plans HIV/AIDS and STI Strategic Plan for South Africa (2012-2016) 2013[6]	This strategy is built around a bold 5-year vision, namely: • Zero new HIV and TB infections; • Zero deaths associated with HIV and TB; • Zero discrimination related to HIV and TB. PMTCT targets include: • Reducing MTCT to <2% at six weeks after birth and < 5% at 18 months of age by 2016. • Strengthening the management, leadership and coordination of the PMTCT programme and ensuring integration with MCH programmes. • Integration of TB screening into PMTCT programme. • Strengthening screening and treatment of syphilis to eliminate neonatal syphilis.
7	National Department of Health Clinical Guidelines for PMTCT (2013)[66]	• This policy focuses on the four prongs of the Prevention of Mother-To-Child Transmission of HIV (PMTCT), which provides the basis for the PMTCT processes and intervention goals.

	Policy	Relevance
	International	
8	Millennium Development Goals (MDG's) 2000.[84]	This global project, aimed at reducing extreme poverty in all its dimensions, provides a framework for monitoring progress towards meeting the MDG's. Goals 4, 5 and 6 are directly linked to health care. Goal 4 to reduce child mortality rate has a direct bearing on PMTCT. In addition, goal 6 to reduce the burden of HIV/AIDS has a direct bearing.
9	UNGASS (2001)[85]	The specific objectives are to: • halt and reverse the spread of HIV, especially among young people; • stop the transmission of HIV from mother to child; • put care and treatment within everyone's reach; • deliver scientific breakthroughs; and • protect those made most vulnerable by the epidemic, especially AIDS orphans.
10	UNAIDS Core Indicators for National AIDS Programmes (2008)[60]	• Presents the 40 core indicators that provide minimum necessary information for national-level monitoring of HIV epidemics and response, and provides detailed specification and guidance on the 15 indicators recommended in addition to the 25 UNGASS indicators.
11	The Global Fund to Fight HIV/AIDS, Malaria and Tuberculosis (2011)[86]	The Global Fund's system for performance-based funding was developed to: • link funding to the achievement of targets and objectives; • ensure that money is spent on services delivered to the intended beneficiaries; • provide incentives to encourage recipients to focus on programmatic results and timely implementation; • encourage learning to strengthen capacities and improve programme implementation; • invest in measurement systems and promote the use of evidence for decision making; • provide policies and tools for grant oversight and monitoring within countries and by the Global Fund.
12	The President's Emergency Plan for AIDS Relief (PEPFAR) 2013[87]	Reflects PEPFAR's strategy to improve metrics and monitoring and evaluation (M&E), increase country ownership of HIV/AIDS efforts and ensure that host countries are at the centre of decision-making, leadership, and management of their HIV/AIDS programs.

2.3.3   Monitoring and evaluation frameworks for PMTCT

Various monitoring and evaluation frameworks are linked to policies implemented to improve the PMTCT programmes. These policies and frameworks have been developed by organisations such as the UNAIDS Core Indicators for National AIDS Programmes,[60] PEPFAR Next Generation Indicators Reference Guide,[87] the UN General Assembly Special Session on HIV/AIDS (UNGASS),[85] the Global Fund to Fight HIV/AIDS, Malaria and Tuberculosis,[86] and the Millennium Development Goals (MDGs)[84] (*Table 2.4*).

To improve programmes aimed at scaling up coverage of PMTCT interventions, it is necessary to understand how well these programmes are implemented, to what extent planned activities are being realised, and whether the programmes are making progress towards achieving their initial targets.[17] Priority Area 3 of the 2007-2011 South African HIV/AIDS and STIs National Strategic Plan (NSP)[5] (p 13) 'recognises monitoring and evaluation as an important policy and management tool' to provide information on how well the programmes operate and contributes

to identify ways to improve them. These will enable policy makers and PMTCT programme managers to make the necessary changes within the programme's components.

2.3.4   Indicators, data elements and data sources for PMTCT

Many international agencies, including the global monitoring and evaluation team (GAMET),[88] have supported the development of standardised indicators for easy monitoring of HIV programmes at the national level, and also to allow for cross-national comparison. These efforts have led to the development of several guidelines for monitoring key programmatic areas, and for reporting to donor and international agencies.

In 2006, UNAIDS, supported by the M&E Reference Group (MERG), set up a multi-agency Indicator Harmonization Group and an Indicator Registry Technical Working Group. These groups were tasked with the main goals of developing 'a web-based indicator registry to facilitate access to information about existing HIV-related indicators; and to provide guidance on core indicators for national-level HIV monitoring'.[60 (p 6)] This has led to the development of several core indicators and data elements (Appendix B). UNAIDS have identified 40 core indicators necessary to provide information for national-level HIV programme monitoring. The indicators consist of the 25 indicators originally identified by the UN General Assembly Special Session on HIV/AIDS (UNGASS),[85] and an additional 15 newly recommended indicators that span across the continuum of care for HIV programmes, and have been strongly recommended[60] [(p 11)] 'as the basis for national HIV monitoring and evaluation systems.' All 189 UNGASS member states, including South Africa, are required to report on these indicators once every two years. However, only 8 of these indicators are relevant for monitoring progress in PMTCT programmes in South Africa (*Appendix B*). The indicators recommended by these policy guidelines have been compared with the current indicators used in the District Health Information Systems[26] to see if they capture all the required indicators for managing PMTCT programmes (*Appendix C; Appendix D; Appendix E;* and *Appendix F*).

Schiavo-Campo[89] proposes five criteria for developing good performance indicators, known as the "CREAM" of a good performance indicator. He argues[89 (p 85)] that a good performance indicator should be:

> 'Clear (precise and explicit), Relevant (appropriate to the subject at hand), Economic (available at reasonable cost), Adequate (providing sufficient basis for performance assessment), and Monitorable (amenable to independent validation and measurable).'

Every indicator involves data collection, data analysis and reporting, which has cost implications, especially during the data collection and analysis stages; therefore programme managers should first consider these implications and determine whether it is economical to have so many indicators from multiple registers. The problem here is that it is not cost effective for nurses to continue to collect indicators that are not relevant, and at times simultaneously being collected by other programmes. Reithinger et al.[71] and William et al.[90] have highlighted the challenges faced with having multiple registers, claiming that this may encourage human errors in terms of data recording since nurses may forget to complete the registers, and information could be entered long after services have been given.[91,92] It is sad that some of the indicators collected at the facility level are not used by decision makers because the routine data are not reliable[15,16,43,54,93] and cannot be trusted. This brings us back to the issue of having an integrated system for all maternal, new-born, and child health programmes: a one-stop care provider, connecting places of care giving throughout the continuum of care from pre-pregnancy to childhood, to avoid the loss to follow-up.[94] Manzi et al.[95] attribute the high loss to follow-up in a PMTCT programme study to distance and travel time between places of residence and of care, claiming that there is a huge turnout at the entry into the PMTCT cascade (100%) compared with the turnout at 36 weeks nevirapine intake for mothers (55%) and at 6 months post-natal visit (19%).

Following the introduction in 2013 of the new PMTCT clinical guidelines,[66] the indicators and data elements for monitoring and evaluating PMTCT programmes have been revised to take into account the new requirements contained in the PMTCT guidelines. The South African National Department of Health (NDoH) has identified a minimum dataset called the National Indicator Data Set (NIDS) which has continually been revised since 1999. This minimum dataset contains about 200 indicators, and the data elements for calculating specific indicators. Only approximately 140 of these indicators are relevant to primary health care.[46,96] The 16 PMTCT priority indicators and the associated 20 data elements proposed by the NDoH are part of the NIDS (*Table 2.5*), and have been categorised to conform to the basic Logic model, which classifies performance indicators into five components (Input, Process, Output, Outcome, and Impact) depending on what the indicators set out to measure. The scope of this study, however, focuses on two of these components: the process and output indicators, which will be reviewed in the context of the PMTCT programme and the routine health information systems that support the programme.

The process indicators represent the numerous activities that are carried out to achieve a programme's objectives, whereas the output indicators refer to the immediate results obtained by the programme through the execution of activities.[72,79] The NDoH is emphasising outcome indicators (*Table 2.5*); however, to improve performance of outcome indicators, it is appropriate to ensure that process and output indicators are not only in place, but that they are functional. Studies have highlighted the importance of process[19,20,21,22,23,24] and output[25] indicators for monitoring programmes. The advantages of process indicators over outcome indicators are that process indicators are easy to interpret, and 'are more sensitive to differences in the quality of care'.[25 (p 479)] The World Health Organization (WHO), in an effort to combat HIV/AIDS, has developed a national AIDS programmes (NAP), and proposed a set of indicators for evaluating PMTCT coverage (*Table 2.6*). Unlike the NAP indicators, the NDoH does not have input, process and impact indicators in the current PMTCT guideline. Indicators such as the number of health personnel trained to administer PMTCT, and the number of facilities providing HAART and HIV testing, are not routinely available. This information is expected to be routinely recorded, but there are no available records of such information in the DMHIS; as a result, these indicators were not evaluated in this study. Nonetheless, an unpublished study by the NDoH revealed that 15% of the public health facilities do not provide PMTCT treatment services.[12]

Table 2.5: NDoH 16 PMTCT priority indicators outlined in the revised Clinical Guidelines

Output[97] indicators	Outcome indicators
Antenatal client HIV 1st test rate	*Antenatal client HIV re-test positive at 32 weeks*
Antenatal client HIV 1st test positive rate	*Baby PCR test positive around 6 weeks rate*
Antenatal client CD4 1st test rate	*Baby HIV antibody test positive at 18 months rate*
Antenatal client initiated on AZT during antenatal care	
Antenatal client initiated on HAART rate	
Antenatal client HIV re-test at 32 weeks rate	
Antenatal client on AZT before labour uptake	
Antenatal client Nevirapine uptake	
Antenatal client delivering on HAART rate	
Baby Nevirapine uptake	
Baby initiated on Co-trimoxazole around 6 weeks uptake	
Baby PCR test around 6 weeks uptake	
Baby HIV antibody test at 18 months uptake	

Source: NDoH PMTCT revised Clinical Guidelines (2010)[65]

Table 2.6: PMTCT Indicators of the WHO National AIDS Programme (NAP). 2008

Input	Process	Output	Outcome	Impact
Funds	Facilities offering treatment services e.g. Highly Active Antiretroviral Therapy (HAART)	Number of clients receiving VCT	Improved provider attitudes	HIV-related morbidity
Supplies/ drugs	Number of health personnel trained to deliver PMTCT services according to national and international standard	Percentage of all HIV-positive women enrolled or referred to a comprehensive care programme	Improved community attitudes towards HIV	Mortality rate/life expectancy
Equipment	Facilities offering HIV testing	Number of HIV-positive women counselled on or referred to family planning	Decreased discrimination	
Policies		Number of clients being referred	Restored productivity	
Guideline & procedures		Percentage of HIV-positive women counselled on or referred to family planning	Appropriate care delivery; referral;	
		Number of women enrolled or referred to a comprehensive care programme	Enhanced quality of life	
		Number of clients receiving care		
		Number of clients receiving People Living with HIV/AIDS (PLHA)		
		Number of clients receiving Home-Based Care (HBC)		
		Number of clients receiving PMTCT prescription		
		Number of people given antiretroviral drugs		

Several data sources have been identified for these PMTCT indicators, most of which are found in registers at health facilities. These data sources include the ANC records, labour records at delivery facilities, facilities providing HAART services, and facilities providing PCR testing. The data elements for the indicators are routinely collected through the District Management Health Information System (DMHIS). According to E. Mhlanga,[a] reporting on the proposed plans for the PMTCT programme, the PMTCT indicators have been implemented in all the provinces and were reviewed during 2011, with a view to integrating them into the maternal, child and women's health (MCWH) programmes. This process is yet to be fully implemented, with a long-term view for PMTCT to be fully integrated and become normalised as part of the overall primary health care (PHC) services.

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[a] Mhlanga E. (Cluster Manager: Maternal, Child and Women's Health, National Department of Health, Pretoria). Letter to all colleagues. Re: PMTCT indicators for monitoring and evaluation (M&E). 26 March 2010.

2.3.5   Lessons in monitoring PMTCT

Numerous studies have been reported on the evaluation of the effectiveness of PMTCT programmes in different settings. This review will focus on challenges faced with monitoring the PMTCT programme as well as successes in improving the information used to manage PMTCT programmes. Gaps highlighted include issues relating to data collection and transmission processes, and challenges in the implementation processes such as coverage of the programme including missed opportunities. It is clear from the literature that monitoring the PMTCT programme has been faced with several challenges, including the unreliability of data used in managing the programme. Mate et al.[15] found that the routine statistics from three districts, with a high HIV-prevalence, were incomplete and inaccurate. The authors concluded that the routine data were not a viable means to track PMTCT process performance or outcomes. This is not unique to South Africa. A similar study assessing the accuracy of routinely collected data on maternal antiretroviral prophylaxis coverage in two government hospitals in Kenya[40] also identified weaknesses in the reporting system. Ferguson et al.[40] argue that poor tools, weaknesses in training, and supervision given to clinic staff involved in the implementation of the PMTCT programme at the facility level, led to data inaccuracies and substantial overestimation of the PMTCT programme coverage in that setting. The challenges faced by the lack of or insufficient PMTCT clinical training for clinic staff have also been highlighted by Doherty et al.[13] In their study of an intervention aiming to improve the coverage of the PMTCT programme through a participatory quality improvement intervention approach, the authors identified several weaknesses in the programme. For example, inadequate infrastructure, insufficient supervision from the district, and the lack of ownership of the PMTCT programme by clinic nurses were highlighted. In addition, the study found that clinic staff did not understand the PMTCT protocol; and only a quarter of the surveyed facilities had a PMTCT protocol on site. However, the study also revealed that poor recording systems contributed to the performance of the health service.

Youngleson et al.[74] also focused on improving the PMTCT programme through a combination of health system strengthening activities focused on quality improvement. Based in a sub-district in the Western Cape Province, their study appears to build on recommendations by Reithinger et al.[71] of using a data stamp approach to link maternal and infant information, to facilitate the implementation of the PMTCT programme. While a data stamp had been used by Reithinger et al. to create space on the infant record to capture HIV related information about the mother, Youngleson et al.[74] (p 5) found that stapling a mother's antenatal patient record to

their baby's 'Road-to-Health Card' not only 'increased the number of babies recorded in a test facility's cohort register by 24%', but also improved data transmission 'between the labour ward and infant-testing sites' to 80%. The authors consider that one of the contributing factors to the success of the intervention was attributed[74] (p 6) to the 'structure of the routine PMTCT monitoring system which facilitated the use of data to drive improvement'. This was enabled by a culture of using information, a responsive district leadership, and the linkages in patient registers throughout the continuum of care. The data stamp approach has also been successfully used in Zambia[98] to monitor coverage of nevirapine in pregnant women.

2.4   Health Information System evaluation

2.4.1   Health Information Systems (HIS)

The health information system (HIS) has been defined by several authors[99,100,101] as a system for generating information for decision making. It allows for the collection and generation of data from health care services at health facilities through to the national level where the information is needed for the purposes of planning, management, and for making decisions. This study will make use of the World Health Organisation (WHO)[102] (p 3) definition which describes HIS as:

> 'A system that integrates data collection, processing, reporting and use of the information necessary for improving health service effectiveness and efficiency through better management at all levels of health services.'

For a health information system to function effectively, several components have to be in place. The Health Metrics Network (HMN)[101] has identified six major components and standards of a health information system, namely: 'HIS resources, Indicators, Data sources, Data management, Information products, and Dissemination and use'.[103] (p 4) The ultimate goal of the information system, according to this framework, is to 'increase the availability, accessibility, quality and use of health information vital for decision-making at country and global levels'.[103] (p 4) In other words, the main purpose of implementing an HIS is to generate useful information; it suffices to extrapolate that an HIS which cannot produce adequate and reliable information is not a functional HIS, and may have issues with either performance or processes. A key component of the HIS that is used for process and output indicators is the routine health information system (RHIS) from health facilities.

2.4.2   Evaluation of Health Information Systems

Lau et al.[51] conducted a meta-analysis of 50 systematic reviews of over 1276 studies on the evaluation of health information systems published between 1966 and 2008. The reviews were selected on the basis that they were systematic reviews published 'in English on health information systems used by health care providers in different settings'.[51 (p 638)] The reviews, however, were found to be on the following focus areas: 'medication management, data quality, care processes/outcomes, preventive care, and health conditions';[51 (p 638)] and were categorised using the Canada Infoway Benefit Evaluation (BE) framework.[104] This framework adapted from DeLone and McLean,[105] and Van Der Meijden et al.,[106] focuses on measuring the success of RHIS, using a multi-dimensional model and will be discussed in more detail in *Section 2.4.9*.

The HIS evaluated in the meta-analysis of Lau et al.[51] included clinical decision support system (CDSS), computerised physician order entry (CPOE), and electronic patient record (EPR). They did not include programme management information. None of these reviews were from resource-limited settings, and only a handful focused on the behavioural aspects of the HIS such as skills, competence and motivation.

In contrast, Hotchkiss et al.[107] conducted a review of studies published on the evaluation of RHIS interventions in low-and middle-income countries that were published between 1970 and 2011. The search was conducted between May and July 2011 in PubMed, Web of Science, and other sources; the key words used for the search include: 'routine health information systems, health information systems', 'health management information system', 'electronic health records', and 'electronic medical records'. Of the 2874 studies found on health information systems, only 14 studies met the inclusion criteria[107 (p 4)] which involve:

> 'studies that present a summative evaluation, and that access the impact of a technical, organisational, or behavioural intervention introduced for the purpose of improving one or more aspect of RHIS performance or health systems functioning; come from low-income and lower middle-income countries; and include a clear presentation of the research methods used.'

Several of these studies evaluated information systems in South Africa and the DHMIS. Odhiambo-Otieno[39] conducted a process evaluation of the district health management information systems (DHMIS) in Kenya, and found that in this setting, key resources needed for the operation of the DHMIS such as personnel, stationery, and management support were

inadequate; basic equipment for data collection and processing were also not available. The findings revealed that over two-thirds of the health information personnel were not trained and lacked basic skills to perform their duties. Problems with the quality of data generated by the DHMIS were also highlighted, and included variations in the data collection forms, overburdening of clinical staff owing to large numbers of data collection forms at the clinics, poor data accuracy, and insufficient use of data for management purposes.

Littlejohns et al.[50] investigated the failure of the implementation of a hospital information system in Limpopo Province. They found that the reasons for the system failure in this setting were similar to those of other electronic systems' failure. These reasons include: inadequate infrastructure, non-acceptance by users because of lack of understanding of the rationale for implementing the system, and users' underestimation of the complexity of the healthcare tasks. The authors argued that the failure to consider healthcare cultures, and ensure users received sufficient training before the system was introduced, were also crucial factors in the unsuccessful implementation of the system.

Muschel[28] reviewed the development of the RHIS in eight districts, focusing on the RHIS processes such as standardised data collection tools, essential minimum data set, equipment for data collection, data analysis, feedback, and the use of information. The review found some inconsistencies in the definitions of some indicators owing to irregularities in respect of the definition of the data elements. The issues of unstandardised data collection tools and data integration were also highlighted. Garrib et al.[53] also examined the functioning of the RHIS in ten rural clinics in KwaZulu-Natal over a 12-month period. Data quality, information use, and staff perceived work burden were assessed. The authors found that although clinic staff had a solid understanding of the data collection processes, they lacked skills to analyse, interpret, and use data. This was mainly due to lack of feedback to the clinics after data collection. Garrib et al.[53] (p 552) concluded that 'clinic supervisors should be trained in the interpretation and use of clinic data focusing on practical indicators of performance'.

Matshidze and Hanmer[99] in their overview of the development and implementation of health information systems in the private sector, found that despite availability of legislation, the need to clarify the role of private health sector involvement in the country's HIS is of vital importance. No formal, integrated HIS existed in the private sector to support patient health care in South Africa; the authors claim that a plethora of disjointed health information exists within health care practitioners, such as hospital service support groups, radiologists, and pathologists;

these have their own HIS. They argue that[99] [(p 100)] a major challenge facing the private sector health information system:

> 'is that there is greater emphasis on reimbursement and risk management than on support for patient care. As a result, there are currently few efforts geared specifically towards the development of information systems (manual and/or electronic) to support effective patient care across multiple settings.'

The Health Metric Network[101] also conducted an assessment of the health information systems in South Africa in 2009 based on the 'framework and standards for country health information systems' which evaluated the six components of a comprehensive health information system. The assessment found that data management (48%) and HIS resources (49%) were present but not adequate. The assessment also highlighted an absence of specific procedures for data management. Despite the presence of dissemination and use of information (53%), information use for resource allocation, implementation and action purposes was not adequate (39%). The authors concluded that South Africa had all the components of a functional health information system, but they all had inadequacies. While fragmentation was identified as a concern, capacity development of HIS staff was highlighted.

2.4.3   Evaluation criteria for Health Information Systems

In an attempt to define a comprehensive set of evaluation criteria for the DHMIS, two studies, one in South Africa [108] and the other in Kenya, [109] proposed several evaluation criteria. Hanmer,[108] in addition to identifying several essential criteria for an effective evaluation of the systems, has also developed an evaluation instrument for the systems. The evaluation criteria include the capacity to obtain required information, the availability of district level information for management purposes (District management information), the availability of individual patient information at the point of care (patient information), appropriateness and accessibility of information (appropriateness and accessibility), acceptability to the community, user acceptance, and timeliness of the information. The author[108] [(p 167)] concluded that the evaluation tool 'is too extensive for use by district health managers for self-assessment of the DHISs'. As this study was conducted in 1999 when the DHIS was emerging, the author recommended a phased DHIS evaluation, so that progress towards the development of the DHIS could be measured. Odhiambo-Otieno,[109] [(p 36)] on the other hand, categorised the evaluation criteria into three groups: 'pre-implementation (policies and objectives), concurrent (operational) (technical

capacity – trained personnel), and post-implementation (management and resources)'. Although the studies were conducted in different settings, and proposed different sets of evaluation criteria, there was concordance between some of the criteria, for example, Hanmer[108] and Odhiambo-Otieno[109] both agree on the follow criteria: policy and objectives, information quality, staff development, user/patient interaction, facility and equipment, just to mention but a few.

2.4.4   Health Information System resources

Health information system resources refer to all the tools and equipment necessary to effectively collect, analyse, and collate data. These resources include skilled personnel, functional equipment such as computers, analysis software, printers, telephones, availability of data collection tools (registers, and tally/tick sheets), and internet connectivity, including access to the intranet. Audits of the human resources and equipment to support the South African routine health information system (RHIS) have been undertaken.[44,45,46,47,49,48] Kumalo,[44] evaluating the trends in the development and organisation of the South African health information system, highlighted some key challenges such as getting managers to use available information for decision making. Also cited are challenges faced with the availability of a reliable health information system and lack of access to good quality data. Issues around staff shortages and inadequate skills for collecting and processing information are also highlighted. The author noted that monitoring and evaluation are vital components of the health system and require good quality data. Recommendations were made about the need to strengthen the human resource capacity, with dedicated health information staff who have a clear understanding of their job descriptions; the authors proposed that ongoing training and support, based on needs, should be provided to improve staff competences and skills. Also recommended was that managers should be encouraged and trained to use information, by improving the quality of, access to, and presentation and packaging of information, and that adequate allocation of resources needed to address the information technology infrastructure should be strengthened.

Rohde et al.,[46] in their review of the role of information in decision making for primary health care, also reiterated some of the challenges identified by Kumalo.[44] They highlighted several challenges with the South African health information systems, such as inadequate and unskilled human resources to support the HIS, data quality issues, and the lack of an information use culture. The authors suggested that managers at all levels need an understanding of the collected

data and calculated indicators, in order to identify problem areas and provide support to data capturers. They are of the opinion that data quality should be a key performance area for managers, claiming that if managers are well trained in the area of data validation, they should be able to pick up and correct errors in the data at the facility level, before signing off the data; this, they believe, will improve the quality of reporting. Unlike Kumalo,[44] who recommended training managers as a way to improve data quality, Rhodes et al.[46] (p 207) advocated for 'a structured approach to training which should take into account adjustments in nursing and medical curricula at the undergraduate level'. They advocated a health information system (HIS) postgraduate qualification which should accommodate current trends in HIS. The authors also recommended an expansion of data reporting, identification of best practices for paper-based data collection, investment in improving data quality, and the establishment of a national standard for HIS integration. Efforts to strengthen the culture of information use were also reiterated.

An audit of the DHMIS in South Africa by Loveday et al.[45] supports some of the findings already highlighted above by Kumalo,[44] and Rhode et al.[46] The audit found that health information staff are not sufficiently skilled to perform their duties, noting that only 45% of a total of 677 HIS staff interviewed, admitted having received at least a week's training to carry out their duties. The study also showed that about 35% of the staff were not in permanent HIS posts, and that about 42% spent less than 80% of their time on focused HIS work. Only about 40% of information officers reported having average or good stills to conduct data quality checks and data validation. Despite three-quarters of staff claiming to have access to computers, most of the computers were either non-functional or needed an upgrade. The authors[45] (p 33) concluded that there was no uniformity in the data generating processes, and recommended that 'the South African National Department of Health needs to develop a policy document on human resource requirements for an effective HIS workforce'. In response to these findings, the District Health Management Information System (DHMIS) policy document[29] and District Health Information System (DHIS) Standard Operating Procedures (SOP) and guidelines[110] were developed. In addition, the South African National Department of Health introduced the 3535 Data Capturer Project with the aim of training matriculants as data capturers with skills to capture and collate data, and then deploy them to work in health clinics.[111]

Drawing on findings and recommendations by Loveday et al.[45] the South African National Department of Health (NDoH) in collaboration with John Snow Inc.'s Enhancing Strategic Information (ESI), conducted a similar study[47] with a larger sample (966) in 2011, as part of its

national HIS strengthening project.[112] This assessment also builds on the 2011 ESI/NDoH District Health Information System (DHIS) Rapid Resource Assessment project,[112] focusing on the same indicators reviewed by Loveday et al.[45] which include: human resources, hardware and software. The assessment revealed that only one-fourth of the respondents had been trained for at least a week, and about 77% claimed to have access to a computer; 68% spent more than 80% of their time on HIS-related tasks. Comparing this assessment with the earlier one by Loveday et al.,[45] there has been some improvement in the indicators assessed; however there has been a decline in the number of hours staff spent on performing HIS-related tasks.

In a recent review of progress made towards strengthening the South African health information system, in the context of current health sector policy initiatives such as the Negotiated Service Delivery Agreement (NSDA) and the re-engineering of primary health care (PHC), English et al.[48] identified several persistent challenges with the HIS, some of which have already been highlighted by other studies. These challenges, which the authors agree have persisted over the years partly due to managers' inability to translate key health regulation and policies into practice, include inadequate human resources, insufficient capacity of health information staff at all levels of the health system, high staff attrition rates, inadequate training, and lack of resources such as registers, data collection tools, computers, and printers,[46,45,47] unstandardised job descriptions, limited HIS 'development planning and lack of established HIS career path and accredited training programmes'.[48 (p 85)]

Also highlighted are the non-existence of a web-based DHIS, resulting in manual extraction of data from various levels to the national level, and the fact that there are no fixed cut-off dates for data inputs, 'resulting in reporting of different information regarding the same facility and indicator';[48 (p 85)] issues with data integration, insufficient use of information for management purposes,[46,49] poor data collection practices, and poor data feedback mechanisms between the different levels of the health system were also highlighted. Reiterating Rhodes et al.[46] and Loveday et al.,[45] English et al.[48 (p 85)] noted that:

> 'there is a lack of standardisation of data collection tools and large numbers of registers, many developed for vertical data collection activities. These are often not controlled at national and provincial levels.'

2.4.5   Organisational aspect of HIS

Organisational factors such as leadership, planning, management, inter-organisational relationships, and culture have been cited in the literature as factors influencing the successful implementation of a functional health information system.[52,56,113,114,115,116,117] Lorenzi et al.,[114] in their study on future directions in evaluation research, argue that people and organisational factors have been overlooked in HIS implementation; and maintain that these factors are capable of determining HIS successes or failures. They however, cite three domains of people and organisational factors that should be researched: motivation, culture, and leadership, arguing that ownership is crucial for success, and that if 'people are actively involved, they will be motivated towards making the end effort a success',[114 (p 84)] and once they are perceived to have ownership of the problem, and the solution, then they will ensure the systems work. The authors also claim that an organisation's culture is influenced by societal culture, that is, the culture of the society or environment in which the organisation is located; and other organisations and individuals with whom they interact and who may influence their norms and values; finally, the authors argue that the success or failure of an organisation, irrespective of the management techniques, depends on the leadership, that is, the qualities a leader possesses. In the same light, Kaplan and Shaw[52] have cited organisational, behavioural and social issues as important factors that can influence HIS successes or failures, stating that[52 (p 220)] 'evaluation studies need to address how well a system works with users in a particular setting, and further, why it works that way there'. One of the suggestions made was that future evaluation studies should focus on issues that involve both individuals who use the system and those who are affected by the system.

The arguments presented above by Lorenzi et al.,[114] and Kaplan and Shaw,[52] have been highlighted in several health information systems evaluations. For instance Southon et al.,[115] building on an earlier study[118] to identify the impediments to the successful transfer and implementation of a packaged information system, showed how organisational factors led to the failure of implementing a health information system in Australia, even when the same system was successfully implemented in other countries. This failure was attributed to differences in the type of organisational configuration present in the study site. Similarly, Kamadjeu et al.[56] highlighted leadership issues as one of the challenges faced with the adoption and sustainability of an electronic health care record in Cameroon. They observed a 50% dropout rate among users of the system, which was attributed to changes in the management staff of the facility. Apparently there was no buy in among the new management staff who did not pay much

attention to the new technology, and hence did not promote a culture of use. In contrast, Yusof et al.[116] argued that organisational factors such as effective leadership and top management support, played an important role in the successful acceptance and adoption of the digital Fundus Imaging System, citing the buy in and involvement of a senior partner in a primary care organisation in the UK as the major factor that led to the promotion of a culture of use, and implementation of the technology. These findings provide a better understanding of the impact of organisational factors on the implementation of health information systems. However they do not explain how these factors promote a change culture.

In her work on building culture for sustainability, Taylor[119] [(p 2)] defined culture as the product of 'the messages people receive about how to behave in order to fit in' to a society, and identified three sources of message change: Behaviours - especially of those we admire, or see as a role model; Symbols - such as who gets promoted and what gets priority in meeting agendas; and Systems - such as rewards, punishments, and taxes. Taylor argued that it is fruitless, and a painful process to try to change an individual's leadership behaviour without first changing the culture of the environment in which the person lives. However, it is by changing the behaviours, symbols and systems that we send messages about what is important. For instance Aqil et al.,[59] postulated that RHIS performance can be improved by promoting a culture of information use, that is, 'the capacity and control to promote values and beliefs among members of an organisation by collecting, analysing and using information to accomplish the organisation's goals and mission'.[59] [(p 222),120] In other words, if a culture of information is promoted by top leadership, personnel are likely to imitate it.[56,116]

2.4.6   Behavioural determinants: RHIS tasks competence

Some of the reasons attributed in the literature to poor quality data and inadequate use of information for decision making are human related, and have been termed 'behavioural factors'. LaFond et al.[121] and Aqil et al.,[92] the first advocates of the phrase in the context of RHIS, have widely promoted works done on this subject, through the MEASURE Evaluation PRISM framework and tools. They define behavioural determinants as the 'knowledge, skills, attitudes, values, and motivation of the people who collect and use data'.[92] [(p 1)] These include personnel's knowledge of the rationale for collecting data, skills to check data quality and solve problems, their confidence and competence levels for RHIS tasks, and motivation and incentives to perform these tasks. The assumption[59] [(p 221)] is that 'if people understand the utility of RHIS

tasks, feel confident and competent in performing the task, and perceive that the task's complexity is challenging but not overwhelming, then they will complete the task diligently'.

One of the challenges faced with the routine health information system (RHIS) in low- and middle-income countries revolves around nurses who are responsible for completing the registers from which all routine health data are derived; they are confronted with the dilemma of seeing patients and compiling monthly statistics. A major concern is that clinic personnel, such as nurses, have multiple responsibilities, including primary clinical responsibilities, which may interfere with the time they allocate to data collection.[45] Clinic staff may value the care of patients over data collection; hence data collection may be completed many days after the event has occurred,[91,92,150,151] and this time lag may impact on the quality of the statistics they produce. The issue of inadequate capacity as a result of a lack of relevant training to carry out their responsibilities in the data collection processes has been widely documented. [13,40,50,48,122]

Several studies have highlighted the deficiencies in numeracy skills among personnel involved with data collection at both the facility and district levels;[120, 123,124,125,126,127,128] these deficiencies can be attributed partly to inadequate numeracy skills in nurse training.[129,130,131] These studies, conducted in the United Kingdom and in Australia, focusing on both undergraduate and qualified nurses, found that nurses lack the necessary numeric skills to solve basic mathematical problems needed to perform daily clinical functions such as drug administration and compiling daily statistics from patients' registers/records. One of the studies[130] looked at the curriculum of undergraduate nursing students in Australia and discovered that mathematics is not a pre-requisite for entry into the nursing degree programme, and that nursing students are not trained in numeracy skills during their degree programme. To address this inadequacy, Rhodes et al.[46 (p 207)] advocated a 'structured approach to training', which should take into account 'adjustments in nursing and medical curricula at the undergraduate level',[46 (p 207)] to include core competencies for data collection and use. In addition, they advocated for an HIS postgraduate qualification to include current trends in HIS.

Furthermore, as part of an effort to improve data demand and information use, a 'Logic model for strengthening the use of health data in decision making' has been proposed.[132 (p 3)] Among the eight interventions suggested in this model is the ability to build the capacity of both data producers and users in data use core competencies, such as the ability to analyse, interpret and synthesise data, and skills to disseminate information. However, the challenges often faced as a

result of staff up-skilling, and one of the reasons cited in the literature for poor data quality, is the issue of staff attrition.[13,99,48] In the investigation of Cristofari et al.[122] of the availability of human resources for HIS in two sub-Saharan African countries, HIS staff shortages were identified as a major problem affecting data quality and information use. They observed the double-edged effects in-service and on-the-job training have on the health information system.[122] On the one hand, training ensures the capacity of staff to effectively perform their tasks, while on the other hand it increases staff's market value, and the opportunity of opting for better paying positions, hence staff attrition. These challenges could be addressed if staff are well motivated and are given sufficient incentives to stay on the job, since lack of motivation and incentives have been cited as barriers to data demand and use.[122,151]

2.4.7   Data quality issues

Data quality is one of two output indicators postulated in the PRISM framework for accessing the performance of routine health information systems.[59] It refers 'to the degree to which data or statistics measure what was intended to be measured when the data collection system was designed'.[133 (p 137)] Accordingly data is said to be of good quality if it is accurate, complete, timely, valid, consistent, and relevant,[100,134,135] that is, if it meets the intended purpose for which it was originally collected such as planning, decision making, monitoring, and management. Despite the importance of good quality data in guiding decision making, many studies have shown that data from routine health information systems in low- and middle-income countries are inaccurate and unreliable.[38,39,42,43,54,136,137,138] Attempts made in South Africa to assess trends in coverage of key, high-impact maternal, new-born and child survival interventions identified in the *Countdown to 2015* initiative,[139] have also identified several data gaps as well as data quality issues.[15,16,54,93]

A major challenge and probably the most important reason for poor data quality has to do with the nature of the routine health information systems in limited-resourced settings. Most of the health information systems in these settings are paper based, involving the manual collection and collation of data. At the facility level, there are multiple registers and tally sheets that need to be collated, summarised and sent to the sub-district level. Training is not usually provided for clinic staff involved in the data collection processes,[46,48,50,122] who often have very limited data quality checking skills and do not understand the importance of collecting data. Other reasons for poor quality data include design/structural issues relating to inappropriate data collection tools and procedures,[13,49,40] poor recording due to inadequate skills,[13, 44,45,46,47,48] inadequate

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resources leading to poor capturing and reporting of data,[43,45,46,47,48,49] errors in processing data,[49] too many data elements,[90] staff attrition,[13,44,48] and lack of use of already generated data,[46] which may hinder constructive feedback to data producers. Feedback is a crucial part of the supervisory process, and is critical for enhancing data quality, especially when audits are done.[48,53]

Despite the challenges identified with the RHIS, several studies have documented interventions to improve the quality of routinely collected data. One of the proposed interventions for improving data quality is a data-use workshop approach by Braa et al.[140] This approach which is based on the assumption[140 (p 382)] that 'the more data is used, the more data quality will improve', involves a quarterly data-use workshops for district health management staff where routine data are presented and critiqued. The approach has been successfully used in Tanzania, Kenya, and Rwanda to improve data quality, data transmission, and data integrity. A data collection and feedback training intervention has also been used to improve the quality of routinely collected data in South Africa. Mphatswe et al.[141] conducted specific training on data management and held monthly data review sessions with health care providers, health information officers, and PMTCT programme managers. Just as in the data-use workshop approach,[140] information about data accuracy and completeness, and the importance of monthly reviewing of data, conducting data audits, and giving feedback, was given to care providers. Other interventions used in resource-limited settings to improve data quality include the use of 'on-site assessment and feedback on data completeness and validity',[141 (p 179)] evaluative operations research approach,[142] and data quality audits.[143]

2.4.8 Information use

Much emphasis has been placed on data collection compared to data use. This is in part related to the suboptimal quality of data generated by the routine health information systems, and the absence of a culture of information use.[44,46,91,92] In 2001 Heywood and Rhode[144] outlined their version of the information cycle model which describes the processes of turning data into useful information. These processes involve the collection of essential datasets that are available in programme registers at the facility level. These data are then processed and analysed into indicators that are presented in pictorial format such as graphs, tables, maps and figures. However, for these data to be useful, they must first be interpreted through comparing the outputs of different analyses to make sense of the data. It is through the process of data interpretation that it becomes useful information for monitoring, planning, resource allocation,

and decision making. The use of information to influence policy making, programme action and research[103] is one of the activities outlined in the definition of a health information system; hence the main purpose for the collection of data is for it to be used. Nutley and Reynolds[132 (p 2)] have defined the use of information as 'the analysis, synthesis, interpretation and review of data as part of decision-making processes, regardless of the source of data'. This implies that for information to be used, it must first be analysed into a usable format, and then interpreted and used to inform decisions.

Despite an increasing demand for and the availability of data, it is worrying however to note that the majority of decisions made by senior management such as district and programme managers in terms of planning and resource allocation for managing HIV programmes are not necessarily based on informed data.[92,145] The inadequate use of information generated from routine health information systems is very alarming, considering the investments made and resources channelled towards collecting such data. To highlight the magnitude of this problem, 120 countries globally were asked to rate their performance in terms of using data for planning, management, and implementation of the HIV programmes. More than half of the countries surveyed rated their data use experience as below average. Only 48% of the 42 countries in sub-Saharan Africa rated their data use as above average.[146]

The situation is not different in South Africa. Almost 15 years after the implementation of the DHIS, the major source of primary health care information, data from the system have not been adequately utilised to inform policies, leaving the data producers with the perception that data collection is only for reporting purposes. Pillay et al.[b] suggest that despite the routine collection of data in all South African public health facilities, just a handful of the information is used by decision makers. Several reasons have been highlighted in the literature for the insufficient use of information for planning and management purposes, and for decision making. Solarsh and Goga[147] have stressed that the lack of a reliable data source will make tracking progress on health service delivery problematic. On the other hand, Burn and Shongwe[148] noted that problems relating to the data collection processes such as poor quality data, and incomplete and untimely data, are the main barriers to the use of information, emphasising the insufficient use of information by managers, which is attributed to their lack of skills to use data.

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[b] Pillay Y, Rohde J, Van den Bergh C. The District Health Information System: a briefing document for Department of Health managers. 2002.

These findings are supported by Loveday et al.,[45] who also identified several barriers to information use. Unlike Burn and Shongwe,[148] Loveday et al. considered additional aspects of barriers to lack of information use such as challenges faced with health information software and issues relating to human resources. Chaulagai et al.[138] and Ledikwe et al.[91] have also cited the lack of data ownership as one of the challenges for the insufficient use and interpretation of data. Other limitations influencing the non-use of data for management purposes in developing countries include some of the constraints already cited for poor quality data such as the lack of skills and competence to analyse and interpret data,[53,92,149,150,151] the unavailability of skilled personnel,[44,45,46,149,151] lack of knowledge of the importance of using information to manage health programmes,[92,152] inadequate feedback to staff at the facility level,[28,53] the lack of skills to use data,[149] lack of access to information,[150,151,153] lack of information use culture,[44,46,91,92] quality supervision,[92] and staff training.[150,151]

Substantial investments to promote and improve data use have been made by organisations such as MEASURE Evaluation.[154] Tools have been developed to encourage data demand and use in developing countries. Nutley and Reynolds[132] (p 3) have applied the 'Logic Model for strengthening the use of health data in decision making'. Based on work by Aqil et al.,[59] the Health Metric Network,[103,169] and Patton,[78] this model involves the use of a set of eight interventions that aim to improve data demand and use. The interventions include: 'assessing and improving the data use context; engaging data users and data producers; improving data quality; improving data availability; identifying information needs; building capacity in data use core competencies; strengthening the organisation's data demand and use infrastructures; and monitoring, evaluating, and communicating results of data use interventions'.[132] (p 3)

2.4.9   Health Information System Evaluation Frameworks

Few frameworks have been published in the literature for strengthening health information systems' performance in resource-limited settings. This section will review and describe available frameworks for assessing the performance of HIS with the objective of choosing an appropriate theoretical framework on which this study will be based.

Review of the literature identified several HIS evaluation frameworks used to assess the performance of RHIS. An extensive overview by Hotchkiss et al.[107] on how the health system in low- and middle-income countries can be strengthened using RHIS, reviewed studies conducted between 1970 and 2011 for HIS evaluation frameworks. Of the 2874 studies that they found on

health information systems, only seven frameworks were identified that describe the determinants of RHIS performance. This current study will, however, build on some of the findings from Hotchkiss et al.;[107] a summary of the reviewed frameworks is presented below in Table 2.8.

A key reference for information system (IS) success in the literature is the well-established DeLone and McLean IS success model.[105] In an attempt to answer the question "What causes Management Information Systems (MIS) success?" DeLone and McLean (D&M) posit a taxonomy that consists of six interrelated and interdependent dimensions, which they claim are responsible for IS successes or failure: 'System quality, Information quality, Service quality, Use, User satisfaction, Individual impact, and Organisational impact'.[105] (p 83,87) The IS success model[105] Figure 2.1 was first published in 1992, and was updated a decade later to incorporate some of the many critiques[155,156,157] it had received over the years. The updated D&M model[158] is presented in Figure 2.2 and includes three new dimensions: Service quality, Intention to use, and Net benefits, derived by collapsing 'individual impact' and 'organizational impact'. Half a decade after the update, Petter and McLean [159] conducted a meta-analytic assessment to determine the validity of the updated IS model, and concluded that most of the hypotheses posited by the model were validated.
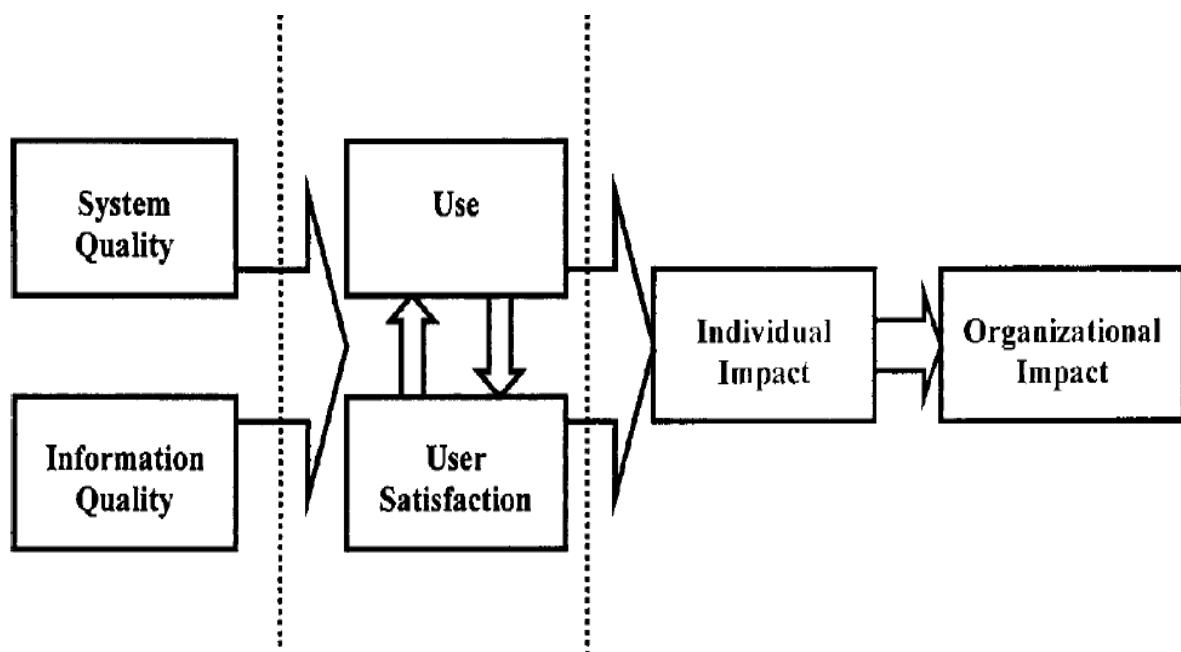
Figure 2.1: DeLone and McLean IS Success Model, 1992.
Source: DeLone and McLean[105]
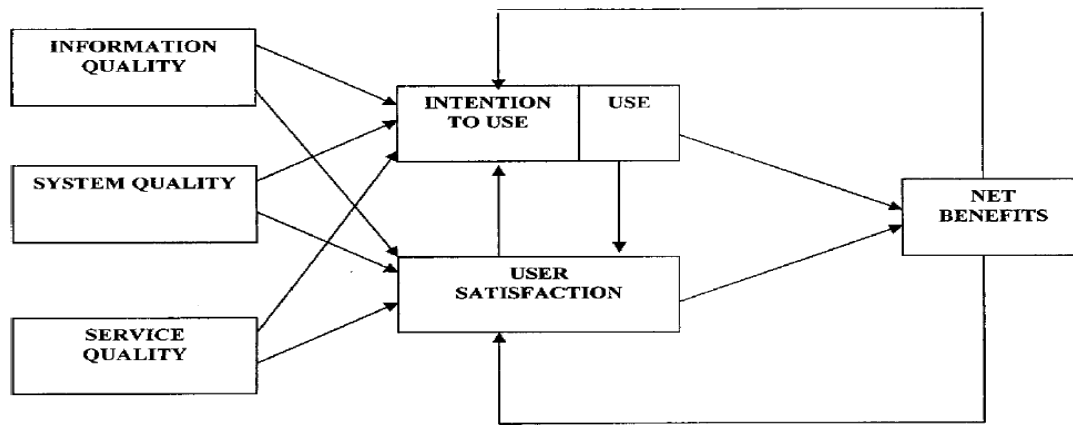
Figure 2.2: Updated DeLone and McLean IS Success Model, 2003.

Source: DeLone and McLean[158]

Goodhue and Thompson[160] posited the 'Technology-to-Performance Chain' (TPC) framework, derived from their critique of two major models linking technology to performance: the 'Task-Technology Fit' theories based on the assumption that technology will improve performance through providing the right support to fit a task, and the 'theories of Attitudes and behaviour (Utilisation)'.[161] They argued that the two theories on their own are unable to effectively influence performance. The TCP framework assumes that individual performance is influenced by two factors: 'task-technology', and utilisation. Utilisation on the other hand, is influenced by precursors of utilisation, individual characteristics, technology characteristics, and task characteristics (*Figure 2.3*).
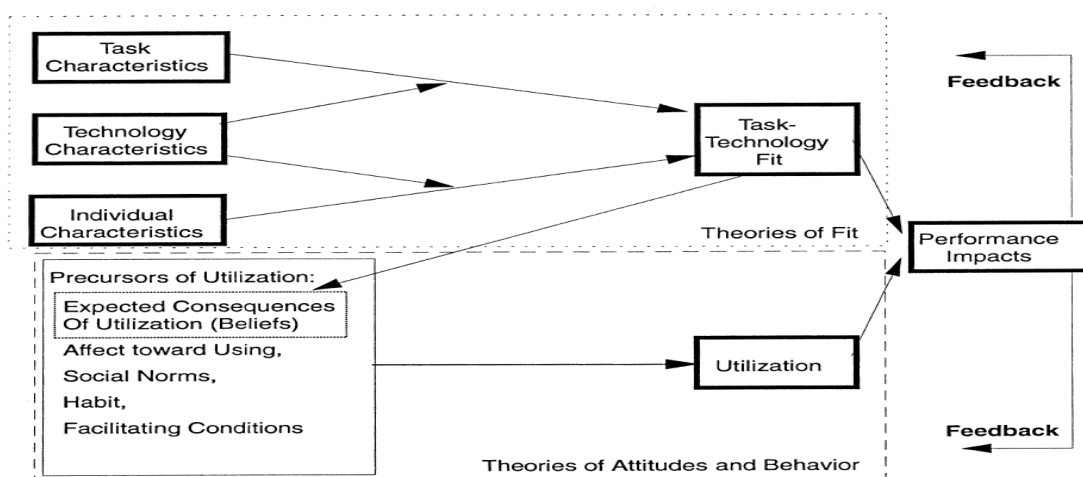
Figure 2.3: The Technology-to-Performance Chain Framework, 1995.

Source: Goodhue et al.[160]

Shaw,[162] postulating a new framework, argued that there are few studies that provide 'a comprehensive framework for evaluation that highlights and addresses all aspects of healthcare that may be affected by the use of information communication technology (ICT)'.[162 (p 210)] To address this challenge, the author proposed a generic ICT evaluation framework for health care; the framework known as the 'CHEATS',[162 (p 210)] has six dimensions: 'clinical, human, and organisation, educational, administrative, technical and social'.

In contrast to the three frameworks[158,160,162] described above, the Data Demand and Information Use (DDIU) conceptual framework [163] (*Figure 2.4*) and the Pathway for Evidence-Based Planning[164] (PEP) framework (*Figure 2.5*) follow a cyclical pathway that connects data to use (DDIU) and data to impact (PEP), with a common goal of using data to make informed decisions. The frameworks describe the process of turning raw data into information. The DDIU framework postulates[163 (p 2)] that 'access to and capacity to use information more frequently and effectively will lead to decisions that improve health by improving the health system's ability to respond to health needs at all levels'. In other words, demand for data will only be enhanced if there is a culture of information use, and managers are willing to use available information for decision making; this action is likely to influence personnel's attitude towards the data collection and analysis processes, and improve accountability. In addition, the Pathway for Evidence-Based Planning framework (*Figure 2.5*) extends the DDIU to include other dimensions such as Evidence, Knowledge, Action, and Impact.
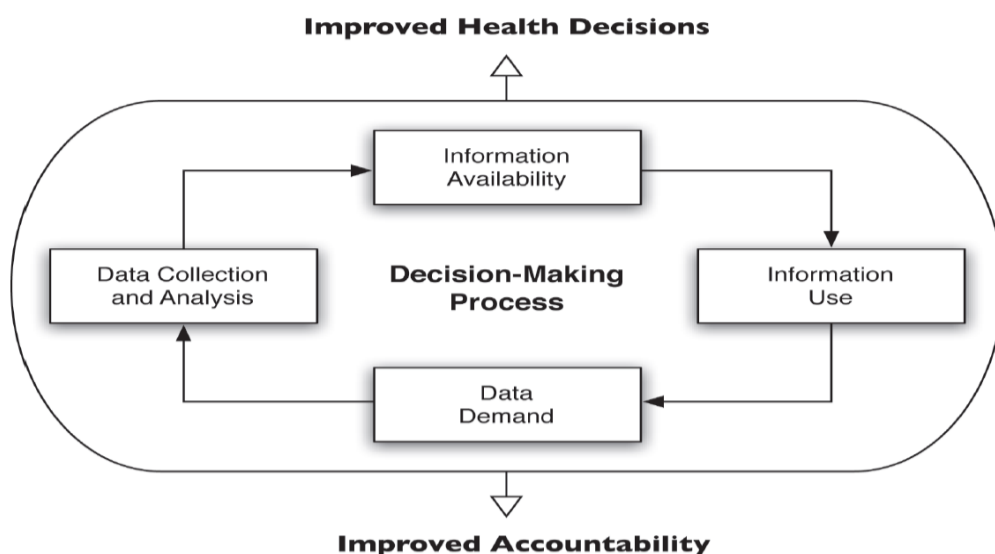
Figure 2.4: Data Demand and Information Use Framework, 2005.
Source: MEASURE/Evaluation[163]
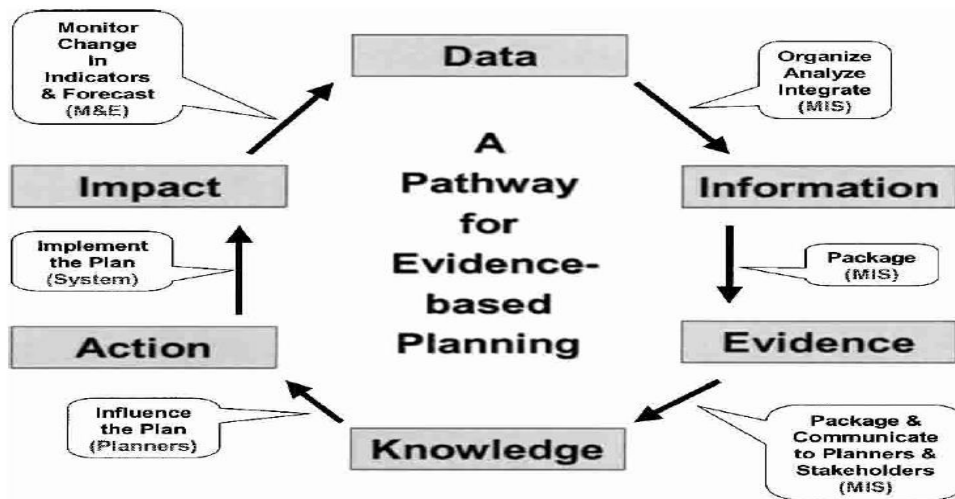
Figure 2.5: A pathway for evidence-based planning, 2004.

Source: de Savigny and Binka[164]

A conceptual model of computerised hospital information system (CHIS) use in South Africa was developed by Hanmer et al.[165] The model, based on DeLone and McLean,[158] Ballantine et al.,[166] and Heeks et al.[167] assumes that 'that user perception of the usefulness of a CHIS is a key determinant of whether or not the system will be used effectively' (*Figure 2.6*).[165 (p 66)] Hanmer et al.[165] posit that dimensions such as CHIS knowledge and understanding (Behavioural), appropriateness of CHIS design (Technical), CHIS performance, and the availability of CHIS resources will affect perceptions of the usefulness of CHIS, and Management's commitment to ensure CHIS success (Organisational), which in turn will determine the effective use of CHIS and/or output.
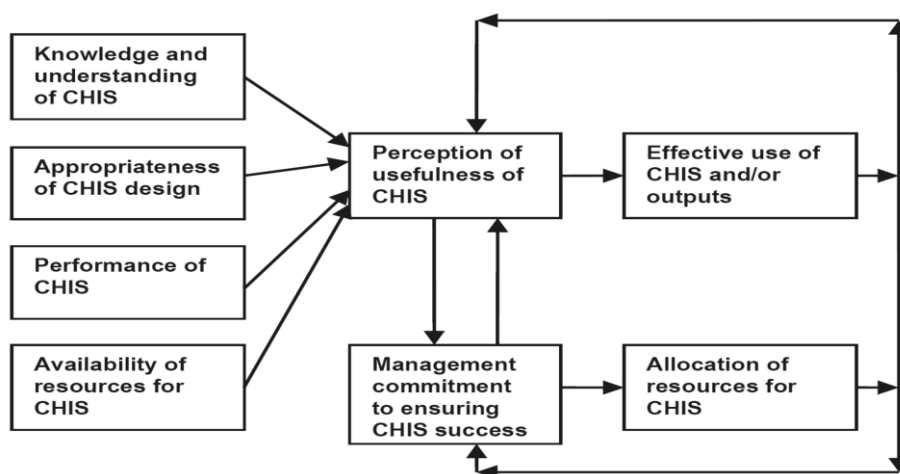
Figure 2.6: Conceptual model of CHIS use, 2007.

Source: Hanmer et al.[165]

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Lau et al.[104] developed yet another framework - the Canada Infoway Benefits Evaluation (BE) Framework (*Figure 2.7*). This framework, which is also an adaptation of the DeLone and McLean (D&M) IS model,[158] incorporating findings from the systematic reviews by van der Meijden et al.,[106] and Lau et al.,[51] was the first framework to apply the IS model to routine health information systems (RHIS). The framework focuses on measuring the success of RHIS, using a multi-dimensional model. Like the D&M IS model, the Infoway BE framework also has six dimensions: three Quality dimensions (System, Information, and Service), and two Use dimensions (Use, and User Satisfaction). However, the Net benefits dimension has been expended to include Quality, Access, and Productivity. Information quality includes two categories: content and availability. The content includes aspects on accuracy, completeness, relevance and comprehension of information over time. The availability includes the timeliness of the information, when and where it is needed, as well as the reliability and consistency of this information over time. This framework, however, failed to address some determinants of RHIS success such as organisational and behavioural factors.
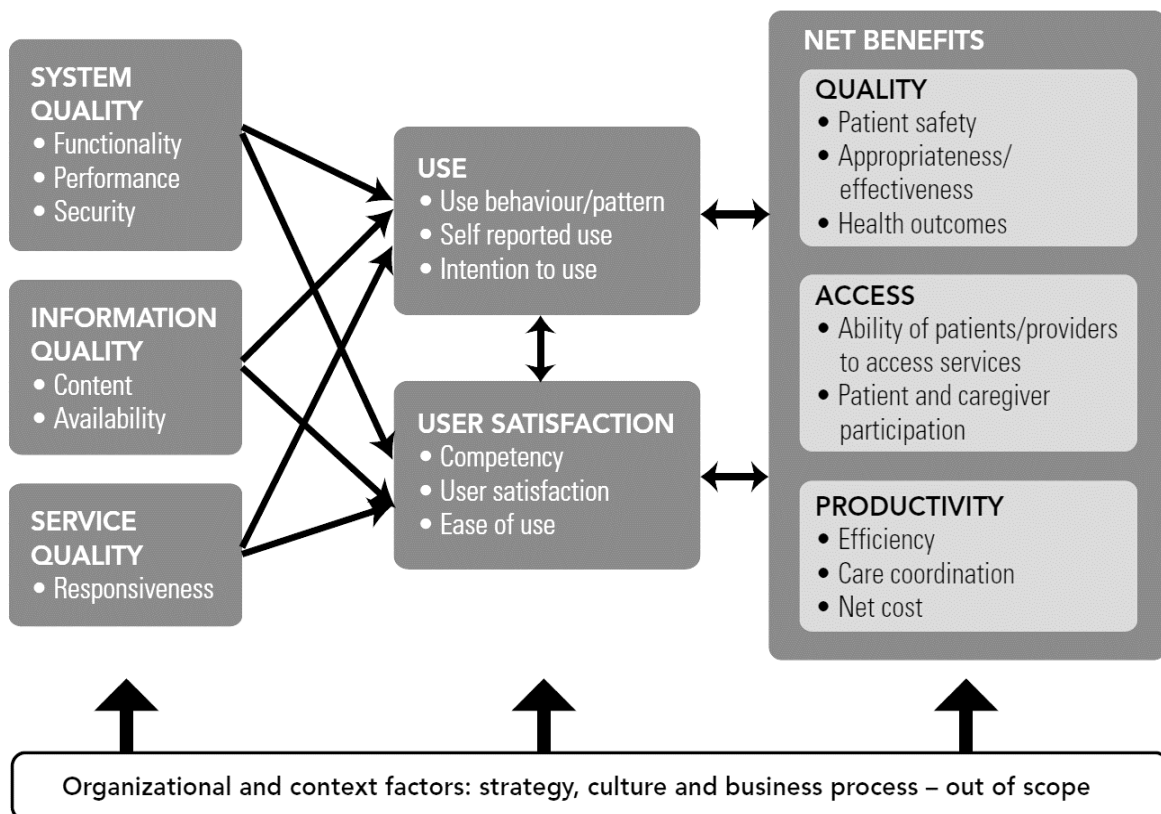
Adapted from DeLone and McLean (2003),[158] van der Meijden et al. (2003),[106] and Lau et al. (2010)[51]

Figure 2.7: The Canada Health Infoway Benefits Evaluation (BE) Framework, 2007.

Source: Lau et al.[104]

In 2008, Yusof et al.[116] improved on the gaps identified in the Canada Infoway BE framework and proposed the human, organisation and technology-fit (HOT-fit) after a critical review of the findings from existing HIS evaluation studies. The HOT-fit (*Figure 2.8*) also builds on previous IS evaluation models, in particular, the M&D IS model,[158] and IT-Organisation Fit models,[168] to bring together a fit between different aspects that influence the health information systems, that is, human, organisation and technology factors. The framework introduced a new dimension (Organisation) and grouped the existing dimensions in the D&M IS model into 3 categorises: Technology (System Quality, Information Quality, Service Quality); Human (System Use, and User Satisfaction); and Organisation (Structure, and Environment). Unlike the D&M IS model[158] and the Infoway BE framework of Lau et al.,[104] the HOT-fit framework incorporates the organisational dimension, which has been acknowledged as a critical component in determining HIS success or failure.[52,56,113,114,115,116,117] However, the 'Net benefits' portrayed in both frameworks differ; whereas HOT-fit considers Net benefits as individual impacts associated with performance such as efficiency, effectiveness, and decision quality, the BE framework, on the other hand, categorises Net benefits in three main groups: Quality, Access, and Productivity, with sub-categories as presented in *Figure 2.7*. A limitation of this framework though is the concept of 'fit', which is perceived to be complex, abstract and idiosyncratic.
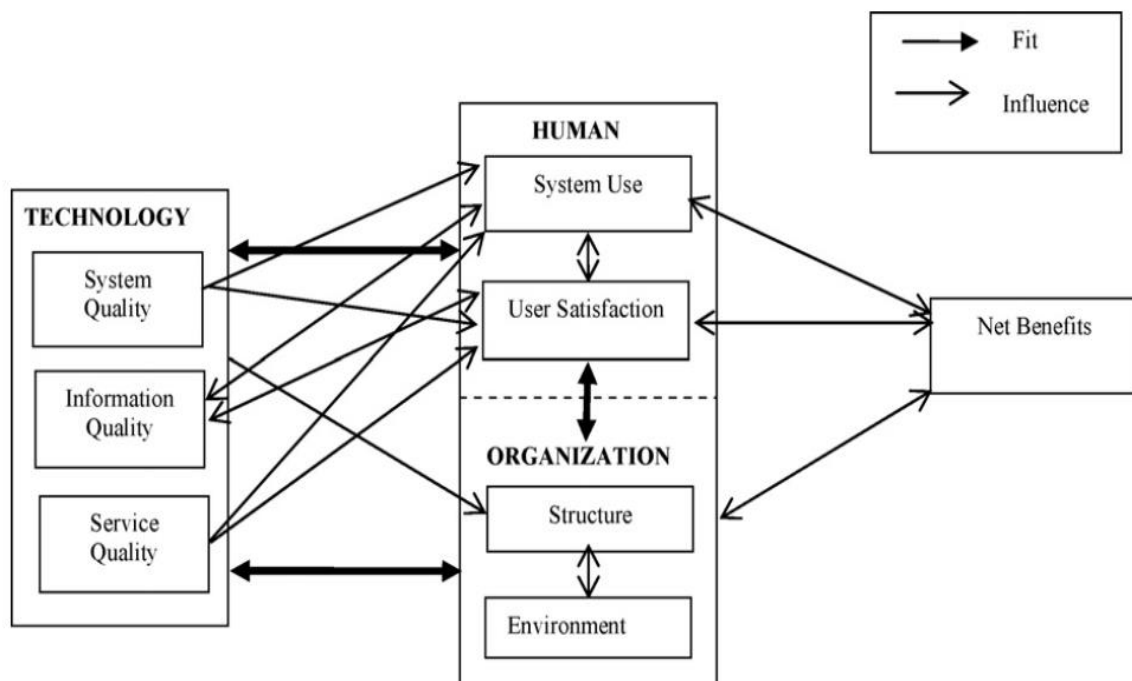
Figure 2.8: Human-organisation-technology fit (HOT-fit) framework, 2008.

Source: Yusof et al.[116]

The Health Metric Network[101] developed a comprehensive framework for a health information system.[103] The framework has six components subdivided into 'Inputs' - (a) Health information systems resources, 'Process' - (b) Indicators, (c) Data sources, (d) Data management, and 'Outputs' - (e) Information products and (f) Dissemination and use, and provides common terminology that can be used for the evaluation of health information systems. In addition, the Health Metrics Network developed an assessment tool incorporating specified standards.[169] The tool has been applied to several low- and middle-income countries, including South Africa, to review the overall performance of the National Health Information System. However, such an assessment is extremely cursory as it attempts to consider the information system in totality.[49]

Table 2. 7: Components of a strong Health Information System

Components of a Health Information System		
Inputs	1. HIS resources	Personnel, financing, logistic support, IT and communication, legislative, regulatory and planning framework.
Processes	2. Indicators	Measurable sets of data that reflect change over time
	3. Data sources	Population or institution-based
	4. Data management	Collection, storage, quality-assurance, processing, compilation and analysis
Outputs	5. Information products	Data transformed into information that can be used by decision makers to improve health care
	6. Dissemination and use	Accessibility of information by decision makers and providing incentives for information use
Adapted from Health Metric Network, 2008.[103]		

Another important development in the evaluation of the routine health information systems is the Performance of Routine Information System Management (PRISM) framework[59] (p 221) which focuses on 'neglected routine health information system (RHIS) processes, such as checking data quality, displaying of information and giving feedback' to health facilities. Developed by John Snow Inc. in collaboration with MEASURE Evaluation Project, 'PRISM represents a paradigm shift in designing, strengthening, monitoring and evaluating routine health information systems'.[92] (p 1) It proposes that performance is determined by RHIS processes (data collection, transmission, processing, analysis, display, data quality checking,

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and feedback), which in turn are affected not only by technical concerns, but also behavioural and organisational determinants. It also argues 'that behavioural determinants have a direct influence on RHIS processes, while technical and organisational determinants can affect RHIS processes directly or indirectly through behavioural determinants'.[59] (p 220)
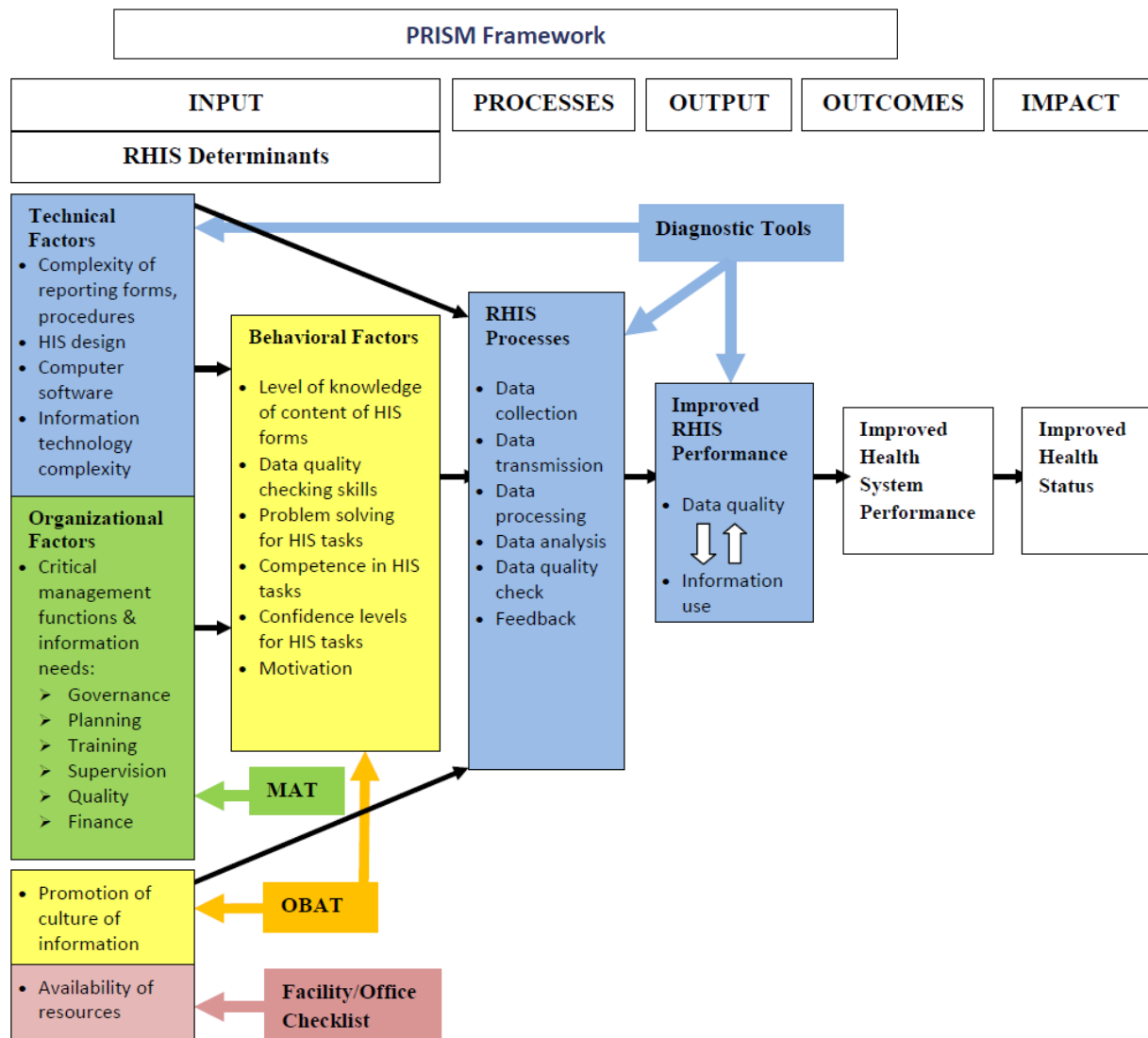
Figure 2.9: PRISM framework and tools, 2009.

Source: Aqil et al.[59]

A series of tools using the PRISM framework (*Figure 2.9*) has been developed and tested in different settings.[120,123,124,125,126,127,128] The PRISM framework and tools are the first of its kind to empirically test the relationships between technical, behavioural and organisational determinants of health information systems processes and performance. They provide opportunities for the development of interventions to bridge identified gaps in the routine health information systems. The PRISM tools comprise the Performance Diagnostic Tool, the Facility

Check List Tool, the Organisational and Behavioural Assessment Tool (OBAT), and the Management Assessment Tool (MAT), and have been validated[128] and applied in Pakistan to reform health information systems,[170] and in Uganda to conduct a situation analysis of health management information systems.[127] The PRISM Framework and tools were also used in Mexico to assess the strengths and weaknesses of the national health information system (NHIS) for better monitoring and evaluation of health information system performance.[171]

2.5   Summary/ Theoretical framework for evaluation

This review of the literature has highlighted the PMTCT processes and intervention goals, documented in the revised clinical guidelines (*Table 2.1*); it has also highlighted the WHO four-pronged strategy for PMTCT programme,[80] which include: primary prevention of HIV, preventing unintended pregnancies among HIV+ women, PMTCT, and providing appropriate treatments, care and support. The progress achieved in the PMTCT programme over the past decade, since its inception in the late 1990s have been documented, including several changes in policies, treatment options, and regimens for managing PMTCT programme, with the recent WHO recommendation of Option B+. Lessons learnt in monitoring PMTCT programme were also documented, and interventions to improve PMTCT programme performance were identified.[74,98] The NDoH has identified 16 PMTCT priority indicators and its associated 20 data elements, which are routinely collected at the facility level from three main registers: Antenatal registers, Labour ward/Delivery register, and Baby registers. The PMTCT programme will form the basis for the indicators, data elements, and data sources which this study seeks to review.

It is clear from the literature that PMTCT monitoring has been faced with several challenges. Gaps in the performance of the RHIS used in monitoring coverage and tracking progress of PMTCT programmes in South Africa, in terms of data quality and use of information for management purposes were also highlighted.[16,33,54] Despite remarkable declines in the mother-to-child transmission rates,[75,9,12] there are still concerns about persistent challenges faced in monitoring and improving the PMTCT programme. Such deficiencies include inadequate resources, insufficient capacity of health information staff,[45,46] the inadequacy of data to manage the programme, the inability of the programme to attain full coverage, and managers' inability to translate key health policies and guidelines into practice, such as planned activities to improve the programmes.[48] However, interventions that focused on quality improvement[13,74,141] have resulted in improved data.

The review has also highlighted different components of the routine health information systems. In the meta-analysis of systematic reviews of health information systems evaluation studies, Lau et al.[51] applied the Canada Infoway Benefit Evaluation Framework[104] to categorise all the studies conducted between 1966 and 2008, and observed that only a handful of the systematic reviews focused on behavioural determinants of the health information system. Furthermore, studies on the evaluation of RHIS performance primarily focus on technical and organisational issues or clinical processes[51,52] and generally fail to explain the determinants of RHIS successes or failures in different settings. Very few studies have examined the people aspect of RHIS, and these only focus on the availability of human resources[44,46] and not on competence and motivation, nor on use of data for decision making and improving service delivery. In addition, the body of knowledge has shown the poor quality of routine health information, and that this information is not often used for managing programmes, however, no study has been conducted in South Africa, and in the context of maternal and child health programmes, investigating factors responsible for poor data quality, and the barriers to using information for management purposes. This current study therefore seeks to address some of the knowledge gaps identified in this review in the context of the PMTCT programme. These gaps include information gaps at different levels, inadequate availability of resources for monitoring progress on PMTCT programmes, non-use of and barriers to the use of routine information for monitoring purposes, and PMTCT data quality at both the facility and district levels. A major gap in the literature which this study will seek to address are issues related to the behavioural and organisational determinants affecting RHIS performance, focusing specifically on skills and competencies of those that collect and manage the routine data. Addressing issues around the relationship between human/ behavioural factors (such as knowledge, understanding, skills, attitudes, competencies) and data quality.

Also identified in this review are theoretical frameworks for evaluating health information systems. The strengths of each of these frameworks have already been discussed, drawing on the overview by Hotchkiss et al.[107] A schematic summary of the frameworks, and how they are linked along the logic model framework, is presented in chronological order in *Table 2.8*. Of the four frameworks that have highlighted the behavioural determinants of RHIS, only two, TPC and PRISM (*Figure 2.3* and *Figure 2.9*), address an aspect usually neglected in RHIS, that is, issues relating to skills, competence, and motivation of health information personnel such as data capturers, facility managers and health information officers. The PRISM framework has been identified as the only framework that has empirically tested the relationships between the three determinants of RHIS processes and performance: technical, organisational and

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behavioural. Furthermore, the framework is the only framework that reviewed the differentials between all four components of an evaluation framework as discussed in *Sub-section 2.4.9*. As a result, the PRISM framework and its associated tools will be adapted in this study and used to assess the availability of RHIS resources, and RHIS staff competence, such as data quality checking skills, problem-solving skills, RHIS processes, data quality (data completeness and data accuracy), data flow and use of information. In addition, the PRISM tool will be used to investigate the relationships between different components of the RHIS, and identifying the causal relationships between behavioural factors and RHIS processes and performance. Furthermore, organisational determinants of RHIS such as critical management functions, and promotion of information use culture at the district and facility levels will be assessed. The adapted framework is therefore expected to help explain the mechanism through which the independent variables predict and explain RHIS performance (data quality and information use).

2.6 Study hypotheses

Studies have identified data quality issues as one of the challenges faced with the information for PMTCT, but no study has investigated why these challenges are occurring. There have been no studies that have investigated the determinants of data quality, and the impact behavioural factors have on RHIS performance (data quality and information use).

Despite the influence of organisational determinants on the RHIS, there is limited research comparing RHIS performance in different organisational settings. This study will attempt to investigate differences in organisational structures and institutional agency/authority by comparing two different settings in two provinces, and determining if being in one institutional agency affects RHIS performance, and whether organisational factors such as governance, planning, training, supervision, and a culture of information use influence RHIS performance.

The hypotheses of this study are as follows:

i.   Behavioural factors such as core competence in RHIS-related tasks, motivation, and knowledge of RHIS rationale have a positive and direct influence on RHIS performance.

ii. Personnel's background characteristics such as educational level, job category, age, gender and knowledge of checking data quality, is not directly correlated with their levels of competence in RHIS-related tasks.

iii. Organisational factors such as leadership, planning, management support, supervision, and culture have a direct influence on data accuracy.

iv. Information use is not directly associated with data accuracy.

Table 2.8: Conceptual frameworks for RHIS evaluation (*in chronological order*)

Authors/ Conceptual Framework	Inputs Determinants	Processes	Outputs RHIS data quality and information use	Outcomes Health systems functioning, health systems performance
Goodhue (1995)[160] - Technology-to-Performance Chain (TPC)	• Task characteristics • Technology characteristics • **Individual characteristics** • Precursors of utilization: expected consequences of use, affect toward using, social norms, habit, facilitating conditions.	• Task-technology fit • Utilization	• Individual performance: effectiveness, efficiency, quality	N/A
Shaw (2002)[162] - CHEATS	• Technical	• Appropriateness of technologies • Video and sound quality • Ease of use • Technology specific training • Reliability of technology		• Clinical • Human and organisational • Educational • Administrative • Social
DeLone and McLean (2003)[158] - IS Success Model Applied to RHIS by Lau et al. (2007)[104] - Benefits Evaluation Framework		• Information quality - completeness, accuracy, availability, timeliness, reliability • System quality - functionality, performance (access, reliability, response time), security • Service quality - responsiveness of IS support	• Intention to use/use - actual system use, self-reported system use • User satisfaction - user competency, user perceptions, ease of use	<u>Net Benefits</u> • Quality of care (patient safety, appropriateness and effectiveness, health outcomes) • Productivity (efficiency, coordination of care, net costs) • Service access

Authors/ Conceptual Framework	Inputs Determinants	Processes	Outputs RHIS data quality and information use	Outcomes Health systems functioning, health systems performance
De Savigny and Binka (2004)[164] - A Pathway for Evidence-Based Planning	• Data	• Data cleaning • Controlling • Organizing • Analysing • Integrating	• Information • Evidence • Knowledge	• Actions/decisions regarding implementation of plans and systems • Impact of actions/ decisions • Monitoring change • Forecasting
MEASURE/Evaluation (2005)[163] - Data Demand and Information Use Framework	• Technical • Organisational • **Behavioural** • Health system and individual level factors	• Data collection and analysis	• Information availability • Information demand • Information use for decision-making	• Service coverage • Service quality • Efficiency
Hanmer et al. (2007)[165]	• Technical- software fit with user requirements, information system supplier knowledge of health system environment; appropriateness of information system design • Resource availability at the provincial and health facility levels • Organisational and contractual mechanisms, management commitment to success • **Behavioural** - knowledge and understanding of information system	• Perceived usefulness of information system	• Effective use of information system and/ or outputs	

Authors/ Conceptual Framework	Inputs Determinants	Processes	Outputs RHIS data quality and information use	Outcomes Health systems functioning, & performance
Health Metrics Network (2008)[103] - Framework and standards for country health information systems	• HIS planning frameworks • Personnel • Financing • Logistics support • ICT • Coordinating mechanisms	• Indicators • Data sources • Data management (data storage, processes to ensure data quality, data processing and compilation)	• Information products • Dissemination and use	
Yusof et al. (2008)[116] – HOT-Fit		• System quality • Information quality • Services quality	• System use • User satisfaction • Organisation structure and environment	• Net Benefits - clinical practice, efficiency, effectiveness, decision-making quality, error reduction, communication, clinical outcomes
Aqil et al. (2009)[59] - PRISM Framework	• Technical - complexity of reporting form, RHIS design, software, IT complexity • Organisational - governance, planning, training, supervision, finances, information distribution, promotion of a culture of information • **Behavioural** - data quality checking skills, levels of knowledge of RHIS rationale, problem solving skills, RHIS tasks competence, RHIS task confidence, motivation	• Data collection • Data transmission • Data processing • Data analysis • Data display • Data quality checks • Feedback	• Data quality - relevance, completeness, timeliness, accuracy • Information use - for identifying problems, for considering and making decisions, and for advocacy	• Service Coverage
Adapted from Hotchkiss et al. (2012)[107]				

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Chapter 3

Methodology

3.1   Introduction

The aim of this chapter is to provide an overview of the methodology used in this study. It includes the study design, study population, sample methods and sample size, characteristics of the study sites, health facility and health information personnel survey, in-depth interviews, observations at facilities, and ethical considerations.

3.2   Study design

The study design is a comparative analytical and observational study, using a multi-method approach involving both quantitative and qualitative data, to investigate the quality of PMTCT data and factors affecting the performance of the PMTCT routine heath information systems (RHIS) in two health districts in South Africa. The quantitative methods were used to address *Objectives 1*, *3*, and *4*, whereas the qualitative methods were used to elicit information from key informants on the barriers to PMTCT information use (*Objective 2*).

Quantitative data were collected through:

a. a facility survey of resources, organisation and use of information
b. a survey of health information personnel
c. assessment of the quality of routinely collected PMTCT data by comparing with information collected from registers, tally sheets and patient records
d. secondary analysis of routinely collected PMTCT data from the DHMIS.

The qualitative data were collected through:

a. in-depth interviews with key informants
b. observations in health facilities
c. an inventory of PMTCT registers, patient records, tally sheets and software at each of the health facilities in the two districts.

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These activities were supported by a desktop review of literature from Medline, PubMed, Sage, ScienceDirect, Scopus, Web of Science, and Google Scholar databases; organisational websites such as the South African national and provincial Departments of Health (DoH), relevant monitoring and evaluation (M&E), Maternal and Child Health (MCH) and HIV/AIDS organisations, and grey literature to identify frameworks for monitoring and evaluating PMTCT programmes. Keys terms like 'data quality', 'health information systems framework', 'M&E', 'PMTCT indicators' were used. In addition, information was sourced through contacting key informants in the field of M&E, and PMTCT to assist in identifying suitable frameworks. This study will use the PRISM framework that assumes a relationships between technical, behavioural and organizational determinants of the routine information processes and performance. The framework will be used to assess the availability, quality, and use of RHIS. *Table 3.1* illustrates the linkages between the study objectives, data collection methods and the PRISM tools.

Table 3.1: The linkages between the study objectives and data collection methods

Data collection	Objective 1 (Gap Analysis)	Objective 2 (Use and barriers to use of information)	Objective 3 (Data quality assessment)	Objective 4 (Behavioural and organisational determinants of RHIS)
Quantitative methods				
• A facility survey of resources, organisation and use of information *(RHIS Overview tool, MAT and Performance diagnostic tool-Use of information module)*	X	X		X
• Desk review	X			
• A survey of health information personnel *(OBAT)*				X
• Assessment of the quality of routinely collected data by comparing with information collected from registers, tally sheets and patient records *(Performance diagnostic tool-Data Quality Assessment module)*			X	
• Secondary analysis of routinely collected data from the DHMIS			X	
Qualitative methods				
• In-depth interviews with key informants using a semi-structured questionnaire	X	X		X
• An observational study in health facilities		X		

3.3   Study population

The study population included two groups of personnel: data collectors and users. The data collectors included health information officers (HIO), health facility managers, professional nurses, data capturers, and clerks involved in data collection at facility and district levels; while the data users included facility managers, PMTCT programme managers, monitoring and evaluation officers and district managers responsible for the sub-districts included in the study. In addition, all health facilities in the Amajuba district in KwaZulu-Natal province (KZN), and in the Khayelitsha and Eastern sub-districts in the MDHS/City of Cape Town (CoCT) district in the Western Cape province (WC) were included in the study. Mobile/Satellite clinics and clinics that were not operational for the full six months under consideration (January – June 2012), or did not provide PMTCT services, were excluded from the study.

3.4   Sampling method and sample size

3.4.1   Districts

Convenience sampling was used to select two districts for practical purposes, each incorporating one of the eighteen priority sub-districts identified by the South African National Department of Health (NDoH) (i.e. Khayelitsha in the Cape Metro/City of Cape Town district, WC, and Dannhauser in the Amajuba district, KZN) as the most deprived, having the highest burden of HIV, with the poorest health status, and poor access to health care and health service delivery. The Eastern sub-district was included in the study because the Khayelitsha/Eastern substructure (KESS) is classified as one of the four substructures in the Cape Metro Health District (MDHS), as shown in *Figure 3.1*

In addition to being priority sub-districts, the sites were chosen to compare the experience in a province with the highest prevalence of HIV (35.7%, KZN), with that with the lowest prevalence of HIV (18.5%, WC) as at 2011. The Amajuba district has an HIV prevalence of 35.9%, which is comparable to the prevalence in Khayelitsha (33.1%), a sub-district in the Cape Metro/City of Cape Town district, with the highest prevalence of HIV in WC. Although both study sites have similar HIV prevalence, socio-economic status, and are poorly resourced, they have different routine health information systems and their management structures are different. The Amajuba district is managed by a single entity – the KZN Provincial Department of Health, whereas Khayelitsha and the Eastern sub-districts have dual management – the Western Cape provincial department of health, also known as Cape Metro District Health Services (MDHS)

and the City of Cape Town (CoCT). Because this study was conducted in facilities managed by different authorities, the term 'sub-structure' – used by the Metro district health services to refer to the organisational level between the facility and district – is used interchangeably to mean the same as sub-district, a term used in both CoCT and the Amajuba district.

At the sub-district, district and provincial levels, at least one health information officer, PMTCT/HAST coordinator/programme manager, sub-district manager, and district manager were selected from each province (*Figure 3.1*).
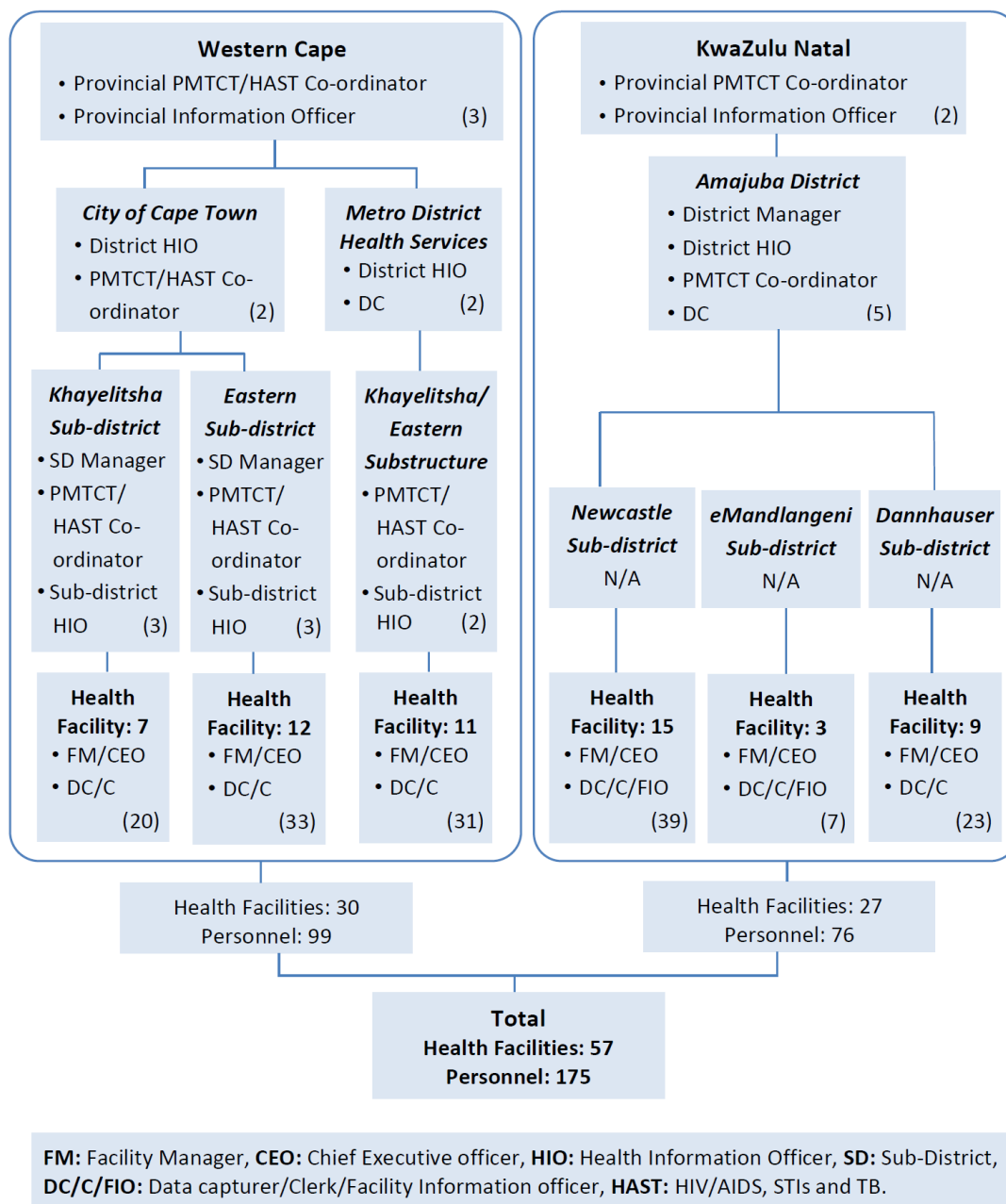
Figure 3.1: Annotation of selected sample for both quantitative and qualitative methods by province

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3.4.2   Facilities

The main selection criteria for inclusion in the study is that health facilities had to have a Health Information System (HIS) for routine data collection of PMTCT indicators. Mobile facilities and facilities that had not been operational for the full six months under consideration (January – June 2012), or did not provide PMTCT services, were excluded from the study. Facilities that do not see women and children, for example, men's clinics only, were also excluded from the study. In total, 57 health facilities, 27 in the Amajuba district and 30 in Khayelitsha and the Eastern sub-districts were included in the study (*Table 3.2*).

The Amajuba district, KZN, has a total of 34 health facilities, including mobile clinics, of which 27 facilities (77.1%) met the selection criteria and were included in the study (*Table 3.2*). These facilities include three hospitals, two primary health centres, 19 clinics and three gateway clinics, and are all managed by the provincial Department of Health (DoH).

On the other hand, there are 35 health facilities in the Khayelitsha and in the Eastern sub-districts of which 30 facilities (85.7%) met the selection criteria for the study. These include three hospitals, three midwife obstetrics units (MOU), two community health centres (CHC), seven community day centres (CDC), and 15 clinics. These health facilities provide a range of services including maternal and child health, HIV testing and counselling, ARVs, TB treatment, and have dual management – CoCT and MDHS (*Table 3.2*).

Within each health facility, the facility manager/deputy manager, and at least two personnel involved in PMTCT data capturing were selected to participate in the self-administered health information personnel survey. A total of 182 personnel were expected from the 57 health facilities included in the study, and from the sub-district and district offices; however, only 161 personnel were surveyed since 6 facility managers, and 15 data capturers were unable to participate in the survey resulting in a response rate of 88.5%.

Table 3.2: List of facilities visited by district authority and type

Facilities	Amajuba District N=27			City of Cape Town District N=19		Cape Metro N=11
	Newcastle SD	eMadlangeni	Dannhauser	Khayelitsha	Eastern	KESS
Hospital	• Madadeni Hospital • Newcastle Hospital	• Niemeyer Hospital				• Khayelitsha District Hospital • Helderberg Hospital • Eerste River Hospital
CDC/ MOU						• Macassar CDC/MOU • Khayelitsha Site B CDC/MOU • Michael Mapongwana CDC/MOU
CHC/PHC	• Newcastle PHC	• Groenvlei PHC			• Macassar CHC	
CDC				• Matthew Goniwe CDC • Nolungile CDC (city) • Town Two CDC		• Kleinvlei CDC • Mfuleni CDC • Nolungile CDC (metro) • Strand CDC • Gustrouw CDC
Clinics	• Madadeni clinic 1 • Madadeni clinic 5 • Madadeni clinic 7 • Osizweni clinic 1 • Osizweni clinic 2 • Osizweni clinic 3 • Stafford clinic • Rosary clinic • Mndozo clinic • Charlestown clinic		• Ladybank clinic • Naas farm clinic • Vedriet clinic • Thembalihle clinic • Nellies farm clinic • Emfundweni clinic • Thandanani clinic • Durnacol clinic • Greenock clinic	• Kuyasa clinic • Luvuyo clinic • Mayenzeke clinic • Zakhele clinic	• Dr Ivan Toms clinic • Ikwezi clinic • Russell's Rest clinic • Gordon's Bay clinic • Fagan Street clinic • Sarepta clinic • Kuilsriver clinic • Sir Lowry's Pass clinic • Somerset West clinic • Wesbank clinic • Bluedowns clinic	
Gateway clinics	• Madadeni gateway clinic • Newcastle gateway clinic	• Niemeyer gateway clinic				
Total	15	3	9	7	12	11

MOU: Midwife Obstetric Units, CHC: Community Health Centres, PHC: Primary Health Centres, CDC: Community Day Centres

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3.4.3   Monthly reports and records

To assess data quality and use of information at the facility, we administered the set of Performance of Routine Information Systems Management (PRISM) tools (*Figure 3.4*), collected routine monthly reports for the months of January and April 2012, and for the same months, collected six of the 20 PMTCT priority data elements from facility registers, which were both in electronic and manual format. The two months (January and April) were purposively selected based on the fact that January is the first month in the calendar year and April, the first month in the financial year.

3.5   Characteristics of study sites

3.5.1   Profile and geography of study sites

The three study settings identified were the Amajuba district in KwaZulu-Natal, the Eastern and Khayelitsha sub-districts (City of Cape Town) and Khayelitsha/Eastern substructure (KESS) in the Cape Metro district, Western Cape. Located in the best resourced province (Western Cape), Khayelitsha sub-district is among the 18 priority sub-districts identified by the national Department of Health as the most deprived in terms of socio-economic status, with a high burden of HIV, and the poorest health status, resulting from poor access to health care and health service delivery.

The Amajuba district is located in the north western region of KwaZulu-Natal (*Figure 3.2*), comprising three local municipalities, Newcastle, eMadlangeni and Dannhauser, with a total population of about half a million in 2011.[7] eMadlangeni occupies the largest area of 3,539km^2, Newcastle 1,855km^2 and Dannhauser 1,516km^2, with populations of 40,997, 366,671 and 102,161 people respectively. The district is mainly semi-urban (partly urban and partly rural) with over 70% of its population below 35 years of age, and an estimated unemployment rate of 26.46%.[172]

On the other hand, the Cape Metro district covers an area of 2,440 km^2 and has a population of about 3.6 million, with eight sub-districts, namely Eastern, Khayelitsha, Klipfontein, Mitchell's Plain, Northern, Southern, Tygerberg, and Western Sub-districts (*Figure 3.3*). Khayelitsha sub-district is a semi-urban informal settlement with an estimated population of 1.5 million residents. The sub-district has a young population with about three-quarters of the population

under 35 years and 29% below 14 years of age; 47% of the residents are unemployed, and 55% are living below the poverty line.[173]
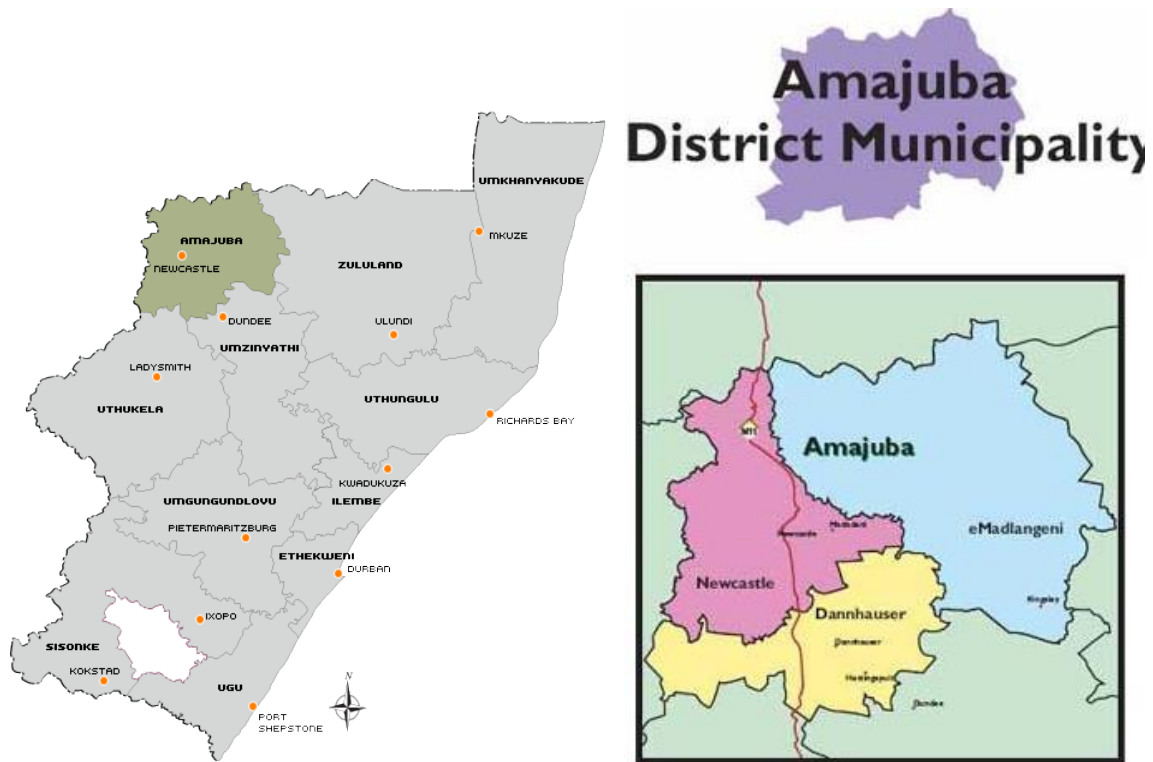
Figure 3.2: Map of Amajuba showing Newcastle, eMadlangeni and Dannhauser sub-districts
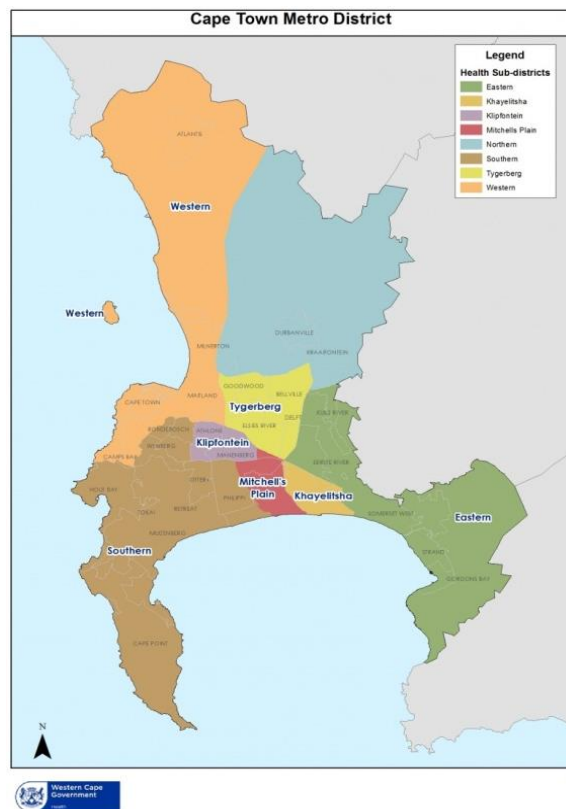
Figure 3.3: Map of Cape Town Metro district showing Khayelitsha Eastern sub-districts

3.6   Health facility and information personnel survey – Quantitative study

3.6.1   Data collection tools

This study used the Performance of Routine Information Systems Management (PRISM) framework, designed along the logic framework (input, process, output, outcome and impact) to identify the health information requirements for decision making to improve health care delivery. The PRISM framework has been described elsewhere (Aqil et al.,[59] and in *Section 2.4.9*). A series of tools (*Figure 3.4*) using the PRISM framework have been developed and tested in different settings;[59,92,123,125,126,128] the tools were modified by the researcher to suit the South African routine health information system and has been adapted to understand the inputs, processes and outcomes of the District Health Management Information Systems (DHMIS) in the context of PMTCT programmes.
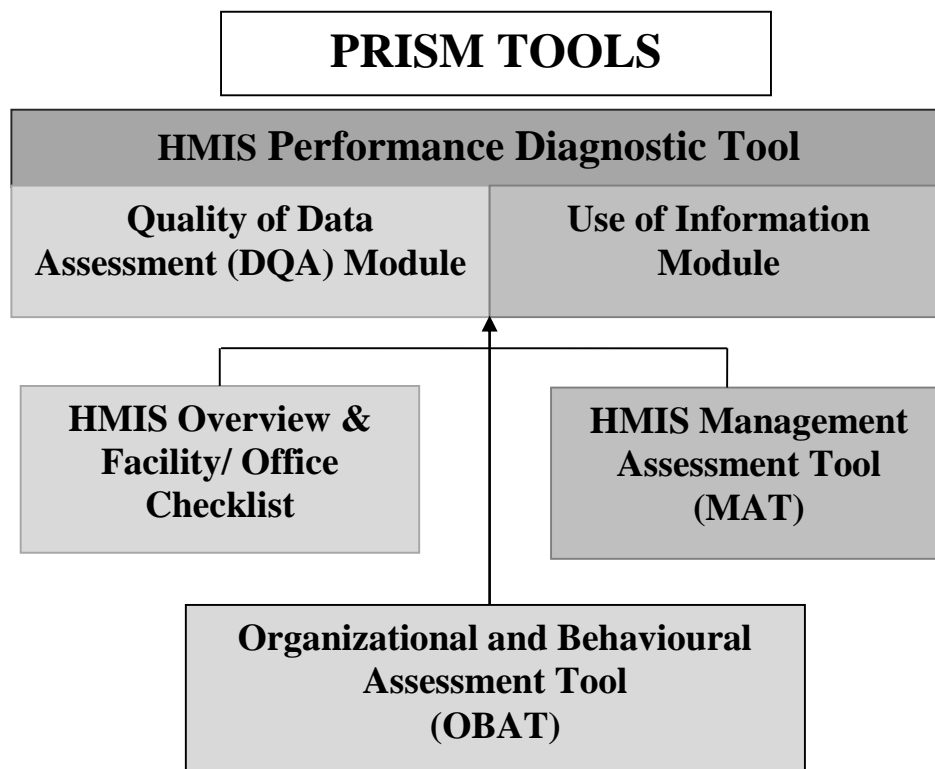
Figure 3.4: The Performance of Routine Information System Management (PRISM) tools

The PRISM tools consist of four instruments – Performance Diagnostic Tool (comprising a data quality assessment (DQA) and a use of information module), Overview and Facility/Office Checklist, Management Assessment Tool (MAT), and the Organisational and Behavioural Assessment Tool (OBAT). See Appendix G for a complete set of the tools.

3.6.1.1   Performance Diagnostic Tool

This instrument, which was used to elicit information from health information officers in each district and staff involved in data collection in all 57 health facilities, consists of two modules:

(a) The *Quality of data assessment module,* a structured questionnaire which is sub-divided into two (*Health facility form* and *District office form*), was used to evaluate RHIS performance (data accuracy, and completeness), and RHIS processes (data collection, transmission, processing, analysis, presentation, data check and feedback). *Table 3.3* shows an excerpt of the questions asked to assess data quality, while *Table 3.4* illustrates an excerpt of questions on RHIS processes.

The six PMTCT data elements used in this study are output indicators (*Table 3.3*). The data elements which were purposely selected include: two antenatal care services, one delivery service and three baby care services, extracted at the facility level from three main registers: Antenatal care register, Maternity/Labour ward register, and Baby follow-up register. Four of the data elements: *Antenatal client HIV 1st test, Antenatal client initiated on HAART, Baby given nevirapine prophylaxis less than 72 hours after delivery*, and *Baby PCR test around six weeks* were selected based on their importance in determining the mother-to-child transmission rate. The data elements were also included to verify the accuracy of reporting since estimates as of 2012 reported that almost 98% of women attending antenatal clinics have been tested for HIV, and only 75% of the antenatal clients who tested positive were initiated on Highly Active Antiretroviral Therapy (HAART).[7] This study was unable to identify any information system that captures data on PMTCT process indicators.

Table 3.3: Excerpt of questions on data quality assessment

Data Accuracy Check					
FQ4	Using the outpatient register, fill in the following information for any two months (Month A and Month B). If the facility does not keep copies of the monthly report, obtain copies at the sub-district/district office. Compare the figures with the computer-generated reports.				
	Item	January 2012		April 2012	
		# from register	# from report	# from register	# from report
FQ4a	*Baby given Nevirapine within 72 hours after birth*				
FQ4b	*Antenatal client HIV re-test at 32 weeks*				
FQ4c	*Baby PCR test around 6 weeks*				
FQ4d	*HIV exposed babies initiated on Co-trimoxazole prophylaxis around 6 weeks*				
FQ4e	*Antenatal client HIV 1st test*				
FQ4f	*Antenatal client initiated on HAART*				
Source: Adapted from Aqil et al.[154]					

Table 3.4: Excerpt of questions on RHIS processes

Routine Health Information System (RHIS) Processes			
FQ 5	Did you receive a directive in the last 3 months from the senior management in the district office to:		
FQ5a	Check the accuracy of data at least once in three months?	1.Yes, *Observed*	0. No
FQ5b	Fill the monthly/quarterly report form completely?	1.Yes, *Observed*	0. No
FQ5c	Submit the report by a declared deadline?	1.Yes, *Observed*	0. No
FQ 6	During the last three months, did you receive notification from the senior management in the sub-district/district office that there would be consequences for not adhering to the following directives:		
FQ6a	If you do not check the accuracy of data?	1.Yes, *Observed*	0. No
FQ6b	If you do not fill in the monthly reporting forms completely?	1.Yes, *Observed*	0. No
FQ6c	If you do not submit the monthly report by the specific deadline?	1.Yes, *Observed*	0. No
Source: Adapted from Aqil et al.[154]			

(b) The *Use of information module*, also sub-divided in two (*Facility assessment form and District assessment form*), is a self-reporting tool that elicits data on the use of information at different levels to inform decision making for maternal and child health, HIV, the health information system, and general decision making, at the individual patient care, facility, district and provincial levels. It collected data on report production, information display, discussion, referral, promotion of information use, quality of supervision, and technical determinants such as complexity of forms, IT, and integration (*Appendix G*).

3.6.1.2   RHIS Overview and Facility/Office checklist

An inventory of records and registers was conducted at health facilities in the two districts to obtain an overview of the flow of information and information tools used at district, facility and patient levels in each district. The RHIS Overview and Facility Checklist, which consist of four sections (Information system inventory tool, Data collection and transmission review sheet, Information flow sheet, and Facility/Office checklist) were administered to health information officers and facility managers in each facility, and to information managers at the district and provincial levels, to assess the availability of resources such as equipment, storage of information, software, and availability of documents including reports and registers in each facility.

3.6.1.3   The Management Assessment Tool (MAT)

The MAT instrument was applied at facility level and at sub-district, district, and provincial levels. It contains structured questions about management processes and protocols including 'critical management functions and information needs, governance, planning, and training' (*Appendix G*), supervision and finance. It also requires interviewers' observations and cross-checking of relevant documentation (such as management organisational chart, RHIS situation analysis, copies of RHIS standard operating procedures, RHIS training manuals, schedules for planned training, RHIS supervisory checklist, and RHIS financial reports) to ascertain whether these processes were actually in place at both the facility and the district offices. Copies of all the minutes of meetings for the months under review were requested and the processes/responses verified.

3.6.1.4   The Organisation and Behavioural Tool (OBAT)

The OBAT is a self-administered instrument used to evaluate behavioural factors influencing the performance of the routine health information systems (RHIS) and assesses whether information personnel have the necessary skills needed to perform RHIS tasks. It also assesses personnel's perceptions of their organisation, and of the promotion of a culture of information use through a rating scale. All personnel involved with health information were requested to complete the questionnaire, which took about 20–30 minutes, depending on the competence of the respondents. Basic information such as background characteristics (age, sex, education, job category, years of employment, and HIS training in the last six months prior to the survey), data-quality checking skills, levels of knowledge of RHIS rationale, and problem-solving skills were collected. In addition, personnel were asked by trained interviewers to rate their perceptions of organisational themes, motivation, and their confidence levels in performing RHIS tasks using a Likert scale (*Table 3.5*); they were then given a self-administered basic competence test (*Figure 3.5*) based on the themes in *Table 3.5*, these were scored and analysed. Participants were given the freedom to spend as much time as needed to finish the test; there were no time restrictions.

Confidence in RHIS tasks

Table 3.5: Excerpt of RHIS tasks questionnaire

On a scale of 0 to 100%, please rate your confidence in accomplishing the following activities. (For example, if you are very confident select 100 %.)											
Rate your confidence for each situation to a percentage from the following scale											
	0	10	20	30	40	50	60	70	80	90	100
SE1. I can check data accuracy											
SE2. I can calculate percentages/rates correctly											
SE3. I can plot data by months or years											
SE4. I can compute trends from bar charts											
SE5. I can explain findings & their implications											
SE6. I can use data for identifying gaps and setting targets											
SE7. I can use data for making various types of decisions and providing feedbacks											
Source: Adapted from Aqil et al.[154]											

Competence in RHIS tasks

> ***Problem Solving Skills***
>
> Please solve the following problems about calculating rates and interpreting information.
>
> **C1.** The estimated number of pregnant women in sub-district K is 340. Antenatal clinics have registered 170 pregnant women. What percentage of pregnant women attended antenatal clinics in sub-district K?
>
> *Source: Adapted from Aqil et al.[154]*

Figure 3.5: Example of RHIS competence questions

Personnel's perceived motivation and perceptions of their organisation and promotion of culture of information use were elicited using a 7-point Likert scale ranging from 'strongly agree' to 'strongly disagree' (*Appendix G*). Questions were asked about decisions made in the health department, superiors in the health department, fellow staff, and about the respondents. The indicators for these questions include 'emphasis on data quality, use of information, evidence-based decision making, feedback from staff and community, sense of responsibility, empowerment and accountability', promoting problem solving, and perceived reward from the Department of Health.

3.6.2   Fieldworker training and quality control

The fieldwork posts were advertised via several media. Prospective candidates were required to reside in close proximity to the study sites (Khayelitsha, Cape Town and Newcastle, Amajuba district, KZN), and to have at least a 1-2 year relevant accredited certificate with skills training in the social sciences and a health-related field (emergency services/nursing/health). Work experience in a research or health-related environment, with experience in conducting research interviews and collecting survey data for community-based research projects, was also required. Candidates were expected to have good organisational skills and the ability to work both independently and in a team, have a strong numeric skills, excellent attention to detail and the ability to detect errors. In addition, they were required to have strong computer skills in the Microsoft Office package, a valid, unendorsed code 8 driver's licence, and to be willing to travel within the district. The ability to speak isiZulu, isiXhosa and Afrikaans was an added advantage, and preference was given to candidates who had excellent people and numeracy skills and experience working in township settings.

Of the 59 applicants, 14 met the criteria and were given an online competency assessment. Eleven candidates were invited for a telephonic interview on the basis of the competency assessment, of which six candidates were shortlisted.

Shortlisted candidates were given a two-day intensive training on the DHMIS and the research protocol, where the background to the study was outlined and the data collection tools introduced. In addition, candidates were taken through the data collection processes, which included a hands-on practical demonstration of what is expected of them on the field, and what should be done before setting out to the health facilities, what data elements to look out for, where to find them, how to collect the necessary information from registers and patients' records using the PRISM tools, what tools to use, what to observe in each health facility, and how to manage the data collected. Candidates also received training on ethics and confidentiality of data collected. A detailed description of what was expected from each fieldworker is documented in the Survey Manual developed for the fieldwork (*Appendix H*). At the end of the training, a competency post-training evaluation was given, focusing on the procedures of this study. Candidates with the best overall scores in both the pre- and post- tests were recruited and fieldwork commenced immediately after the training.

To ensure the quality of the fieldwork, teams were given log sheets that were to be signed by managers of facilities visited. The log sheet included names of facilities visited, time spent in the facility, date of visit, etc. For the Amajuba district sites, these sheets, including the completed survey tools and copies of the routine monthly reports, were couriered fortnightly to the Cape Town project office. The project manager was given the task of going through the completed instruments and communicating any inconsistencies with the supervisor/fieldworkers to resolve any data quality problems that were experienced during fieldwork. Fieldworkers were remunerated monthly, based on satisfactory completion of the questionnaires, in addition to submission of the daily log sheet maintained by the supervisor, and the submission of a completed contractor's claim form.

3.6.2.1   Sub-sample

In order to ensure quality control of the data collection process, we randomly drew five patient folders from each register. Five health facilities selected at random from each district were revisited after the initial evaluation to repeat sections of the PRISM Organisational and Behavioural Tool (OBAT) and Performance Diagnostics Use of Information tools with the same people who had completed the tools on the first visit. This information was used for validation purposes.

3.6.3   Data entry

Data collected from both study sites were captured and recaptured into the PRISM's customised Data Entry and Analysis Tool (DEAT) software by a research assistant after undergoing training on the use of the PRISM DEAT to capture and manage data. The DEAT is open-source software customised to capture data from the PRISM tools. It allows for modifications made on the PRISM tools, especially in respect of data elements chosen to check for data accuracy, availability of equipment and resources, reports and registers; and categories of health personal at the facility. As has already been alluded to in *Section 3.6.1*, the PRISM tools were modified to suit the routine health information system in South Africa in the context of PMTCT programmes. These modifications were incorporated into the DEAT to allow for easy capturing.

To ensure data reliability, duplicate data entry was undertaken, and the data were randomly checked by the investigator. Captured data were then extracted into Microsoft Excel, and compared using the Excel Comparison tool. Data inconsistencies were identified and validated

against the captured questionnaires. Further data cleaning and validation were done by generating frequency tables for each data element to identify missing or inconsistent values which may have occurred during data capture. The cleaned data was then exported to STATA® Version 13, where it was recoded to allow for comparison of variables that were not standard across districts, for example, job category.

3.6.4   Indicators for analysis

A set of indicators were derived from data elements, and categorised into themes according to the study objectives (*Appendix I*).

3.6.4.1   Availability of resources: (Objective 1)

Elements used to calculate this indicator included: equipment, software, information storage, communication capacity, availability of human resources and RHIS training, District Health Management Information Systems (DHMIS) forms, registers, and utilities such as electricity, water, and air conditioning for computers.

3.6.4.2   Use of information for decision making: (Objective 2)

The indicator 'Use of information' was assessed at both the facility and district levels using a set of weighted elements which included: RHIS report production, frequency of RHIS report, types of report produced, display of information in facility, use of information in available report at facility, types of decisions based on types of analyses, discussion and decisions based on RHIS information, 'promotion and use of RHIS information', and supervision by district office.

3.6.4.3   Data accuracy: (Objective 3)

Data accuracy was assessed at the facility level by counting the numbers of six PMTCT output data elements in the registers/records for the past six months (January – June 2012) and comparing them with what was actually captured in the monthly reports. The six PMTCT data element are: *Baby PCR test around six weeks, Antenatal client HIV re-test at 32 weeks, HIV-exposed babies initiated on co-trimoxazole prophylaxis around 6 weeks, Baby given nevirapine prophylaxis less than 72 hours after delivery, Antenatal client initiated on HAART,* and *Antenatal client HIV 1st test.* To assess the quality of reporting, the facility monthly summary tally sheets (RMR) used to collate data elements from the registers before transmitting to DHIS were analysed to see if they were regularly documented as scheduled and if the reports reflected

the actual situation captured in the registers. Data accuracy at the district level was assessed by counting the PMTCT data elements in the reports submitted by each facility and comparing them with what was actually captured by the DHIS. Monthly variation in data collection was also identified.

3.6.4.4   Data completeness: (Objective 3)

This was measured at the facility level by assessing the completeness of the monthly reports. The number of PMTCT data elements filled in was compared with the total expected number of data elements. The list of the expected numbers of PMTCT data elements by facilities were derived from the district office, and include the number of facilities reporting on the 18 PMTCT priority data elements. Data were complete if there was a value reported in the DHIS for each month of the twelve-month study period. At the district level, completeness was measured by comparing the number of data elements reported in the RMR with the numbers captured on the DHMIS.

3.6.4.5   Timeliness: (Objective 3)

Timeliness could not be measured at the district level using quantitative approach since there were no records of the number of facility reports that were received at the district by the stipulated deadline for handing in such reports. However, the in-depth interview were used to illicit information from participants of the extent to which routine monthly reports (RMR) were submitted by each facility.

3.6.4.6   Behavioural and organisational factors: (Objective 4)

The PRISM Organisational and Behavioural Tool (OBAT) and Management Assessment Tool (MAT) were administered to health information officers in each of the 57 health facilities and at district and provincial levels. Behavioural factors were measured in terms of data-quality checking skills, level of knowledge of RHIS form content, problem-solving skills, competence in HIS task, confidence level for RHIS task, and motivation, while the Management Assessment Tool (MAT) was adapted to determine the levels of DHMIS support services, which were measured in terms of critical management function, information needs, planning, training and supervision at facility and district levels.

Behavioural factors were measured in terms of knowledge of methods of data-quality checking skills, problem-solving skills, competence in RHIS tasks, confidence levels for RHIS tasks,

knowledge of RHIS rationale, and motivation. See *Sub-section 3.6.1.4* for a full description of how these were measured.

Organisational factors were measured in terms of promotion of culture of information use, based on the following indicators: 'Emphasis on data quality, use of information, evidence-based decision making, feedback from staff and community, sense of responsibility, empowerment and accountability', promoting problem solving and perceived reward from the Department of Health. In addition, management indicators included RHIS governance, use of quality performance standards, planning, training, availability of finance, and supervision.

3.6.5 Data analysis

Secondary data analyses of routinely collected data were also undertaken using STATA® Version 13 to assess the quality of data and reporting of such information at each facility. To explore the consistency and completeness of the DHIS data, we extracted and plotted the number of facilities reporting each of the six PMTCT data elements for each month during a four-year period (2009 – 2012). The average absolute deviation from the mean was calculated for each month. Data collected in the facilities were compared with monthly reports received from each facility for accuracy and completeness. Differences and similarities in the health information systems for PMTCT programmes for the two districts were identified by careful review of the results.

3.7   Qualitative study - In-depth interviews

Kvale [174] documents seven processes of conducting in-depth interviews. These processes include: 1) theme creation, which involves clarifying the reasons for conducting the study (objectives); 2) designing the study, including designing the study guide; and 3) the actual interviewing, which consists of four parts – actively listening to the respondent, patiently guiding the interview to cover main themes, flexibility in the way questions are asked, and audio recording of the entire process. The other stages include: 4) transcribing of the audio recordings; 5) analysing the data, which involves coding the information collected and trying to make sense of the data in relation to the objectives; and 6) data verification to check the credibility and validity of the information collected. The final process is 7) the reporting of the results to stakeholders.

In-depth interviews as defined by Guion[175] [(p 1)] are:

'open-ended, discovery-oriented methods that are well suited for describing both program processes and outcomes from the perspective of the target audience or key stakeholder. The goal of the interview is to deeply explore the respondent's point of view, feelings and perspectives'.

The in-depth interviews were used in this study to elicit information from health information officers, district managers/coordinators, sub-district coordinators, PMTCT programme managers, monitoring & evaluation officers, facility managers, and staff involved in data collection in the selected facilities, using an interview guide to explore their experiences regarding data production and data use, and their perceptions on information use barriers. The key informants were purposefully identified based on their positions and experience with either producing data and or using data for management purposes in each of the study sites. A purposive sample of 22 health information personnel from different organisational levels in the two study sites were interviewed. Table 3.6 presents the characteristics of the participants, which include: one district manager and two sub-district managers: eight health information officers at the facility, sub-district, district, and provincial levels; five provincial/district/sub-district PMTCT/HAST programme managers and co-ordinators; one hospital CEO; and five facility managers. Nine of the participants function at the facility level, while four participants function at the sub-district and another five function at the district level. The rest of the participants function at the provincial level.

Table 3.6: Participants interviewed by organisational levels

Function	# of staff interviewed	Facility Level		Sub district Level		District Level		Province level	
		KZN	WC	KZN	WC	KZN	WC	KZN	WC
PIO	3							1	2
PMTCT/HAST	5	1			2	1			1
DIO	3					1	2		
DM	1					1			
SDM	2				2				
HIO	1				1				
FM	5	3	2						
FIO	1	1							
CEO	1	1							
Total	22	6	2		5	3	2	1	3

PIO: Provincial information officer, **PMTCT:** Prevention of mother-to-child transmission of HIV; **HAST**: HIV/AIDS, STI & TB coordinators; **DIO**: District information officer; **DM**: District manager; **SDM**: Sub-district manager; HIO Health information officer **FM:** Facility managers; **FIO:** Facility information officer; **CEO**: Chief executive officer (Hospital)

The individual interviews which lasted between 20–45 min per session were conducted by the principal investigator and a research assistant who had completed some training in qualitative data collection processes. Appointments were made in advance with each of the key informants and the interviews were conducted face-to-face in the privacy of their offices. Participants were informed of the importance of the interviews and were assured of the confidentiality of their responses, and informed of how the data would be used. Permission to document the interviews using an audio recorder was obtained from each participant. Using an interview guide, we made sure informants gave as much information as necessary and unclear or unsatisfactory responses were probed.

3.7.1   Interview guide

An interview schedule was developed with a list of pre-determined sets of questions and themes on data quality and use of information, training, skills and information flow. This served as a checklist to ensure that the same questions were administered to all key informants in order to elicit systematic responses that could be easily categorised and analysed. The guide was used in both study sites and is included in *Appendix J*.

3.7.2   Transcription

Audio recordings from the in-depth interviews were transferred into a computer where they were transcribed by a trained researcher. The transcripts were proofread and read over and over, first by the research assistant, and later by the author, who compared the transcripts for consistency while listening to the original audio recordings; errors were then corrected.

3.7.3   Data analysis and coding

A general inductive approach based on the techniques of systematically identifying emerging themes, categories, or patterns from the data was used.[176] Responses from participants were independently coded by the author and an experienced qualitative analyst. The preliminary analyses were done by first examining the transcripts, which were read over and over, and similar emerging themes were identified, coded and categorised. These independent analyses were then compared for consistency; areas of discrepancies were identified through critical evaluation of the sets of themes. The source quotes were reviewed and agreed upon, and a final thematic report was generated from the combined analyses. The results were then shared with programme managers and staff at the district level for validation.

3.8   Observations at facility and district levels

3.8.1   Data collection

The interviews were complemented by an observational approach that was adopted at facility level through observing the availability of any form of report such as wall charts, quarterly reports, feedback reports or health service reports. Field workers were required to observe the display of maternal and child health-related information, in the form of graphs, charts or tables at each of the health facilities visited, and also had to verify if the displayed information was updated. In addition, the RHIS processes at the facility, sub-districts, and districts levels such as data collection, data transmission, data processing, data analysis, data display, data quality checks, and feedback, were observed and information derived was used to map the RHIS for monitoring PMTCT programmes in the study sites.

3.8.2   Data analysis

The observational information collected at each facility regarding the display of information products was collated for each facility and compared across facilities. In addition, information from key informants were collated and the information flow described. The descriptions of the information system, including the map of the information flow, were discussed with key informants for verification.

3.9   Pilot study

The main purpose of the pilot was to test the research instruments and identify whether they needed to be adjusted further for the South African setting and the focus on maternal and child health, specifically on PMTCT programmes. The pilot, which took place between May and July 2011, was conducted in eight of the 57 health facilities (four from each province) which were identified by the district and sub-district managers in the study sites. The health facilities included two hospitals, four clinics, and two Community Health Centres (CHC)/Midwife Obstetric Units (MOU) (*Appendix K*).

Table 3.7 outlines the tools piloted, addressing objectives 1–4 of the study, and applied to selected staff in the Cape Metro and in the Amajuba district, KZN (a detailed schedule is shown in *Appendix L*). The first nine tools are PRISM tools while the last tool is a semi-structured tool designed by the researcher to elicit information on barriers to the use of information from key

informants in each of the study sites. Those interviewed included district managers, facility managers, health information officers at different levels of care, PMTCT/ HAST coordinators, and data capturers.

Table 3.7: Number of PRISM tools piloted in the eight health facilities in both provinces

	Instrument	WC	KZN	Total
1.	Facility/Office Checklist	4	4	8
2.	Routine Health Information System Overview	2	1	3
3.	Use of Information: Facility Assessment Form	7	4	11
4.	Use of Information: District Assessment Form	4	2	6
5.	Quality of Data Assessment: Health Facility Form	7	4	11
6.	Quality of Data Assessment: District Office Form	3	1	4
7.	Organisational and Behavioural Assessment Tool (OBAT)	18	21	39
8.	Management Assessment Tool – District	1	1	2
9.	Management Assessment Tool – Facility	2	4	6
10.	Semi-structured Interviews	9	9	18
	Total instruments per province	**57**	**52**	**108**

A total of 50 health information personnel at various levels of the Department of Health participated in the pilot, comprising of 22 staff in the MDHS/CoCT district and 28 in the Amajuba district. The pilot, which used a multi-method approach, include 18 in-depth interviews with key informants such as district managers, information officers, district PMTCT/HAST coordinators, hospital CEOs, and facility managers.

During the pilot, the team observed some structural issues with the PRISM tools, and also the way in which the questions were phrased. These problems were spotted during the initial stages of the survey, and revisions were made to the instruments as well as to the Data Entry and Analysis Tool (DEAT) using lessons learnt from both provinces, and the tools adjusted appropriately and used in the main study. The issues identified during the pilot are summarised in Appendix M. It was concluded that on face validity, the tools were capturing the information they were meant to. No problems were identified with the flow of questions and their comprehension. However, it was observed during the pilot that the indicator 'data timeliness' could not be ascertained using quantitative methods, since no records were kept at the sub-district (WC) and district (KZN) levels of facilities that submit their routine monthly reports

(RMR) by the specified deadline of the 5th of every month for CoCT-managed facilities, the 7th of the month for provincial facilities, and the 1st of each month for Amajuba-managed facilities. Hence these questions were raised during the in-depth interviews.

3.10   Ethical consideration and permissions

To conform to the Faculty of Medicine and Health Sciences' good clinical practice guidelines regarding the use of patients' records, ethics approval was sought from the University of Stellenbosch Health Research Ethics Committee, and the study was approved (Ethics reference number: N10/10/322). The major ethical consideration in this study was the confidentiality of information from patients' records and that of key informants. Inclusion or removal of patient identifiers was discussed and strict confidentiality adhered to with regard to the protection of information obtained from patient records. Consent was also obtained from key informants and staff at the facility, sub-district, district and provincial levels.

Written permission to access data and health facilities was also granted by the relevant health authorities (Western Cape Provincial Department of Health reference number: RP03/2011; Western Cape City Health ID NO: 10211; and KwaZulu-Natal Department of Health reference number: HRKM174/10). Copies of the ethics approval, and approvals from relevant authorities are included in *Appendix N*.

Chapter 4

Gap analysis: Mapping the RHIS

4.1 Introduction

The first objective of this study was to map the routine health information systems (RHIS) in two districts (Amajuba, KwaZulu-Natal and part of the Cape Metro/City of Cape Town, Western Cape), and to investigate what is currently used in monitoring progress on HIV programmes in maternal, new-born and child health and identify information gaps at different levels of care.

This chapter reports the findings from the data collected about the RHIS tools and resources in the facilities, and describes the information systems used in monitoring PMTCT programmes at health facility, district and provincial levels. The information flow from the health facilities to the provincial level in each of the two district is described, including various registers used to collect information on the 20 PMTCT priority data elements (for the 16 indicators). The information gaps in each of the districts are highlighted and the chapter concludes with a brief summary and discussion.

4.2 Data sources

The data used for this chapter include:
- an inventory of registers, patient records, tally sheets and software at each of the health facilities in the two districts
- facility survey of health information resources, personnel and organisation.
- qualitative research using in-depth interviews with key informants.

4.3 Data analyses

Information from the multiple sources were used to describe information tools, data flow, and the available information resources in each study setting. Data from the PRISM overview and facility checklist tool were analysed using simple, visual descriptive statistics such as bar charts and cross-tabulations. Organisational factors such as the availability of health information resources were also described and gaps highlighted. Microsoft Visio 2010 was used to construct

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data flow charts, drawing on information elicited from key informants and observations at different organisational levels. The data flow charts were discussed with key informants for verification, and suggestions made were incorporated into the final version

4.4   Results

4.4.1   Availability of information tools and resources

There are 16 PMTCT priority indicators and 20 associated data elements identified by the South African national Department of Health for the monitoring of PMTCT programmes. These data elements, which are routinely collected at the facility using six data collection tools and assessed in this study, include: *Antenatal client HIV 1ˢᵗ test, Antenatal client initiated on HAART, Baby given nevirapine prophylaxis less than 72 hours after delivery*, and *Baby PCR test around six weeks*. The six data collection tools of interest are ANC register, HCT register as well as the tally/tick sheets, and the daily/admission register, Labour/Delivery register, and Baby register.

The availability of resources was also investigated in this study, and includes: personnel, internet and intranet connectivity, and equipment such as functional computers, telephone, printers, and calculators.

4.4.1.1   Registers and tick sheets

Figure 4.1 shows the availability of registers and tick sheets used in each of the study sites. The tick/tally sheets, daily/admission, and HCT registers seem to be available in all the facilities visited. CoCT authority does not have an MOU and hence the facilities do not require Labour/Delivery registers. It is worthwhile to mention that no facility provide the full range of antenatal, MOU and child health services, hence the results presented in *Figure 4.1* should be interpreted with caution. *Figure 4.1* illustrates that 26% and 4% of facilities in the Amajuba district have had stock outs of daily/admission register and tick/tally sheets respectively, in the past 12 months prior to the survey, while 37%, 11% and 25% of the facilities in the CoCT had stock outs of tick/tally sheets, HCT registers, and ANC registers respectively (*Figure 4.1*). The figure shows that MDHS facilities have had fewer stock outs of registers and tick sheets; however, 30% of the facilities claim they had stock outs of HCT registers in the past 12 months preceding the study.
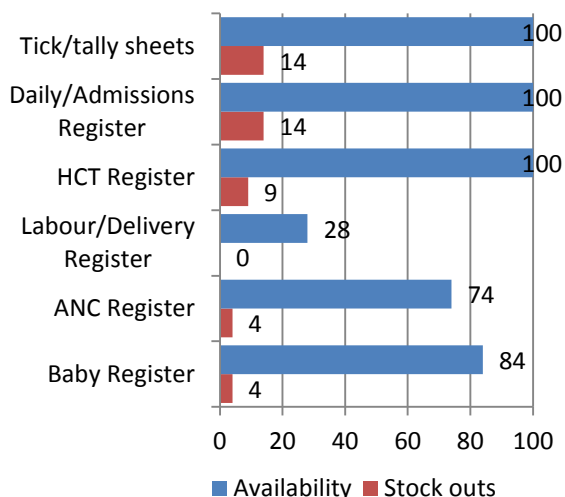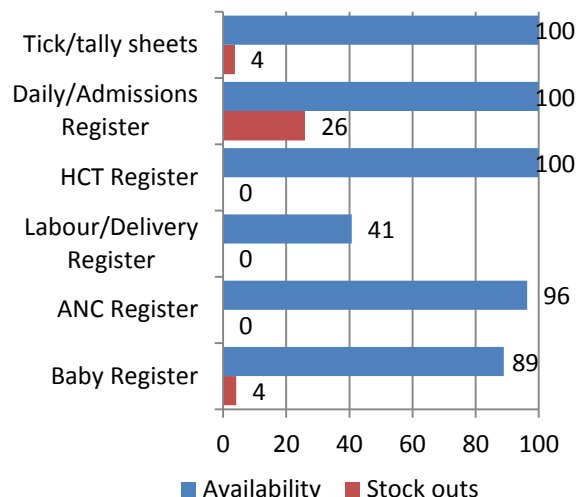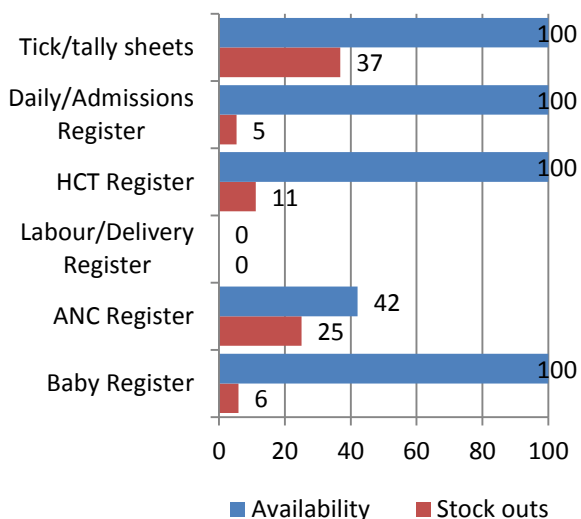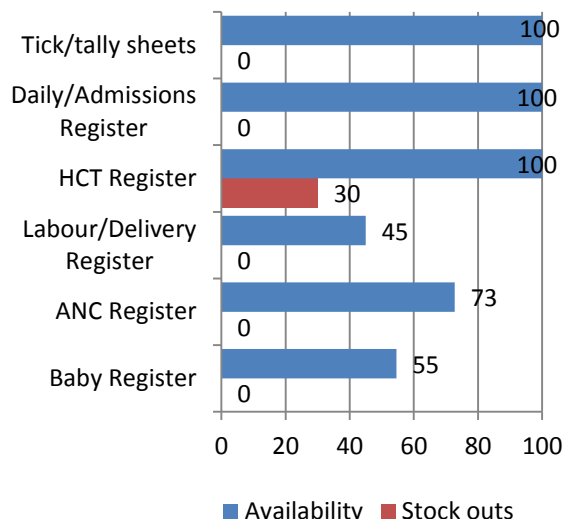
Figure 4.1: Availability of registers for monitoring PMTCT and stock outs by authority

4.4.1.2   Available resources for RHIS: Personnel

The availability of personnel in the study sites is presented in *Table 4.1* and *Table 4.2*; among all personnel involved with routine health information system (RHIS) tasks, there are on average 2.1 health information officers/clerks per facility in the Amajuba district, 14.6 comprehensive registered nurses, 9.6 comprehensive enrolled nurses, 8.1 nursing assistants and 0.7 clinical nurse practitioners per facility (*Table 4.1*).

Table 4.1: Average number of personnel by category and health facility type, Amajuba

Amajuba district, KZN	Hospital Average per facility	Clinic/ CHC/ PHC/ Gateway Average per facility	Total Average per facility
Number of facilities	**N=3**	**N=24**	**N=27**
Medical Officer	36.3	1.4	5.3
Comprehensive Registered Nurse	78.7	6.6	14.6
Comprehensive Nurse Enrolled	69.0	2.1	9.6
Nursing Assistant	46.0	1.5	8.1
Clinical Nurse Practitioners (CNP)	1.0	0.6	0.7
Dispenser/Pharmacist	6.7	0.8	1.4
Health Information Officers/Clerks	6.0	1.6	2.1
Community Health Worker	0.0	1.0	0.9
Other NGO staff	0.0	0.1	0.1
PH Dentist/Assistant	0.7	0.1	0.2
Midwife	66.0	6.1	11.8
Support Staff	69.3	4.8	12.0
Physiotherapist	0.0	0.0	0.0
Patient Advocate	0.0	0.0	0.0
Lay Counsellors	0.0	2.3	2.0
Health Educator	0.3	5.7	5.1
Mother-to-Mother counsellors	0.0	0.2	0.2

In the Cape Metro/CoCT district, there are on average 6.3 health information officers (HIO)/clerks, 12.4 comprehensive registered nurses, 6.8 comprehensive enrolled nurses, 8.8 nursing assistants, 2.2 clinical nurse practitioners and 0.7 mother-to-mother counsellors per facility (*Table 4.2*). The tables show that there are more Health Information Officers/Clerks per facility in the MDHS/CoCT district (6.3) compared to Amajuba district (2.1).

Table 4.2: Average number of personnel by category and health facility type, CoCT/MDHS

Personnel	CoCT	MDHS			Total Average per facility
	Clinic/CHC/ PHC/ Gateway Average per facility	Hospital Average per facility	CHC/ MOU Average per facility	Clinic/CHC/ PHC/ Gateway Average per facility	
Number of facilities	**N=19**	**N=3**	**N=3**	**N=5**	**N=30**
Medical Officer	1.1	34.7	5.0	0.7	5.2
Comprehensive Registered Nurse	5.5	61.7	12.7	1.8	12.4
Comprehensive Nurse Enrolled	1.3	46.7	7.0	0.8	6.8
Nursing Assistant	1.3	57.0	18.3	0.5	8.8
Clinical Nurse Practitioners	1.2	0.0	7.3	0.9	2.2
Dispenser/Pharmacist	1.4	7.0	9.7	0.8	3.2
Health Information Officers/Clerks	3.1	25.0	5.0	1.6	6.3
Community Health Worker	1.3	0.0	0.3	0.2	1.0
Other NGO staff	2.6	0.0	2.3	0.0	2.3
PH Dentist/Assistant	0.0	0.0	3.3	0.3	0.5
Midwife	0.0	5.7	13.0	0.0	1.9
Support Staff	2.4	59.0	24.0	0.9	10.5
Physiotherapist	0.0	1.3	0.7	0.1	0.3
Patient Advocate	0.2	0.0	0.7	0.0	0.2
Lay Counsellors	2.2	0.0	3.3	0.5	2.1
Health Educator	0.7	0.0	2.0	0.2	0.8
Mother-to-Mother counsellors	0.6	0.0	3.3	0.0	0.7

4.4.1.3   RHIS training

Table 4.3 presents the proportion of all personnel trained in RHIS tasks in the past three years preceding the survey, categorised by authority. Only 42%, 31%, and 13% of personnel working as health information officers (HIO)/clerks in the Amajuba district, CoCT, and MDHS respectively, received training in RHIS tasks in the past three years preceding the survey. There are more trained clinical nurse practitioners in RHIS tasks in the Amajuba district (17%) compared to CoCT (4%), and MDHS (2%).

Table 4.3: Proportion of personnel trained in RHIS tasks at the facility in the past three years preceding the survey by authority

Staff	Amajuba			CoCT			MDHS		
	# of staff	# Trained on RHIS tasks	%	# of staff	# Trained on RHIS tasks	%	# of staff	# Trained on RHIS tasks	%
Medical Officer	142	1	0.7	20	0	0.0	135	0	0.0
Comprehensive registered Nurse	395	12	3.0	104	11	10.6	267	10	3.7
Comprehensive Nurse Enrolled	258	1	0.4	24	1	4.2	179	0	0.0
Nursing Assistant	218	0	0.0	24	0	0.0	239	0	0.0
Clinical Nurse Practitioners	18	3	16.7	23	1	4.3	44	1	2.3
Dispenser/Pharmacist	38	0	0.0	26	0	0.0	70	0	0.0
Health Info Officers/Clerks	57	24	42.1	59	18	30.5	129	17	13.2
Community health worker	24	0	0.0	25	0	0.0	5	0	0.0
Other NGO staff	2	0	0.0	62	0	0.0	7	0	0.0
PH Dentist/Assistant	5	0	0.0	0	0	0.0	16	0	0.0
Midwife	806	0	0.0	0	0	0.0	56	2	3.6
Support Staff	324	0	0.0	45	0	0.0	270	0	0.0
Physiotherapist	0	0	0.0	0	0	0.0	8	0	0.0
Patient Advocate	1	0	0.0	4	0	0.0	3	0	0.0
Lay Counsellors	54	1	1.9	42	0	0.0	21	0	0.0
Health educator	137	0	0.0	13	0	0.0	10	0	0.0
Mother–to-Mother counsellors	5	0	0.0	11	1	9.1	10	0	0.0

4.4.1.4   Available resources for RHIS: Equipment

Table 4.4 shows the average number of equipment per facility in the Amajuba district and MDHS/CoCT district respectively. The survey shows that there is an average of 7.1 computers per facility in the Amajuba district compared with 4.8 and 42.2 computers per facility in the CoCT and MDHS authorities, respectively (*Table 4.4*). However, clinics, primary health care

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centres (PHC), community health care (CHC) and gateway clinics in the Amajuba district had on average 2.3 computers per facility and those in the CoCT and MDHS had 4.8 and 12.4 computers per clinic, respectively. *Table 4.5* shows that 18% of the 2.3 computers per clinic in the Amajuba district are out of order, compared with CoCT where 8.7% of the 4.8 computers per clinic are not functional.

In terms of printers, the total average per facility in the Amajuba district is 5.7; an average of 0.8 printers per clinics/CHC/PHC/Gateway and 44.7 printers per hospital (*Table 4.4*). CoCT has on average 2.3 printers per facility, while MDHS has on average 20.4 printers per facility, with an average of 6.8 printers per clinics/CHC/PHC/Gateway and 56 per hospital. In the Amajuba district, 68% of the 0.8 printers per clinics/CHC/PHC/Gateway are reported to be non-functional, while only 4% are reported to be out of order in the MDHS/CoCT district (*Table 4.5*).

Table 4.4: Average number of equipment per facility by authority

Type of facility	Amajuba (N=27)			CoCT (N=19)		MDHS (N=11)			
	Hospital	Clinic/ CHC/ PHC/ Gateway	Total	Clinic/ CHC/ PHC/ Gateway	Total	Hospital	CHC/ MOU	Clinic/ CHC/ PHC/ Gateway	Total
Number of facilities	**N=3**	**N=24**	**N=27**	**N=19**	**N=19**	**N=3**	**N=3**	**N=5**	**N=11**
Computer	45.7	2.3	7.1	4.8	4.8	126.0	8.0	12.4	42.2
Printer	44.7	0.8	5.7	2.3	2.3	56.0	7.3	6.8	20.4
Telephone	78.7	3.0	11.4	7.4	7.4	138.3	15.3	19.8	50.9
Calculator	7.3	1.0	1.7	1.9	1.9	20.0	1.0	2.2	6.7

There are on average 11.4 telephones and 1.7 calculators per facility in the Amajuba district, while the MDHS/CoCT district has an average of 23.3 telephones and 3.7 calculators per facility (*Table 4.4*). However, Table 4.5 shows that 7% of the telephones and 17% of the calculators in all the clinics/CHC/PHC/Gateway managed by the Amajuba district are out of order.

Table 4.5: Proportion of out-of-order equipment by facility type and authority

Equipment	Type of facility	Amajuba (N=27)			CoCT (N=19)			MDHS (N=11)		
		Total	Out of order		Total	Out of order		Total	Out of order	
			(%)	#		(%)	#		(%)	#
Computer	Hospital	137	1.4	2	-	-	-	378	0.0	0
	CHC/MOU	-	-	-	-	-	-	24	0.0	0
	Clinic/CHC/ PHC/Gateway	55	18.2	10	92	8.7	8	62	0.0	0
Printer	Hospital	134	3.7	5	-	-	-	168	0.0	0
	CHC/MOU	-	-	-	-	-	-	22	4.5	1
	Clinic/CHC/ PHC/Gateway	19	68.4	13	44	6.8	3	34	0.0	0
Telephone	Hospital	236	0.0	0	-	-	-	415	0.0	0
	CHC/MOU	-	-	-	-	-	-	46	0.0	0
	Clinic/CHC/ PHC/Gateway	71	7.0	5	144	5.6	8	99	0.0	0
Calculator	Hospital	22	4.5	1	-	-	-	60	0.0	0
	CHC/MOU	-	-	-	-	-	-	3	0.0	0
	Clinic/CHC/ PHC/Gateway	24	16.7	4	37	0.0	0	11	0.0	0

4.4.1.5   Available resources for RHIS: Internet connectivity

In terms of internet connectivity, only one hospital in the Amajuba district had access to the internet; none of the clinics/CHC/PHC/Gateways have internet access. The MDHS/CoCT district, on the other hand, has more than half (53%) of its facilities without access to the internet (*Table 4.6*).

In total, 85% of the facilities managed by the Amajuba district don't have access to the intranet, while only 4% of the clinics have intranet access. In contrast, 97% of all MDHS/CoCT district managed facilities have access to the intranet (*Table 4.6*).

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Table 4.6: Availability of internet and intranet connectivity by health facilities type and authority

Type of facility	Amajuba (N=27)			CoCT (N=19)		MDHS (N=11)			
	Hospital	Clinic/ CHC/ PHC/ Gateway	Total	Clinic/ CHC/ PHC/ Gateway	Total	Hospital	CHC/ MOU	Clinic/ CHC/ PHC/ Gateway	Total
Number of facilities	**N=3**	**N=24**	**N=27**	**N=19**	**N=19**	**N=3**	**N=3**	**N=5**	**N=11**
Internet access									
%No	66.7	100	96.3	52.6	52.6	0	100	60	54.6
%Yes	33.3	0	3.7	47.4	47.4	100	0	40	45.4
Intranet access									
%No	0	95.8	85.2	67	5.23	0	0	4	0
%Yes	100	4.2	14.8	33	94.7	100	100	96	100

4.4.2   RHIS data collection forms, information technology at sub-district/district levels

Technical issues affecting the performance of the routine health information system (RHIS) at the sub-district and district levels, such as the complexity of monthly reporting forms, the user friendliness of the RHIS manual, user-friendly data software, easy-to-manage information technology, whether the information system gives a comprehensive picture of the health system performance, and if RHIS information is present in other information systems, are highlighted in this section. This information were derived from a structured questionnaire administered to six health information personnel functioning at the sub-district and district offices in each of the study sites.

Figure 4.2 presents the technical issues identified at the sub-district and district levels and shows that all the respondents claim that the information technology in place is easy to manage, while five out of the six respondents report that the data software is user friendly, the data collection forms are easy to use, and that RHIS information is present in other information systems. They also claim that the information system gives a comprehensive picture of the health systems' performance. A third of the respondents claim a software or data warehouse exists that integrates data from different sources, and half of the respondents agree that information technology exists to provide access to information to all district managers and senior management. However, only two-thirds claim the RHIS process manual is user friendly.
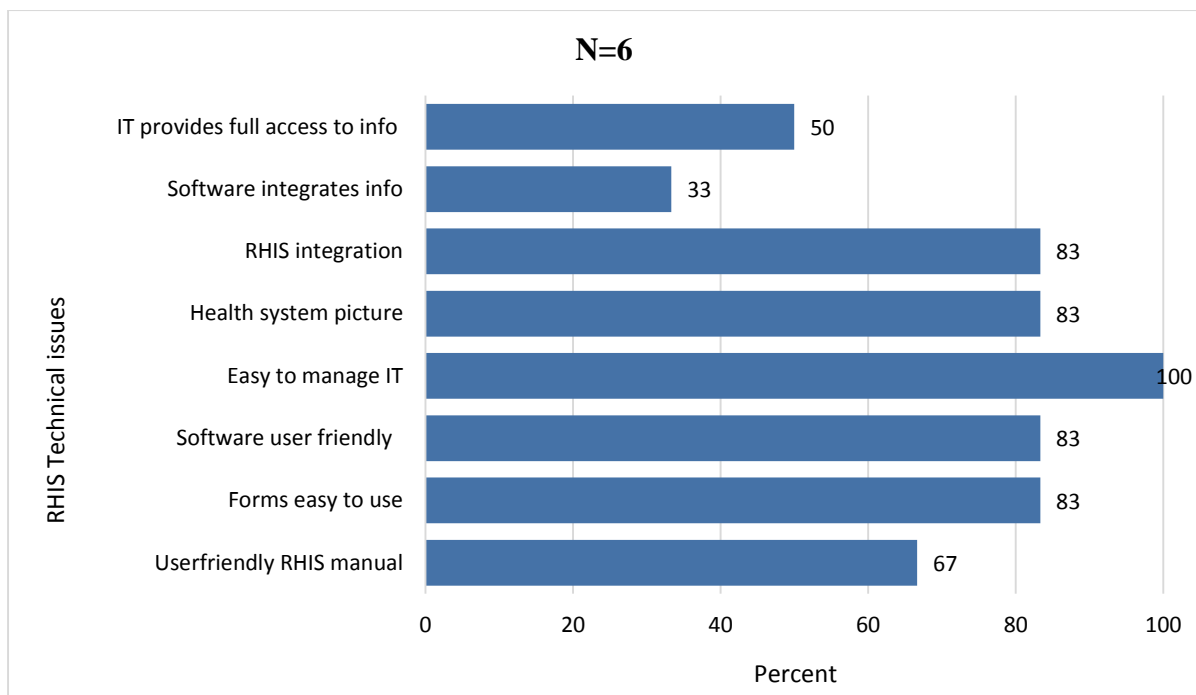
Figure 4.2: Technical issues affecting the RHIS at the sub-district and district levels

4.4.3 PMTCT information flow

Figure 4.3 – Figure 4.6 illustrate the data flow diagrams for the WC and KZN. For the WC there are three separate diagrams, one for each of the three PMTCT registers. For KZN, the three PMTCT registers follow the same flow and have been combined in one diagram.

4.4.3.1   PMTCT data flow in the Western Cape

The PMTCT data in the Western Cape comes from three source registers − the Antenatal HCT, Labour Ward and Baby follow-up registers. These registers are placed in three different service areas; not all facilities offer all three services. Owing to the dual authority in the province, facilities are managed either by the provincial (MDHS) or municipal (CoCT) authorities. In terms of the PMTCT, the majority of well-baby sites offering Baby follow-up services, resort under the municipal authority. Antenatal care occurs in most provincial and some municipal clinics, while all delivery sites are under the provincial authority.

The PMTCT data elements do not appear on the Routine Monthly Report (RMR), but are reported on separate monthly report templates which summarise the month's data from the registers. Currently the data from the Antenatal HCT, and Labour Ward registers follows the same path as the RMR data. There is a data-flow policy for PMTCT in place, yet no specific

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data flow policy for the Baby follow-up data is in place and this data follows a slightly different route with historical origins.

The following sub-sections attempt to map out the PMTCT data flow from the three service point registers to the national DHIS, for both municipal and provincial authorities.

4.4.3.1.1   PMTCT antenatal HCT

The PMTCT data is recorded in the antenatal HIV counselling and testing (HCT) register at all facilities offering antenatal care (ANC). Some of these sites fall under City of Cape Town (CoCT) authority, while others are provincial (MDHS) sites. There is a protocol for data flow for HCT, which follows the normal RMR data flow.

Each site has one paper-based register which should include all pregnant women presenting for ANC. Those who received HCT are also entered into the register which is partly completed by an HCT counsellor and partly by a professional nurse (*Figure 4.3*). At the end of each month the register columns are tallied by the data capturers or clerk and entered into the antenatal HCT monthly reporting template. However, while some facilities use an electronic Microsoft Excel template which has built-in validation rules to facilitate data checking before it leaves the facility, others use a paper template. CoCT and MDHS facilities do not have the same standard template.

The templates are checked and signed off by the facility manager and faxed or delivered to the HIV/AIDS, STIs and TB (HAST) coordinator at the sub-district office. Those facilities with the electronic template email the report and send a signed paper copy to the sub-district office. Each authority has different deadlines for the submission of the monthly reports. CoCT facilities must submit their data by the 5th, while the MDHS facilities must submit by the 7th of the month following the reporting period.

At the sub-district offices the data is validated by the HAST coordinator and queries referred to facilities. Once checked, the data is signed off by the sub-district manager, and then captured onto Sinjani by the information officer (IO) at the sub-district office, for both CoCT and MDHS facilities. Once captured, the data can then be viewed by anyone with access to the data base. (Data must be captured and signed off at the sub-district level by the 15th.)
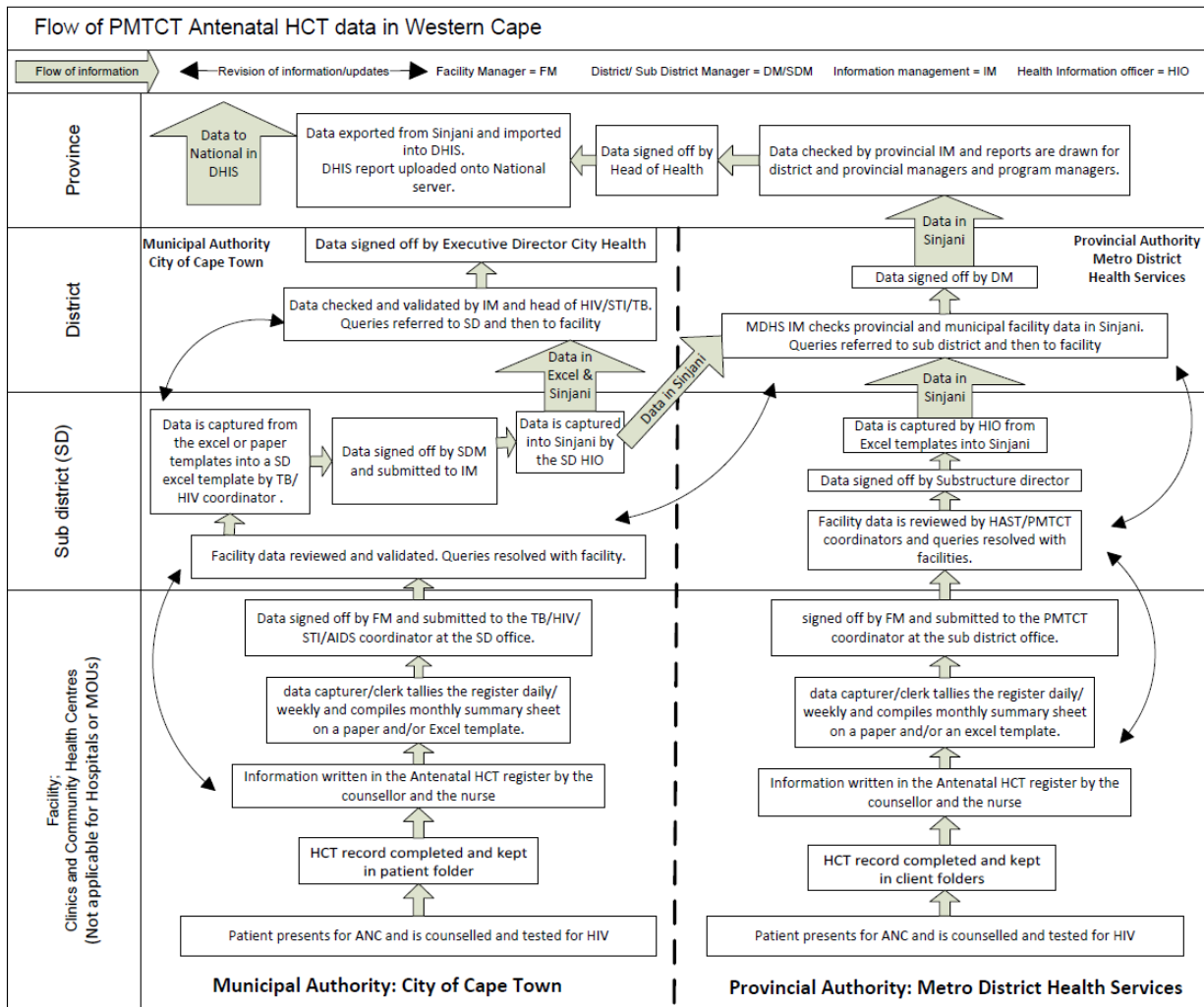
Figure 4.3: Diagram showing PMTCT antenatal HCT data flow in the Western Cape

At the MDHS office, the data is checked by information management (IM) and queries will be conveyed to sub-districts and then to the facilities. Once the data has been validated, it is then signed off by the district manager, and the provincial IM will be notified that the data has been verified. This must happen by the 28th.

The data is checked again by the provincial IM and once checked, reports are drawn for district managers, programme managers, etc. The relevant data elements are exported out of Sinjani and imported into DHIS for national reporting. Data must reach the national level within two months of the end of the reporting period.

4.4.3.1.2 Labour ward data flow

The PMTCT labour ward register is completed at all delivery sites (MOU). However, because the delivery sites are MDHS facilities, this information does not flow through the CoCT, even though the data follows the normal RMR data flow (*Figure 4.4*).
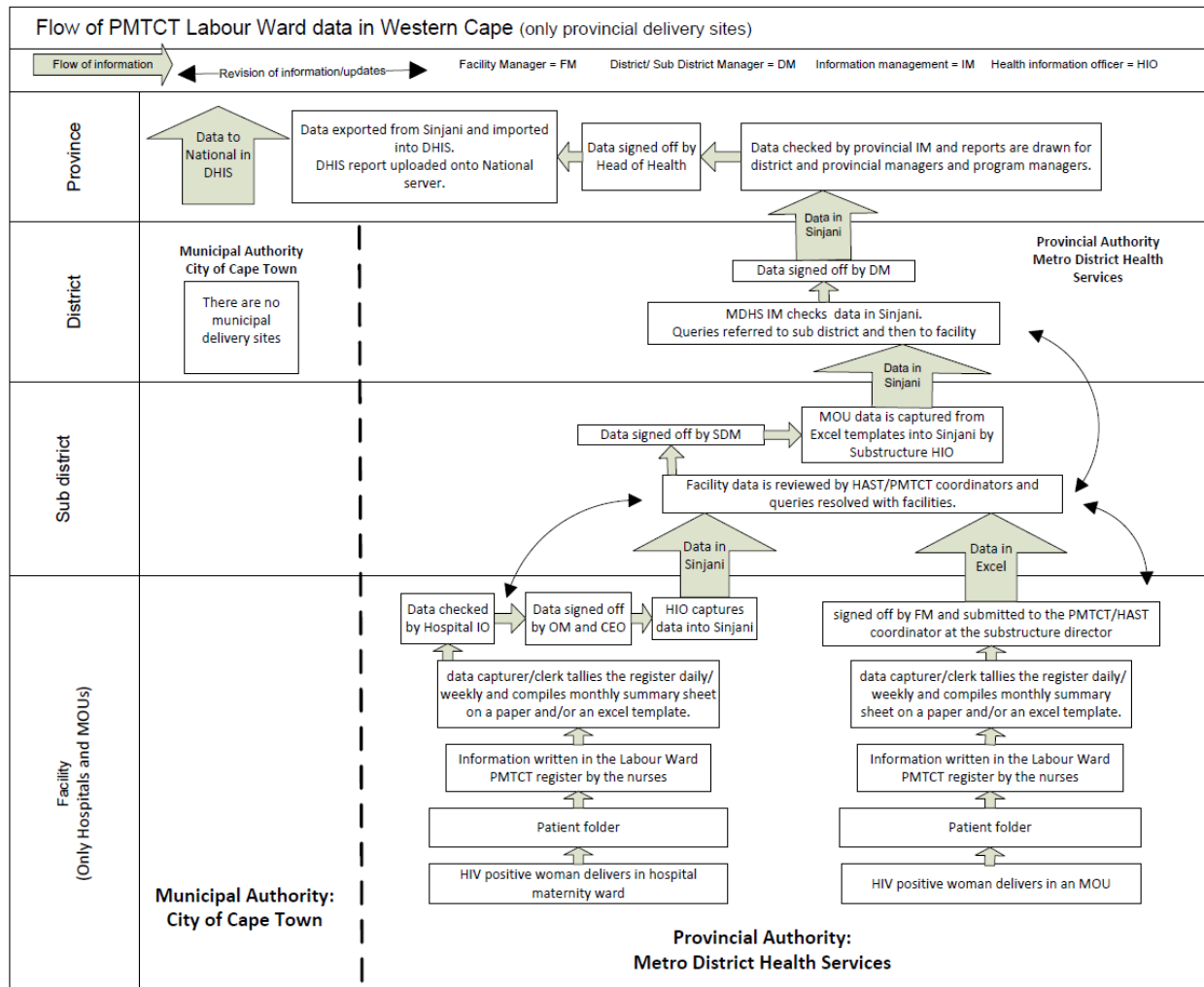
Figure 4.4: Diagram showing PMTCT Labour ward data flow in the Western Cape

Each site has one paper-based register, where all deliveries to HIV-positive woman are recorded. Patient information is collected at presentation and during labour by the nurses in the labour ward. At the end of each month the totals are tallied by the IO and entered into a PMTCT labour ward monthly report template. All facilities have an electronic Microsoft Excel template, with built-in validations, which is completed and checked by the facility IO. A copy is printed and signed off by the MOU's operation manager (OM) and the facility manager. Hospitals enter their data directly onto Sinjani and report to the MDHS sub-structure office. MOUs and Community Health Centres (CHCs) submit their monthly reports via email and hardcopy, to the

sub-district IO by the 7th of the month. Data received from the MOUs is checked and signed off by the sub-district manager; and then captured onto Sinjani by the IO. Data must reach the district by the 15th. Once this is done, the data can be viewed by anyone with access to the database.

At the district, the MDHS IM checks the data and queries are conveyed back to the sub-district and then to the facilities. The data is then signed off by the district manager after validation, and the provincial IM is notified of the verified data, which must happen by the 28th. At the provincial level, the flow then follows the same process as described above in *Sub-section 4.4.3.1.1* for the PMTCT antenatal HCT data.

4.4.3.1.3   Baby follow-up data flow

The PMTCT baby follow-up register is used at all baby wellness clinics to collect information on care given to all HIV-positive babies. Almost all of these clinics are managed by the CoCT authority; only a few are MDHS clinics. However, there is no specific protocol for PMTCT baby follow-up data flow and the flow does not follow the normal RMR data flow. *Figure 4.4* illustrates the PMTCT baby follow-up data flow in the Western Cape.

Each clinic has a paper-based register where all HIV-positive babies are recorded by their birth months irrespective of when they present at the clinic. For instance, all babies born in January 2012 were entered in the register under January 2012, even if they only presented at the clinic in later months. These visits are recorded daily in the register by a PMTCT nurse; at the end of each month the register columns are tallied by the data capturers or clerks and entered into the PMTCT baby follow-up monthly reporting template.

Some facilities use an electronic Microsoft Excel template, while others use a paper template. The templates are completed, including the register totals for the last six months. Templates are checked and signed off by the facility manager and faxed or delivered to the HAST coordinator at the sub-district office. Those facilities with the electronic template email it and send a signed paper copy to the sub-district office.

For the CoCT facilities, data must arrive at the sub-district office by the 5th of the month, where it is captured by the HAST coordinator onto a Microsoft Excel template with built-in validation rules to facilitate data checking. The HAST coordinator then checks the data and refers queries

back to the facilities. Once checked and corrected, the data is signed off by the sub-district manager and the Excel templates are emailed to the head of HIV/TB at City Health for further validation, from where it is then emailed to the MDHS information management (IM) who captures the data onto Sinjani (*Figure 4.5*).
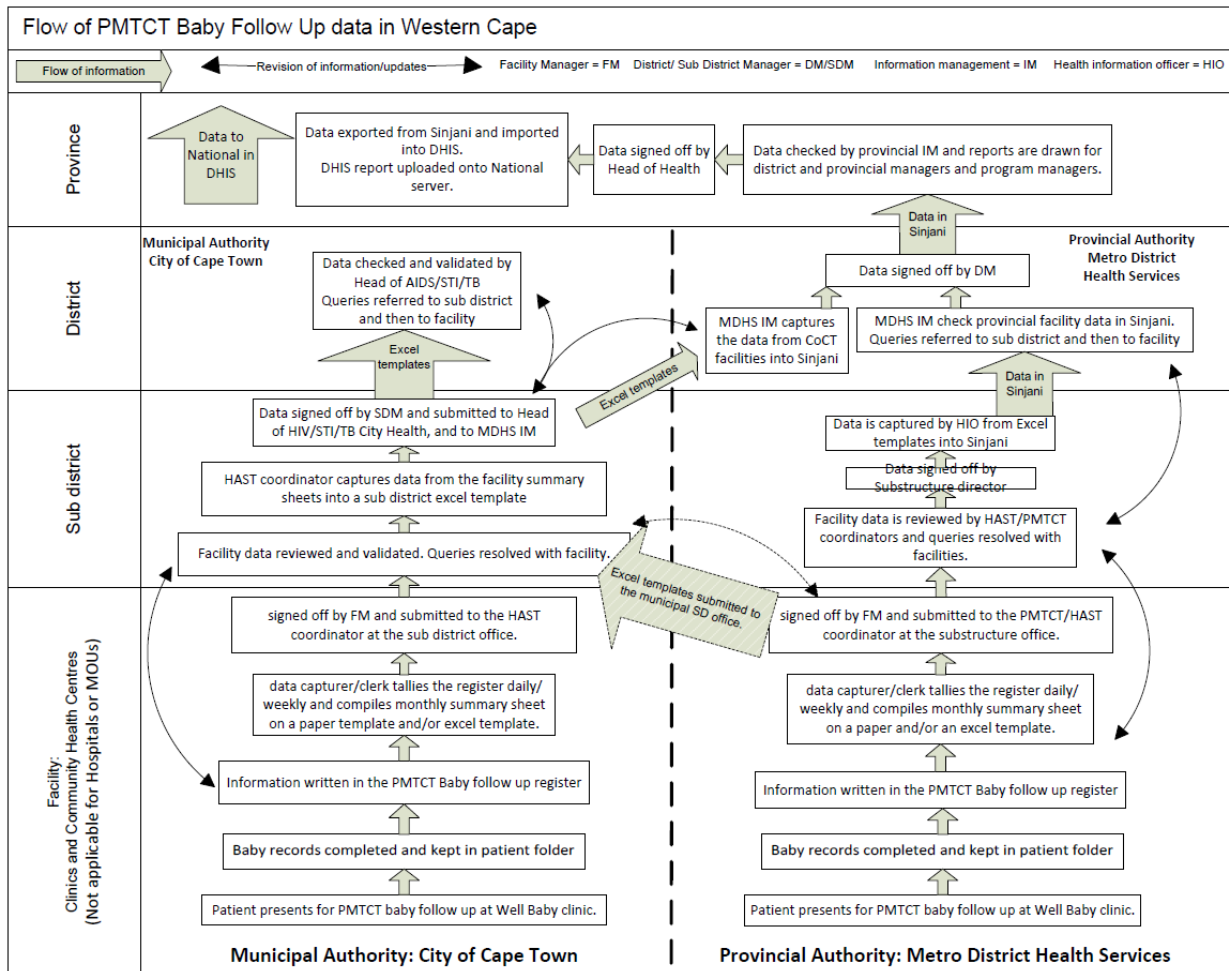
Figure 4.5: Diagram showing PMTCT Baby follow-up data flow in the Western Cape

For provincial facilities, data from the facilities arrive at the sub-district by 7th and are checked by the PMTCT/HAST coordinator and queries referred back to the facilities. These data is then signed off by the sub-district manager and captured into Sinjani by the sub-district health information officer (HIO) before the by 15th.

At districts the data is checked by MDHS IM and queries conveyed back to the sub-district and then to the facilities. Once the data has been checked and signed off by the district manager, the data follows the same process as the Labour ward and Antenatal HCT data described above.

4.4.3.2. PMTCT data flow in KZN

PMTCT data flow in KwaZulu-Natal follows a different path from what has been described above in *Sub-section 4.4.3.1*. Apart from the fact that all health facilities in KwaZulu-Natal are managed by a single authority in contrast to the Western Cape, all the three PMTCT service registers have the same flow path (*Figure 4.6*).

Tally sheets and PMTCT registers at the facility are completed daily for all clients by the nurses. The tally sheets are used to record head counts and all relevant care received by each client. All tally sheets used by each nurse are submitted weekly to the data capturers who manually collate the data elements onto weekly summary sheets; the summary sheets are manually added up on the 1st of each month, reviewed and compiled into monthly statistics. These are then signed off by the facility manager.

The monthly reports are then submitted to the hospital or to the district office, usually by fax. All data for the hospital and clinics is then captured onto the DHIS by the hospital facility information officer (FIO) and data capturers. However, because of heavy workloads and a shortage of staff, the FIO forwards the clinic data to the district, where it is captured onto DHIS, and only captures the hospital data.

Once captured onto the DHIS at the district office, pivot tables are drawn to check the data and queries are referred back to the hospitals/facilities. The DHIS data is then signed off by the district manager and submitted electronically to the province, and then forwarded to the national Department of Health.
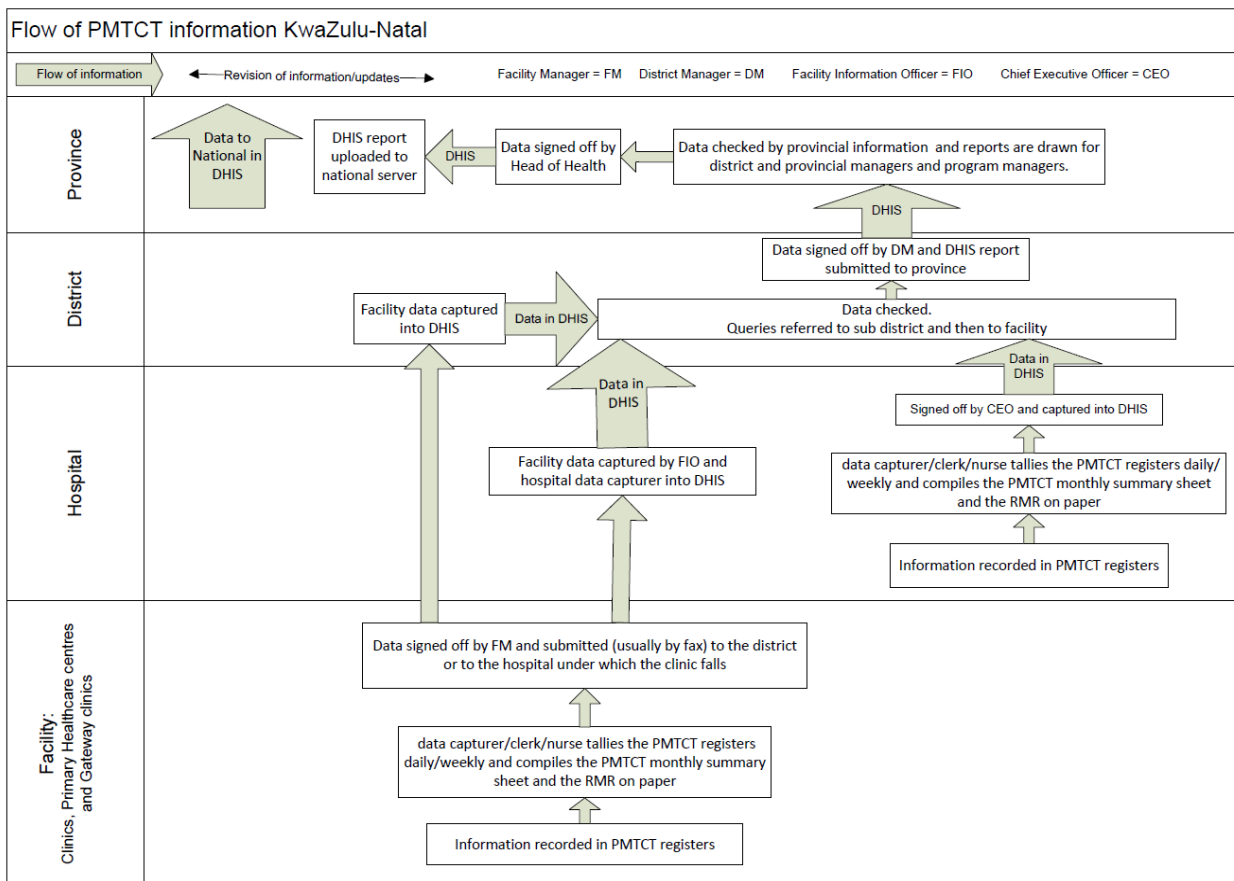
Figure 4.6: Diagram showing PMTCT data flow in KwaZulu-Natal

4.4.4   Health Information Systems

Multiple health information systems are used in the management of maternal and child health programmes in both provinces. Of all the information systems used for monitoring PMTCT programmes, only one system (DHIS) is common to both provinces, though the information flow processes are different. The Western Cape has multiple parallel systems compared with KwaZulu-Natal, where the DHIS is the only system in place at the clinic level to collect monthly routine data. Detailed descriptions of the identified information systems are presented below.

4.4.4.1   District Health Information System (DHIS)

In addition to the DHIS, which has been described elsewhere in Chapter 2, the Western Cape has several parallel health information systems at the facility level, and a web-based system at the district level that feeds into the DHIS at the provincial level.

4.4.4.1.1 DHIS data collection process

The data collection processes start at the clinics and hospitals where data is supposed to be entered directly onto the DHIS if the facilities are equipped with computers. Since most facilities do not have access to a computer, data is collected in paper format from tally sheets, registers, and monthly data collection forms. These are transmitted monthly to the sub-district level where they are captured into an electronic format (Excel), and then imported into the DHIS at the district level. These data are then analysed and reports are generated for the district, provincial and national health departments. Hospitals and clinics are encouraged to use this DHIS generated information in their performance-improvement initiatives.

4.4.4.1.2   Challenges with the DHIS

As data is collected in paper format at the facility level and then converted to electronic documentation at the sub-district level, there are a number of opportunities for transcribing errors (OTE). Training is not usually provided for clinic staff involved in data collection processes, who often have very limited data-quality checking skills, do not understand the value of the data being collected, and don't even have training on the use of the data collection tool itself; data captured onto the RHIS may therefore be of low quality.

Another challenge at the facility level is that nurses may forget to capture information on every patient that presents for care as a result of the multiple roles they play. These may lead to under or over reporting; hence it is difficult to keep accurate statistics, and this does not give a true reflection of care given in the facility.

The various collection tools at the facility are also a challenge. These collection tools are sometimes not aligned with the DHIS. There are lots of data elements collected at the facility level that are not captured onto the DHIS. There are also other elements required in the DHIS that are not on the clinic registers. Often clinics experience stock-outs of registers and the nurses are forced to use sheets photocopied from unused pages of old registers, and may misplace the loose sheets, resulting in data loss. At times the writing on the copied sheet may not be legible, making it difficult for the data capturers to read the information on the sheets during capturing. This will also impact of the quality on data collected.

Another challenge is with the database itself; there are problems with the formulae embedded in the DHIS software which ends up over-estimating the indicators when generating reports.

Owing to differences in versions of the DHIS, problems have been encountered with accessing the database. In relation to this, the issue of training is also a problem. Most DHIS users complain of having difficulties using the system; other advanced users at the district level claim the reports retrieved from the system are often different from what was captured at the point of origin.

4.4.4.2   Sinjani

Sinjani is a web-based information database introduced by the Western Cape Department of Health as a result of the limitations and inadequacies of the DHIS to meet the needs in the Western Cape Province. The system was developed to respond to the prescribed national data elements and provincial indicator data sets (PIDS). Sinjani is used only in the Western Cape to capture all patient data received at the sub-district level from the clinics via the registers; it is accessed by management at different levels, depending on administrative privileges.

In addition to storing data, the system can generate reports for different programmes and can also be used as a monitoring tool where validation can be made and errors checked. However, other parallel clinical systems used in the province at the facility level like the Patient Record and Health Management Information System (PREHMIS) and Primary Health Care Information System (PHCIS) are not linked to Sinjani. Reports from these systems are captured manually onto Sinjani at the sub-district level.

4.4.4.2.1 Data collection process

Data from all registers and folders at the health facilities are submitted manually on paper to the sub-district information officers, where it is captured onto Sinjani, and signed off by the director as correct and complete, and the form is then submitted to the district office. At the district office the data is checked regularly to make sure each sub-district office has submitted its data. The data is then made available at the provincial level.

4.4.4.2.2   Challenges with Sinjani

In as much as Sinjani is a web-based system, it is also faced with some challenges. Sinjani was not designed to calculate indicators; hence programme indicators are calculated manually. The process of manually calculating the indicators requires a good understanding of the indicators' definitions and the required data elements, as well good mathematical skills. The indicators are

calculated by extracting the required data elements from the system onto a Microsoft Excel sheet, and based on the indicator definitions, the formulae needed to derive the indicators are identified and applied. This process is time consuming, requires skills, and provides opportunities for errors when calculating indicators for the whole province. In Sinjani, more than one person may have access to enter data for the same facilities (e.g. at MDHS and CoCT sub-structure offices). All data entry is marked by the name of the capturer but issues have been reported, for example, where data that was captured on the system was either removed or over-written.

The transfer of data from Sinjani into DHIS takes place at the Information Management (IM) Directorate in MDHS provincial offices. This is an export/import process that does not require the data to be recaptured. There are, however, discrepancies between the naming of facilities and data elements in Sinjani and DHIS. Some data elements in Sinjani do not align with the minimum National Indicator Data Sets (NIDS) required by the South African Department of Health; this is because of the inclusion of additional indicators needed in the province, and the fact that some indicator names and definitions are slightly different from what is on the DHIS. For this reason, Sinjani elements are manually linked to their corresponding elements in the DHIS. This linked file must be amended when any elements are added/removed or edited, providing room for errors. *Table 4.7* highlight the issues and differences between the DHIS and Sinjani, organised according to structure, functionality, and standards, while *Table 4.8* highlights the differences in data elements in the context of the PMTCT programme.

Table 4.7: Comparison of District Health Information System (DHIS) and Sinjani

DHIS	Sinjani
STRUCTURE	
District Health Information System- used at national level.	Provincial Health Information System used only in Western Cape
Contains all NIDS, fewer data elements than Sinjani	Should contain all NIDS, plus extra elements deemed necessary for M&E in Western Cape. Some problems, not all NIDS being reported. Does not always align to national requirements. More data elements that DHIS
Cannot be centrally manipulated and changes cannot be made centrally. Problems with updating because it is not web based.	Central changes can be immediately in effect for everyone using the system
Still calculates some indicators manually even though system has this ability of automatically calculating the indicators	Need to manually calculate indicators
Has some built in validations, but not extensive	Has some built-in validations but not fully developed. Checks based on outlier reports. Outlier range not correctly calculated or appropriately updated for all data sets.
Data exported out of Sinjani and imported into DHIS monthly at provincial level	Data captured from facility monthly reports into Sinjani at sub-district level. (Only KESS have implemented Sinjani at facility level.)
Used in all nine provinces	Only used in the Western Cape
FUNCTIONALITY	
Not web based, so reports must be generated and sent onwards after capturing. Monthly provincial data sets are very large - used to send to all DM but now only on request.	Web based: Once captured this information is available to anyone with access to the data base.
More flexible, can be manipulated as needed. For example if one facility does not collect one specific element, the element can be removed for just that one facility.	Not very easily manipulated. Cannot remove one or two elements for only one facility. Results in missing data and zeroes being generated which is a problem when importing into DHIS to report to national.
Can generate multiple report types, graphs, tables - reports can be customised to suit needs at sub-district. District, provincial and national level.	Does not generate reports, graphs, and tables. Data must be extracted and indicators calculated. Manually generates tables, graphs etc., and therefore requires more data analysis skills.
STANDARDS	
Uses slightly different terminology for facility names	Uses slightly different terminology for facility names and data elements.
Different terminology for data elements	Some data elements do not align with the national definitions.

Another functionality limitation with the system is that Sinjani basically helps to aggregate all the information from the registers (data elements), but has limited capacity for analysis of the data and indicators are calculated at a different level. This limits the scope for districts to review targets and performance.

Table 4.8: Comparison of DHIS and Sinjani (Data elements)

2012 PMTCT DATA ELEMENTS	
ANTENATAL HCT: 1. **Antenatal client HIV 1st test** 2. **Antenatal client HIV 1st test positive** 3. **Antenatal client on HAART at 1st visit** 4. **Antenatal client HIV re-test at 32 weeks or later** 5. **Antenatal client HIV re-test positive at 32 weeks or later** 6. **Antenatal client initiated on HAART** 7. **Antenatal client eligible for HAART** 8. Antenatal client CD4 1st test 9. Antenatal client known HIV positive but NOT on HAART at 1st visit	**ANTENATAL HCT:** 1. **Accept testing - PMTCT initial test** 2. **HIV +ve client category - PMTCT initial test** 3. **On HAART (antenatal client)** 4. **Accept testing - PMTCT repeat test at 32 weeks** 5. **HIV +ve client category - PMTCT repeat test at 32wks** 6. **HIV positive client referred/provided HAART – No/Yes (antenatal client)** 7. **HIV positive client requires HAART – No/Yes (ANC client)** 8. HIV positive client CD4 results received (ANC client) 9. Accept testing - other client medically referred ANC client 10. Accept VCT at antenatal booking visit – Yes/No 11. Accept VCT later after refusing at ANC booking visit 12. ANC client counselled for HIV testing - 15 years and older 13. Antenatal client counselled for HIV testing - Female 14. Antenatal client counselled for HIV testing - under 15 years 15. HIV positive client category - other client medically referred antenatal client 16. Accept PMTCT dual therapy – Yes/No 17. HIV test result - Confirmatory test –ve/+ve (ANC client) 18. HIV test result - ELISA test –ve/+ve (antenatal client) 19. HIV test result - Screening test –ve/+ve (ANC client) 20. Known HIV positive antenatal client referred for care 21. HIV positive client WHO clinical staging done (ANC client) 22. Refuse testing - other client medically referred ANC client 23. Refuse testing - PMTCT initial test 24. Refuse testing - PMTCT repeat test at 32 weeks 25. Symptoms of TB identified on screening – Yes/No/Not applicable (antenatal client) 26. TB test done – Yes/No/Not applicable (ANC client)
PMTCT MATERNITY AND NEONATAL SERVICES: 10. **ANC client delivering on HAART** 11. **Antenatal client Nevirapine taken during labour** 12. **Antenatal client INITIATED on AZT during antenatal care** 13. **Live birth to HIV + woman** 14. **Baby given Nevirapine within 72 hours after birth** 15. **Antenatal client on AZT before labour** 16. Baby HIV antibody test at 18 months 17. Baby HIV antibody test positive at 18 months	**PMTCT MATERNITY AND NEONATAL SERVICES:** 27. **On HAART at delivery – Yes/No** 28. **Nevirapine received in labour – Yes/No** 29. **Adequate AZT antenatally (> 4 weeks) – Yes/No** 30. **Live birth at facility (PMTCT)** 31. **Nevirapine given to baby – Yes/No** 32. **AZT given in labour ward (3-hourly) – Yes/No** 33. Deliveries to women on PMTCT programme 34. Feeding choice on discharge – Breast/Formula 35. BBA (PMTCT) 36. Babies born on PMTCT programme 37. Nevirapine TTO given to baby – Yes/No 38. Adequate PMTCT therapy – Yes/No 39. Still birth (PMTCT) 40. TDF and FTC given in labour stat – Yes/No 41. Transfer in during labour – Yes/No 42. Transfer out in labour – Yes/No
PMTCT BABY FOLLOW-UP: 18. **Baby PCR test around 6 weeks** 19. **Baby PCR test positive around 6 weeks** 20. Baby initiated on Cotrimoxazole around 6 weeks	**PMTCT BABY FOLLOW-UP:** 43. **Accept PCR Test** 44. **PCR test result – pos/neg** 45. Repeat PCR test result – pos/neg 46. Feeding method at first visit – Breast/Formula 47. Number of babies in cohort 48. Six month feeding summary – Breast/Formula
	NIDS elements not on Sinjani 1. *Antenatal client CD4 1st test* 2. *Antenatal client known HIV positive but NOT on HAART at 1st visit* 3. *Baby HIV antibody test at 18 months* 4. *Baby HIV antibody test positive at 18 months* 5. *Baby initiated on Cotrimoxazole around 6 weeks*

4.4.4.3   The Patient Record and Health Management Information System (PREHMIS)

The Patient Record and Health Management Information System (PREHMIS)[177] is an electronic patient record (EPR) system used in all the CoCT clinics to routinely collect patient information. The system uses a wireless internet access network to link all the clinics to a central database.

4.4.4.3.1   Data collection process

Data elements at the clinics are printed on a data collection sheet which is barcoded. The clinician, after seeing each patient, ticks off the care given on the patient's folder. Folders are taken to the front desk where the data collection sheets are scanned onto the PREHMIS by a handheld scanner. Because PREHMIS is a web-based system, it allows a facility clerk to capture his facility's data using the system in place at another facility. Once captured, the system automatically collates the data according to the client's folder number or according to the care given, depending on what the focus of interest is. At this point, different facility-based reports, such as a list of all immunisation done in the facility in a particular month, or the history of immunisations received by babies born in a particular month, can be generated from the system at the facility level. In the context of the PMTCT programme, the system can only generate reports on limited information related to Antenatal HCT, such as *Antenatal first visit before 20 weeks*, *Antenatal first visit 20 weeks* or later, and *Antenatal follow-up visit*. Also PREHMIS is able to generate service-specific reports and registers. However, the generated reports are still sent monthly in paper format to the sub-district level, where they are captured onto Sinjani.

4.4.4.3.2   Challenges with PREHMIS

The main problem with this system is that of internet connectivity. Once the system goes offline for a period of time, it means the folders can't be captured and the implication of this is that data collection may be completed many days after the event has occurred. However, a backup tool, referred to as a 'downtime' tool, was designed for the purpose of maintaining the folders until connectivity is restored, and the data from the 'downtime' tool can be captured onto PREHMIS. In theory, the backup plan appears ideal, but that is not always the case when internet connectivity is lost for more than a day. The challenge here is that the data clerks will have to capture the information twice, first on the 'downtime' tool and then onto PREHMIS, once the system is back online, creating a backlog of information. Even with the 'downtime' tool, data

clerks sometime forget to use the tool and when they do, they at times misplace the loose sheets. Hence the data is lost because it wasn't captured immediately after care was given.

4.4.4.4 Central Reporting of All Delivery Data on Local Establishment (CRADLE) [178]

CRADLE is a patient-based information system for the clinical management of obstetric and neonatal patients. The system, which was introduced by the CoCT, captures information on mother and new-born during pregnancy, labour, delivery and neonatal periods. CRADLE was piloted in some Midwife Obstetric Units (MOUs), and was used until February 2012, when it was replaced by the Primary Health Care Information System (PHCIS).

4.4.4.5 PHCIS and Clinicom

The Primary Health Care Information System (PHCIS)[179] is a tool developed by the provincial government of the Western Cape for keeping patient records at the clinics. The system is part of four modules (CRADLE, PHASe, eKapa and PHCIS) [180] that comprise a full PHCIS. It was rolled out in 2006 and is currently being used in all MDHS facilities, and with the aid of a unique identifier (folder number), patient records can be accessed in any of the facilities where the software has been installed. PHCIS collects maternity demographics, date of booking at MOU, other bookings at other facilities (e.g. ANC), delivery details, date of birth, time of birth, alive/stillborn, and weight. Clinicom, on the other hand, is the equivalent of the PHCIS used in hospitals.

4.4.4.6 Division of Revenue Act (DoRA)

The Division of Revenue Act (DORA) requires provinces to report certain indicators on a quarterly basis to secure conditional grants. PMTCT falls within the Comprehensive HIV and AIDS Grant. The indicators required for PMTCT (according to a Western Cape circular [H50/2012]),[c] are listed in *Table 4.9* below. These indicators are extracted from the DHIS and Sinjani at the provincial level.

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[c] Western Cape Government, Information Management Directorate. Division of Revenue Act (DoRA). Circular H50/2012. Cape Town: Western Cape Government; 2012.

Table 4.9: PMTCT: National Condition Grant and APP indicators to meet DORA reporting requirements for 2012/2013

DORA	Annual Performance Plan (APP)
Number of ANC clients HIV 1ˢᵗ test	Proportion of babies PCR tested at 6 weeks who test PCR/HIV positive
Number of ANC clients HIV 1ˢᵗ test positive	
Number of ANC clients CD4 1ˢᵗ test*	
Number of ANC clients initiated on lifelong ART	
Number of babies given Nevirapine within 72 hours after birth	
Number of babies PCR tested around 6 weeks	

*This element is not available on DHIS for the Western Cape. On Sinjani the closest equivalent is *HIV positive client CD4 results received (antenatal client).* This does not appear on the list of Sinjani/DHIS element links received from the PGWC.

4.4.5   Information gaps and challenges

This section highlights some of the information gaps and challenges identified with the RHIS for monitoring the PMTCT programme. It gives a detailed description of the challenges associated with RHIS equipment (computers, printers, calculators and telephones), data collection tools, software, personnel, and organisational issues. It also identifies data elements that are needed to monitor the programme, but are under-reported at the national level.

4.4.5.1   Appropriate data elements

The PMTCT clinical guidelines[65] have highlighted 20 PMTCT priority data elements needed to manage the programme. These data elements are expected to be routinely collected from all health facilities and reported to the South African national Department of Health; however, some of the indicators are not being reported at national level, even though they are routinely collected at facility level. These data elements include *Baby PCR test around six weeks* and *Baby initiated on co-trimoxazole around six weeks,* which are not reported at the national level in the Western Cape. The implications of such underreporting could cause some challenges in planning.

4.4.5.2   Analysis process at district level and feedback to programmes

Data can only be used if it has been analysed and processed into a meaningful format that is available to facility and programme managers. Results from this study have shown that fewer than half of the facilities surveyed do not have a data analysis process in place at the facility

level; only 16% of facilities managed by the CoCT have a process of analysing data. Although data analysis takes place at the district level in the CoCT, feedback is not optimal. The lack of an analysis process at the facility level implies that facility managers will have to rely on personnel at the district level for data analysis, before such information can be used, thus posing a challenge in situations where such information is not sent back to the facility.

4.4.5.3   Equipment

There are a number of challenges in terms of equipment. The analyses show an uneven distribution of computers across facilities in the two study sites. The MDHS/CoCT district-managed facilities are better resourced than their counterparts in the Amajuba district. There are on average 6.4 computers per clinic in the MDHS/CoCT district, compared with 2.3 per clinic in the Amajuba district. The availability of computers is essential for data collection and management at the clinic level, yet 18% of the 2.3 computers available per clinic in the Amajuba district have been reported to be non-functional (*Table 4.5*). Computers have been reported stolen and some are very old, very slow and run on old operating systems.

Printers are also very important for data processing. The analyses show that 68% of all printers in Amajuba clinics are out of order, compared with 4% in the MDHS/CoCT district. Another challenge with equipment is with calculators. Health information personnel are required to collate data elements from tally/tick sheets and registers on a daily, weekly and monthly basis for onward transmission, and require the use of a calculator to do this. The analyses show an average of one calculator per clinic in the Amajuba district and two calculators per clinic in the MDHS/CoCT district. However, 17% of all calculators used in Amajuba district clinics are not functioning. A few facilities in both provinces do not have working telephone lines.

4.4.5.4   Use of registers

A major problem with monitoring the PMTCT programme is that the programme is fairly big, with three main data collection tools, the Antenatal, Labour and Postnatal (Baby) registers; so apart from all the stationery and folders having to be filled in, multiple staff at different levels have to complete the registers. There are also challenges associated with the use of data-collection tools which may impact on the quality of the data being collected. In a few facilities, registers were not correctly and completely filled in. For instance, it was observed in some of the clinics visited that the element *PCR tests at 6 weeks* was wrongly recorded in the PMTCT baby registers, in a column meant for the data element *repeat PCR at 18 months*. The PMTCT

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nurse at the clinic explained that this was consistently what they did, but it was unclear where or if they were recording the *repeat PCR at 18 months* data element.

In some facilities, not all data elements were completed on the register but totals for these elements were computed on the monthly reports. They were assuming totals from other elements in the register. In the antenatal HCT register, for example, the element *Antenatal client HIV 1ˢᵗ test* was not completed in the register, but the total in the report was equal to the element *accepted VCT at booking*. In other facilities, not all columns in the register were completed fully, even for elements that need to be reported. Furthermore, the register format seems to change quite frequently. Some facility registers do not match the register being used at the province, so the same data may not be collected. Assumptions are made and gaps filled in on the monthly summaries. Errors in tallying register totals are quite common.

4.4.5.5   Transfer from Excel – Sinjani/DHIS and Sinjani – DHIS

Another challenge identified in the study has to do with the multiple information systems functional in the MDHS/CoCT district, and the fact that the indicators needed at the national level need to be reported in the DHIS for easy comparison with other provinces. For this reason there are multiple points where the data must be transferred from Sinjani to the DHIS, and this usually involves manually capturing the data, hence creating room for human error.

While compiling Excel files from Sinjani and the DHIS at the district and provincial level, discrepancies were observed with data from facilities that have both a Midwife Obstetrics Unit (MOU) and a CDC/CHC. Prior to March 2012, data elements were reported separately for the CDC and MOU. In March 2012, the staff started reporting all data elements under the CDC, including the MOU data. It was observed that data collected after March was actually entered in DHIS under both the MOU and the CDC. Antenatal and labour ward elements were reported as MOU data. In Sinjani, the ANC and labour data for April 2012 is reported for the CDC and not for the MOU. In DHIS, however, the same data is present under the CDC and the MOU, which means these elements are being counted twice. It was also observed that some facilities have data elements in Sinjani that are not reported in DHIS. These problems were brought to the attention of Information Management at the provincial office and corrections have been made to the DHIS data.

Baby follow-up data is not being reported for all of the facilities that have baby follow-up services. Two CoCT facilities that have baby follow-up services are reported as zeroes in Sinjani and do not appear at all for those elements in DHIS. There are also some discrepancies on how data elements are captured from the Excel monthly register summary templates onto Sinjani. For example, on the monthly summary for PMTCT baby follow up, there is a column for *6-month feeding summary*. These numbers appear to be captured in Sinjani as *feeding method at first visit*. Some elements such as *babies receiving co-trimoxazole* and *mother's CD4 available* are recorded in the register but are not reported in Sinjani. Other elements are on Sinjani and DHIS but are not completed in the registers (e.g. *formula compliance*).

Another challenge is with the elements being reported. There are some indicators required at national level which the Western Cape is not reporting on Sinjani. For instance, the element *Antenatal client 1st CD4 count test* is required for the reporting of the Global Fund / NDoH Data for Action Reports (in the indicator *ANC client CD4 test rate*) and as the element for DORA / NDoH PMTCT Report. This element is not available on DHIS for the Western Cape since it is not captured on Sinjani. The closest equivalent on Sinjani is *HIV-positive client CD4 results received (antenatal client)*, which does not appear on the list of Sinjani/DHIS element links received from PGWC.

4.5   Discussion

The main purpose of this chapter was to investigate and map out the routine health information systems used for monitoring PMTCT programmes in the study sites, in addition to identifying information gaps at different levels of care. This study identified multiple information systems used for the monitoring of PMTCT programmes in both provinces (*Section 4.4.4*). The district health information system (DHIS) is the only system common to both provinces. Challenges identified with this system have been highlighted and discussed in *Sub-section 4.4.4.1.2* and include lack of training on data-collection processes, data-quality checking and analysis skills, and use of the data-collection tools. This study corroborates findings from other studies that examined the functionality of the DHIS.[47,53]

An important finding of this study was that information tools and resources necessary for monitoring PMTCT programmes were sometimes either not available or out of order. Data collection is the first level in the information cycle model and occurs at the point of contact between the clients and care providers, where information about the clients is recorded on

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tick/tally sheets and service registers (*Figure 4.1*). It is unacceptable to have stock-outs of these tools. *Figure 4.1* shows that 26% of the clinics in the Amajuba district had stock-outs of daily/admission registers and 24% of the clinics in the MDHS/CoCT district had stock-outs of tick/tally sheets in the past 12 months preceding the survey. For the routine processes to continue, nurses are forced to photocopy unused pages of old registers. The implication of this is that the loose sheets may be misplaced, resulting in data loss. Also the problem of legibility may arise as a result of poor-quality copies, hence making it difficult for the data capturers to read the information on the sheets during capture. This may compromise the quality of the data collected.

The study also identified challenges with the availability of equipment in both study sites, even though the facilities in the MDHS/CoCT district appear to be better resourced than the facilities in the Amajuba district; whereas the former has an average of 18.5 computers, 8.9 printers and 3.7 calculators per facility, the latter has an average of 7.1 computers, 5.7 printers and 1.7 calculators per facility (*Table 4.4*). This result should be interpreted with caution since the clinical workload per facility in the study sites may differ. However, the findings show that 18% of the average 2.3 computers per clinic, 68% of the 0.8 printers and 17% of the calculators per clinic in the Amajuba district are not functional (*Table 4.5*). In addition, only one hospital in the Amajuba district has internet connectivity, and 85% of the clinics in this district don't have access to an intranet; this is in contrast to the MDHS/CoCT, where 97% of the facilities have access to an intranet (*Table 4.6*). These results are consistent with a study that assessed the DHIS information needs.[47] The study involved all information management staff in the nine provincial departments of health in South Africa, and focused on human resources for the DHIS, hardware such as computers and printers, and access to electronic equipment, among others. The 2012 study found that 19% of the respondents didn't have access to computers, 55% had no access to a printer, 50% never access the internet and 38% never access an intranet.

Another major finding is that personnel are not sufficiently trained in RHIS tasks. Training is not provided for clinic staff involved in data collection processes, who frequently have very limited data-quality checking skills and do not understand the value of the data being collected, and lack sufficient understanding of the full picture of the PMTCT programme. As such, data captured onto the RHIS may be of low quality. *Table 4.3* shows that only a quarter of the health information officers/clerks, 6% of clinical nurse practitioners, and about 4% of comprehensive registered nurses had received training in RHIS-related tasks in the past three years preceding the survey.

The PMTCT data flow is unique to each of the two provinces; unlike KwaZulu-Natal, the information flow in the Western Cape is complex, as facilities are managed by dual authorities. This study show that data are still collected in paper format at the facility level; these data are derived from three registers: Baby, ANC, and labour/ward registers. The information in the registers is recorded by nurses after care has been provided. The data clerks or data capturers manually capture the data from the registers onto the routine monthly report (RMR), which is submitted on a monthly basis to the sub-district level where it is captured onto an electronic format (MS Excel), and sent to the district level for onward capturing onto the DHIS (KZN) or Sinjani (WC), as the case may be.

As with the organisational authorities, differences were also observed in terms of the functionality of the RHIS. Unlike in the MDHS/CoCT district (WC), the Amajuba district (KZN) does not have sub-district offices. Instead, some facilities submit their RMR to the three major hospitals in the district for capturing onto the DHIS. For instance, Madadeni clinics 1, 5, 7, and Madadeni gateway clinic submit their RMR to Madadeni hospital, while Newcastle PHC and Newcastle gateway clinic submit theirs to Newcastle hospital. The data are captured by the facility information officers and data capturers, and exported in an electronic format (MS Excel) which is sent to the district office where they are imported into the district DHIS database. Those facilities that are not affiliated to either of the three hospitals submit their reports directly to the district office, where they are captured by data capturers under the supervision of the district information officer. Other organisational differences have been highlighted and discussed elsewhere in *Chapter 7, Sub-section 7.4.3*. These differences are likely to compromise the quality of the PMTCT data generated in the Western Cape.

The South African Department of Health has published a District Health Management Information System (DHMIS) Policy[29] [(p 14)] which stipulates the 'requirements and expectations of the NDoH from all users of the DHMIS at all levels of the health system'. The policy states that all DHMIS users must have access to both internet and intranet connectivity (sub-section 5.7.3e), [(p 38)] and that each district health manager should ensure that required data collection and collation materials such as tools, guidelines, computer hardware and software, and telephones etc. are made available to all health establishments (S*ub-section 5.3.1d*). [(p 26)] The Amajuba district has some way to go to meet the standards in the DHMIS policy.

Chapter 5

Use of and barriers to use of information

5.1   Introduction

The Health Metrics Network defines a health information system as 'an integrated effort to collect, process, report and use health information and knowledge to influence policy-making, programme action and research'.[103] Much emphasis has been placed on the data collection component of the above definition, compared with using the data and other components.

This chapter attempts to address objective two of this study which to investigate the use of information, and barriers to using routine health information for monitoring progress of maternal and child health HIV interventions. Firstly, the results from the quantitative study, on information use at both the facility and district levels are presented. These are followed by results from the qualitative study, including participants' perceptions of information use, data quality issues, and barriers to the use of information at different levels of the health systems. And then a discussion of the findings and conclusion are presented.

5.2   Data sources and analysis

The data for this chapter include:

a. an inventory of registers, patient records, and tally sheets at each of the health facilities in the two districts
b. observations in health facilities
c. qualitative research using semi-structured interviews with key informants

Qualitative research was conducted using semi-structured interviews with key informants, and observational information from the facilities; the information from the participants was collated using content analysis to derive themes based on the general inductive approach.[176] Detailed descriptions of the data collection and analysis processes have been described elsewhere in Chapter 3, sub-section 3.7.

5.3   Result

5.3.1 Promotion and use of information

Information use at the facility level was measured by two criteria: (1) the availability of reports such as feedback, quarterly reports, health services, minutes of meetings; and (2) reviews of these reports for evidence of use of information. Elements for this indicator include: RHIS report production, frequency of RHIS report, types of reports produced, display of information at the facility level, use of information in available report at facility, types of decisions based on types of analyses, discussion and decisions based on RHIS information, promotion and supervision by the district office. The 'Use of information', as defined by the PRISM tool, is based on the principle that for information to be used, meetings will have to be held to discuss available information; decisions based on available information can then be taken, and a follow-up on the outcome of the decisions made. Furthermore, the promotion of use of information at the facility level indicates whether mechanisms and processes that encourage information use are in place. The combination of the questions used to compute this indicator are presented in *Appendix G.*

Figure 5.1 presents the percentage distribution of information use at the facility by authority, during the three months prior to the study. The indicator 'Promoting use of information', a district level indicator, is included in Figure 5.1 to compare against 'Information use'. The figure shows that whereas about two-thirds of the facilities reported having mechanisms and processes in place to facilitate information use at the facility level, the average information use is 53%. When compared by authority, Amajuba-managed facilities reported a higher percentage use of information (63%), while MDHS reported a low information use of 38%, despite 80% of the facilities reporting having in place mechanisms and processes that facilitate the use of information.

Regardless of the availability of RHIS reports in 98% of the facilities, only half of all the facilities, and 2% of facilities managed by the MDHS, use the information presented in these reports. The figure also indicates that while 82% of the facilities claimed they kept official records of meetings held during the last three months preceding the survey, only about two-thirds of the facilities held meetings with discussions on RHIS findings such as patient utilisation, disease data, service coverage, or medicine stock outs. In addition, facilities

managed by the Amajuba district seem to perform better than the other authorities in all the indicators assessed at the facility level.

a) All (N=57)

Information Use	53
Promoting use of information	68
Info use during meetings	49
Decision referred	25
Decisions based on RHIS info	46
Discussion on info held	65
Meeting records available	82
Use of info in available report	50
Availability of report	98

b) Amajuba (N=27)

Information Use	63
Promoting use of information	64
Info use during meetings	63
Decision referred	30
Decisions based on RHIS info	65
Discussion on info held	78
Meeting records available	93
Use of info in available report	75
Availability of report	100

c) CoCT (N=19)

Information Use	49
Promoting use of information	66
Info use during meetings	40
Decision referred	26
Decisions based on RHIS info	32
Discussion on info held	55
Meeting records available	74
Use of info in available report	41
Availability of report	95

d) MDHS (N=11)

Information Use	38
Promoting use of information	80
Info use during meetings	33
Decision referred	9
Decisions based on RHIS info	27
Discussion on info held	50
Meeting records available	73
Use of info in available report	2
Availability of report	100

Figure 5.1: Percentage distribution of information use at the facility by authority

An overview of elements assessed for the promotion of information use at the district level is presented in *Figure 5.2*. In above 90% of all the facilities surveyed, managers reported having received annual/monthly planned targets from the district offices that were based on RHIS information, and that they had participated in meetings at the district level to discuss RHIS performance over the three months prior to the survey. However, managers reported that documentation showing information use for advocacy purposes, and examples from the district offices of how RHIS information has been successfully used in the past, were not available in more than half of the facilities surveyed.
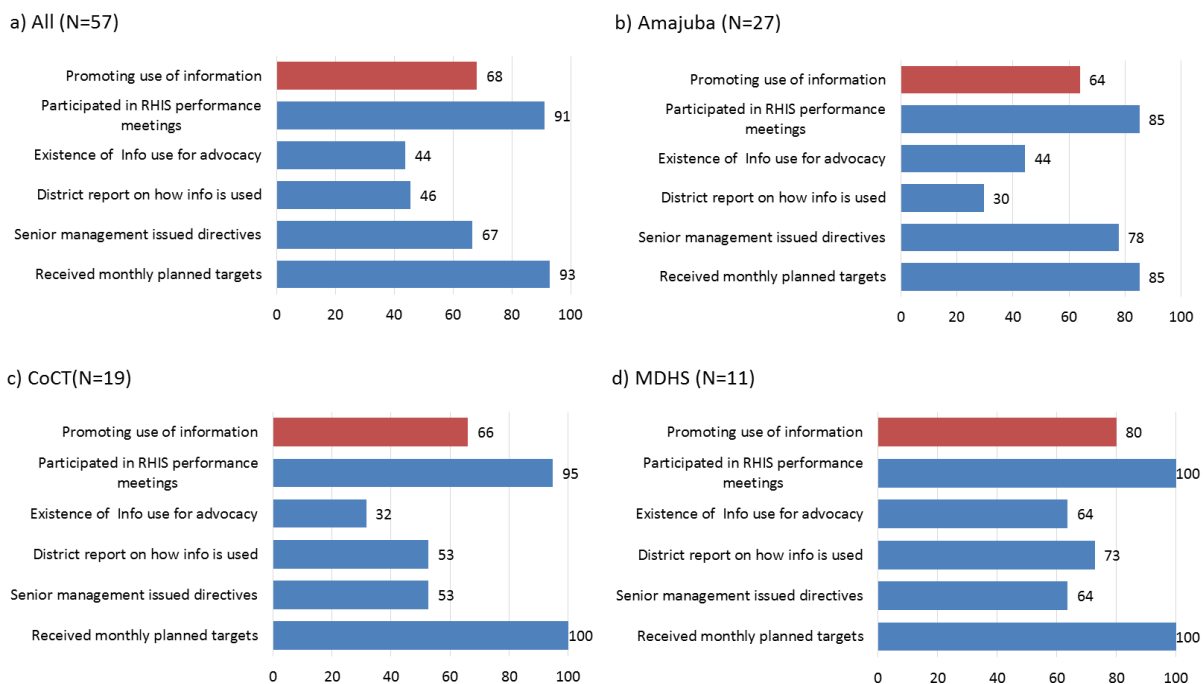
Figure 5.2: Distribution of promotion and use of RHIS information by the district level

For information to be utilised for decision making, it must first be analysed. *Figure 5.3* shows the distribution of information use for specific decisions in available reports at the facility by authority. Despite 82% of the facilities reporting the use of RHIS information to review strategy for achieving performance targets, only about half of the facilities actually used the information to make decisions on resource mobilisation based on comparison by services. However, two-thirds of the facilities reported having used the information to advocate for additional resources.
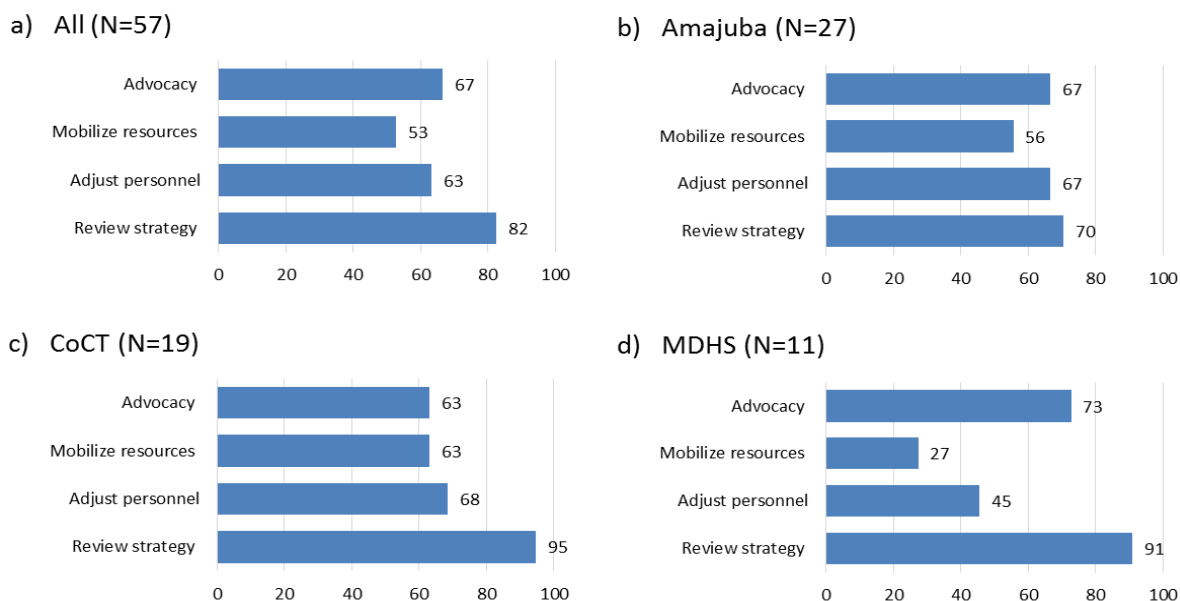
Figure 5.3: Information use for decisions in available reports at the facility by authority

One of the elements assessed during the survey was the proportion of facilities displaying RHIS-related information that is current and that had been updated six months prior to the survey. Facilities were observed for any type of information on maternal and child health services, including information on facility utilisation, population by target groups, and the presence of a map of the facility catchment area. *Figure 5.4* shows that about 60% of the facilities displayed RHIS information, but only in half of the facilities was the displayed information updated. Information on maternal and child health is displayed in above two-thirds of the facilities, while about 60%, 47%, and 50% of the facilities have maps of their catchment areas, displayed information on disease surveillance, and displayed information on facility utilisation, respectively.

When compared by authority, Amajuba-managed facilities have a greater display of RHIS information across all the elements observed; in contrast, information display seems to be an issue in MDHS facilities; only 11% of the facilities displayed RHIS-related information, and just 2% have updated information.
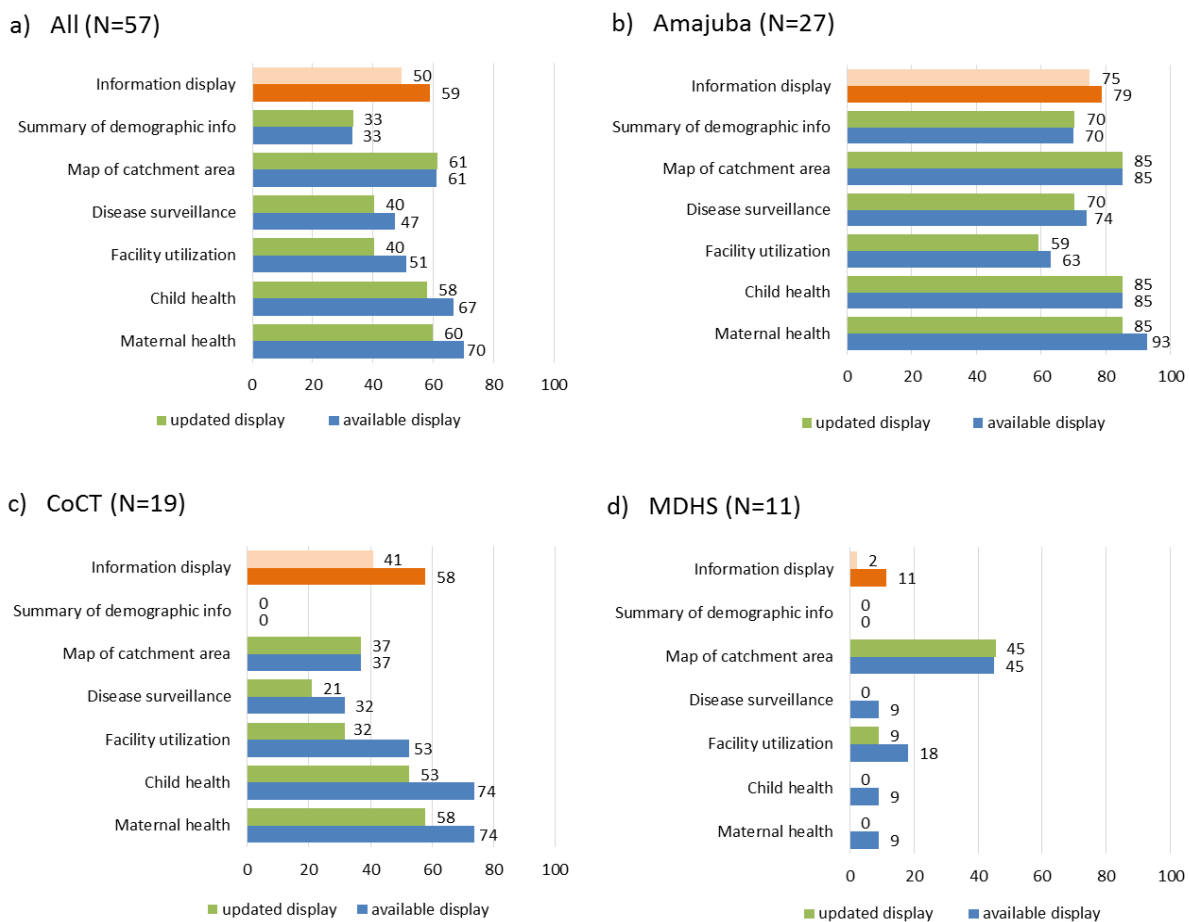
Figure 5.4: Proportion of facilities displaying updated RHIS information by authority

5.3.2   Barriers to information use

The perceptions of health information personnel about barriers to the use of information for planning purposes were explored using a qualitative approach. The guiding questions used to elicit information during data collection are presented in *Table 5.1*; the questions were informed by the Information Cycle model[144] and the Health Metrics Network framework.[103]

Table 5.1: Guiding questions for data collection

Questions
1. What has been your experience as a health manager in terms of: • data collection • data usage? *(Probe further depending on the responses given)*
2.   What specific challenges have you experienced when it comes to producing (generating) and using data? *(Probe)*
3. Will training of staff make a difference, and what will make training useful? *(Probe)*
4. Do you feel the information you produce (generate) is used by decision makers? *(Probe)*
5. From your experience, what do you think are the barriers to the use of information? *(Probe)*

Several themes and categories relating to the use of information, and reasons why information is not always used for monitoring purposes, were identified when analysing the responses. *Table 5.2* presents the summary of general themes and categories about data collection and use of information relating to the experiences of staff at different levels of the health information systems; these are grouped according to organisational levels (See *Appendices O, P,* and *Q* for the data). A total of five themes, five sub-themes, and 45 categories emerged from the data, and are discussed below.

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Table 5.2: Emerging themes by facility, sub-district/district levels and programme managers

Facility managers	Sub-district/district/provincial/health information managers	PMTCT programme managers
Use of information		
- Selective use for reporting	- Selective use of information for monitoring outcomes for political purposes; reporting and campaigns; - Different perspective on quality data for the use of data	- Selective use for reporting - Inadequate use of data for planning purposes
Barriers to use of information		
- Lack of trust - Willingness and attitude of users - Lack of culture of information use - Ripple effect of lack of staff at facility level - Timeliness of information	- Lack of skill to interpret data for planning - Lack of culture of information use	- Data not trusted - Packaging of information - Lack of culture of information use - Lack of skills to use data - Lack of accountability for accurate data
Data quality issues		
- Perceptions of "poor quality data" - Inaccurate information provided by patient	- Perceptions of "poor quality data"	- Staff at different levels involved in several registers for one programme - Cooperation between staff at facility level
Reasons for poor data collection		
a) Human resources		
- Staff attitude of non-care - Human error in data collection - Work overload/ staff turnover - Lack of trained data capturers/clerks - Lack of ownership of RHIS process - Limitations of supervisory visits/ monthly audit	- Staff attitude of non-care - Clinicians unprepared /lack of skill for data collection - Staff rotation and turnover - Lack of feedback/data interrogation - Lack of numeracy skills	- Three data collection tools for one programme - Follow up issues: results not captured - Migration of parents/mothers - Access to /tracing all babies born into the cohort - Lack of feedback/data interrogation - Lack of accountability
b) Equipment		
- Lack of resources and equipment for recording		
c) Validation issues		
- Lack of skills for validation	- Lack of validation at facility level, burden on higher levels - Snowball effect of non-validation at facility level - Extent of validating and coordinating overwhelming at district level	- DHIS (resistance?) and data accuracy - No proper data validation at sub-district level
d) Limitations of Information technology		
- No provision for exceptional cases (PREHMIS)	- DHIS and Sinjani elements not synchronised - Issues relating to paper-based and electronic data collection tools	- No provision for exceptional cases
e) Training		
	- Structure and content of training should be interactive and experiential in nature	- Experiential training/applied learning based on adult learning principles as preferred option which should be relevant, participatory, learner-centred, ownership - Staff turnover challenge in training
Other issues: Limitations of data collection/ recording instruments		
	- Change of data tools is "a step back"	- Clinical SOPs are not user friendly - No provision for exceptional cases

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5.3.2.1 Information use

There are mixed feelings among participants about information use for managing programme and service delivery across all levels. Despite concerns about data inaccuracy, district managers indicated using the data, since 'it gives a sense of what needs to be addressed'. Participants agreed that the information had been selectively used, either for monitoring outcomes, political purposes, or reporting to the next level, or for publicity and/or campaign purposes. One provincial manager, expressing her views, claimed that data were widely used for measuring programme output, business plans and budgeting purposes:

> *... varying degrees ... I don't think the data is completely accurate but I think ... it's definitely giving you a sense of what needs to be addressed. (BD20)*

> *I report on about five different platforms, most of the PMTCT data ... lots of the information I use for reporting purposes, many of them measuring output and programme performance ... and then in terms of business plan and budget there's some of them where, especially feeding options, whether we need to procure less or more milk ... (BD13)*

However, some participants are concerned about the lack of use of information by senior management to drive programmes, improve service delivery, inform decision making for developing action plans, and budget. Some ascribe their lack of commitment in respect of health information tasks to the fact that little or no evidence exists to prove that information from the facilities is used to address problems arising such as lack of resources and issues relating to patients' access to care. Some participants see data collection as a waste of their time, since the data is not used. For example, one district manager stated:

> *They use the figures as to say our programme is doing very well ... but besides looking at the data what else are they looking [at]...? Do they talk to the data as well? Like I indicated Births before arrival (BBA) are not something new. We have HH and MK hospitals that are in the middle of nowhere. There are no taxis going [in] that direction. What are the heads of the department doing ...? What is the government doing about that? Are they providing any transport to say there is a transport system for patients? (BD67)*

One district manager highlights a different dimension to the use of information, arguing that managers often get caught up in managing problems without first sitting down to look at the source of the problem. The assumption here is that the data are able to give an indication of what the cause of the problem is; instead of planning blindly, managers should 'consider the important little aspects required when collecting data'. The manager indicated that:

> *Most managers are [so] busy managing problems that they don't have enough dedicated time to sit down and plan with the data. I think there is not enough attention paid to it and often decisions are being made in a way that does not consider the important little aspects required*

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when collecting data and I think it's a lack of maybe understanding people when it comes to managing a facility. First of all people [facility managers] don't even understand what a percentage is. They don't understand what it is going to be used for. (BD40)

5.3.2.2   Barriers to using data

Participants were asked to give reasons for the inadequate use of data for management purposes. *Table 5.2* presents some of the key barriers emerging from the data, which are discussed below, and which include issues relating to lack of trust in the quality of data, lack of understanding and skills to interpret data, lack of skills to use data, information packaging, lack of accountability for accurate data, timeliness of information, and poor culture of information use.

5.3.2.2.1   Lack of trust in the information collected

The issue of trust was highlighted by almost all the participants as a major challenge for not using information. A general consensus was that most managers don't bother using the information because they dot trust the data captured from the registers into the database.

> *They just don't trust the information. There are many managers out there; they will very proudly tell you that they don't bother with the information because it is just rubbish and they are very proud of it ... I wouldn't trust the information at all ... When you look at the information with a magnifying glass, you see many holes. Of course we could do a lot better but we have come a long way and I am very confident that we are deluding ourselves. (BD40)*

> *... Then you would question the integrity of the data ... this does not look as if it is correct, really. At times you can't trust the data because people can just tick and tick and tick and yet something is not done and you are not there to look at it. (AF58)*

Despite lack of trust in the data, one district health manager was of the opinion that people don't plan to use the data, claiming that working with poor data is better than not using the data; and that one of the ways of improving data quality is to use the data. Furthermore, the manager argued that it is only in the process of analysing and making sense of the data that one would be in a good position to give feedback to data producers as to what the problem with the data is, and how to improve on the quality of the data. As indicated by the district manager:

> *We are just planning for where we have got poor performance but we should really be planning for the best utilisation of resources ... I feel that even when the information is not good, the only way to make it good is to use it. I am not waiting for the information to be good to then use it, because it is never going to be good if you don't use it. So using poor information that is unreliable and undependable, is always the starting point, and it is only in*

the process of analysing it, making sense of it and giving feedback to the people that produced it so that they understand what the data is used for, that you really get information to be good. (BD40)

5.3.2.2.2 Lack of understanding and correct interpretation of data

Another reason highlighted for the limited use of information is that personnel, especially facility managers, lack the skills to understand and interpret data for planning, and that information is just being reported without being interrogated to see if the data are usable. The participants emphasised the importance of strengthening facility managers' understanding of the rationale for collecting data, stressing that once they understand the importance of data, more attention will be given to ensure the data they send out is of good quality. The following remarks demonstrate the issues of lack of skills:

People do not understand the data and interpret the data correctly ... So they will take what is given to them by information management as the final result without interrogating the data. And then report on data without realising the issues that specific data set has ... people sometimes report data without thinking about the data. Um, I've been to many sessions where people will report data where the indicator was not calculated correctly ... (DB13)

When you talk of use of data ... if I do not understand the data myself, I don't know what the statistics are saying. There is no how I can use it. So I think it's probably a lack of skills on the part of the CEOs. They don't know what these figures represent. Now they just collect the data and send them through to head office ... (AD83)

The issue of professional nurses' inability to interpret data, as a result of their lack of numeracy skills, was also highlighted. Participants claim that this issue has absolutely nothing to do with colour or race, and is a major barrier to using information. The problem is even more pronounced, considering that most of these professional nurses function as facility managers, who are expected to oversee the day-to-day affairs of the clinics.

I think that a lot of people are slightly nervous of figures. There's a kind of numeracy mental block ... (BD20)

There are so many barriers to the use of information. First of all people don't even understand what a percentage is. They don't understand what it is going to be used for. I remember giving feedback to nurses, professional nurses. These were not even from Khayelitsha, so it is not like 'oh the blacks have got bad mathematical skills' not at all. It was in another area, no blacks, in Cape Town ... then I will say 80% and they will say 'what do you mean 80%? We only saw 19 patients ...' So they thought I was saying they saw 80 patients. You see what I mean. I had to start from the beginning ... (BD40)

5.3.2.2.3   Lack of skills to use information

The lack of skills to use data, which is related to the inability to understand and interpret data, and is also related to poor information use culture, is another category that emerged from the data. In an organisation with a limited culture of information use, there is a high likelihood that staff competence to use information will also be limited. Participants attributed the inability to use information to the fact that most managers, especially facility managers are not trained to use data; they just collect and transmit the data onward to the next level.

> *We give the information to the senior managers. They are able to use the information for planning. People believed that you collect information; you send it to district, to province, national, then national will see what they want to do with that information. (AD83)*

> *You can have information but you will find that they (management at head office) cannot budget according to what you have given them ... (BF80)*

> *... at facility level, I would say that maybe it's the clinic manager not practising her managerial role and they cannot use information obviously; it's just daily routine coming to the clinic ... (AD71)*

Nonetheless, district managers argue that facility managers need to be skilled to use information, and to ensure the data produced are validated and of good quality, before such data are signed off; adding that managers should be held accountable for decisions made in terms of releasing invalid information.

> *We need to capacitate managers on the ground on how to use that data. And then to ensure that all the managers ... will actually sign off the data to ensure it is valid, and to hold managers accountable for decisions taken. (BD18)*

> *Teaching people how to use the information is much more relevant ... how can you teach somebody to check for quality? Managers don't know that, whether they are programme managers or health managers in general, they don't know enough of it. (BD40)*

5.3.2.2.4   Packaging of information

The way information is packaged is of vital importance in determining whether information is used or not. Information packaging has been highlighted as one of the reasons why managers don't use information. The participants argued that people are not numerically inclined, and are not used to figures and numbers, hence they will require extra effort to interpret the information before it can be used. They suggested that information should be presented in a simple, easy to understand, and usable format.

> *I think that a lot of people are slightly nervous of figures. There's a kind of numeracy mental block ... you have to find a way to package the information, in [a]digestible way, like sugar coat it almost. You know I think a lot of people aren't used to looking at data ... we will be*

given all the provincial data and then there's just these Excel spreadsheets and there are numbers everywhere ... but the M&E manager sort of packaged it in a way that she'd show us these graphs ... we had someone who could distil and interpret and give it to us, so if anyone asked practically anyone in the programme, nurses, counsellors ... they could tell you [interpret the data]. (BD20)

5.3.2.2.5   Timeliness of information

One of the dimensions of data quality is that it must be timely. Untimely information sometimes becomes irrelevant for the purpose for which it was collected. This has been highlighted as one of the barriers to using information; participants claimed that for information to be useful, it should be received on time, when it is needed. They argued that delayed information is an obstacle for information users, since it will no longer be relevant. One of the participants claimed that:

... the issue of it not coming on time ..., and when you go back to correct it, the time gets delayed ... everything has some sort of a time frame ... if my office is having a problem producing a report that is required ... it becomes a bit of an obstacle for whoever needs the information if it's not submitted ... the timeous presentation of information, which means if the information is not accurate, that is also an obstacle. (BF73)

5.3.2.2.6   Poor culture of information use

Related to the issue of timeliness discussed above is a poor culture of information use. Timeliness, as has been discussed, is not only relevant to information (data) but also to feedback, which the participants claim hinders the culture of information use. The study found that there is no tradition of using information for planning and tracking the quality of care. Apart from the information always having been poor, issues such as the inability to use data, and the inadequate feedback to the facility regarding the improvement of data, were also raised as barriers to using information. The participants argued that even when feedback is finally received, it is no longer relevant. In other words having timely feedback when it is needed is an important factor that influences data quality and promotes a culture of information use.

So you throw it [data] out and then you wait for them [senior management]to give you feedback, which never happens; maybe it happens years down the line and they [sic] are quickly irrelevant ... so the culture of the use of information is not there. There is no tradition of using information because the information has been so poor ... (BD40)

... But I also think people just aren't used to it, it's a paradigm thing of using data to track quality of care. I think it's something that almost has to be instilled in people ... (BD20)

5.3.2.2.7   Lack of accountability for accurate data

The participants are concerned that staff at the facility level are nonchalant in the way they go about their daily duties, owing to lack of supervision and accountability. They are of the opinion that processes to monitor data accuracy should be put in place at all levels, suggesting that managers at the facility, sub-district, and district levels be held accountable for ensuring that data is validated on a monthly basis before it is signed off.

> *Baby follow-up, missing data ... lots of outstanding results and some babies weren't tested; it seems as if it does not concern the staff member; I think he thought his job was to hand out free tins of formula milk. That was his job. He didn't see the whole picture ... it's almost like they choose what to take seriously ... I think it's because of all sorts of issues, training, and accountability. The labour ward register is also slightly confusing ... why they don't fill it in at the beginning is that ... they sort of think 'it's not my problem anyway'... (BD20)*

> *I think managers need to take responsibility and be accountable for their districts and for their sub-districts. And making sure that what they are signing off on a monthly basis is correct, so they must make sure that the information that they are providing to the next level is correct ... (BD12)*

5.3.2.2.8   Ripple effect of lack of staff at facility level

Also emerging from the data are issues relating to shortage of staff at the facilities. Participants claim that another reason for the lack of information use is a ripple effect of the shortage of staff at the facility level, which leads to poor data collection, hence inaccurate and untimely data; they claim that nurses can't be held accountable for the inaccuracy of the data they generate if the issue of staff workload is not urgently addressed.

> *You don't have any right to blame the nurses that collect the data if the workload on them is much [*sic*]and nothing is done ... I am having a serious problem and I can see that the way that we are not doing well in terms of data collection emanates from the fact that we are short staffed. Then they [senior management] will say: 'OK fine, you need to create a post, you need to appoint people ASAP, but make a submission ...' (BF84)*

> *... Information is not accurate, it's useless and the issue of it not coming on time ..., and when you go back to correct it, the time gets delayed and stuff like that, so that is the ripple effect I am talking about. (AF73)*

5.3.2.3   Data quality issues

Data quality issues relate to participants' perceptions on the quality of the PMTCT data generated at the facility level. This theme is categorised into four sub-sections: the perception of poor quality data, staff at different levels involved in several registers for one programme, inaccurate information provided by patients, and cooperation between staff at facility level.

5.3.2.3.1   The perception of poor quality data

All participants in the study, at different levels, were concerned about the quality of data they receive from the facility. The facility managers agree that there are problems with the data collection processes, and that there is a need to focus on the data sources, and on those who collect the data, to ensure that they are recording the right numbers. Also highlighted was that training alone does not necessarily improve data accuracy. One participant argued that despite the frequency of training given to staff on data collection processes, there were still issues with data quality. Another participant was of the opinion that other factors, apart from training, may be at play, such as human error, and staff attitudes towards data collection. These will be discussed at a later stage.

> *A major problem which we actually found was that there were about six discharges in the paediatric ward, and maybe I don't know whether the lady (nurse) was drowsy or something, she will put that [*sic*]six under deaths; you see now that's a HUGE problem. (BF73)*

> *Data accuracy is always a challenge and the challenge is that you would teach or show people how the data collection is supposed to be done and then you don't see any improvement. (AF58)*

Participants at the sub-district and district levels are also disturbed about the data they receive from the facility managers which they agree is not of good quality, and is a major challenge to them, since the data do not reflect the actual situation at the facilities.

> *Data is captured in the hospitals and then it's reported to the districts and we have a lot of problems with that data ... what I have on the data is not what is happening in the facilities. (AD71)*

> *Baby follow-up-missing data ... lots of outstanding results and some babies weren't tested; it seems as if it does not concern the staff member; I think he thought his job was to hand out free tins of formula milk. That was his job. He didn't see the whole picture ... (BD20)*

When asked to rate the quality of data they collect on a scale of 1–10 (1 being worst and 10 best), health information officers rated the quality of the data as average. One participant attributed the poor quality of data to challenges faced with the database, and the fact that the data have to be captured manually.

> *I can still put 5 out of 10 [for data accuracy*, [the] reason being that we had lots of challenges with the database. And some of the information we have to do it manually ... (AD83)*

> *Probably say about 6 [out of 10]. I would say fair. It's just that, I wouldn't say that the quality is poor ... (BD63)*

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5.3.2.3.2   Incorrect information provided by patients

Participants expressed their concern about the nature of information received from patients, claiming that patients sometimes give wrong information to nurses during their visits to the clinics. The issue here is that once the information fed into the system is inaccurate from the source, this will cause a ripple effect right through the system until it gets to the national level, and no amount of validation will solve the problem since the information was inaccurate from the outset.

> *I don't know why people lie about where they live ... that is one of the barriers, people losing documents due maybe to a fire or being robbed or misplacing them completely ... we have foreigners, quite a number of Somalis, Ugandans and Kenyans coming in and there is a language barrier at times. (AF60)*

> *... data collection I would say is quite problematic; what we need to focus on is the source where data is initiated, where data moves from two different points ... if the data that you put in there is wrong, then even the system will give you wrong information at the end of the day. It goes a very long way. (BF84)*

Another issue raised relates to the nature of the data being recorded. One participant expressed concerns that the issues surrounding poor-quality data are multifaceted. The manager argued that data are sometimes wrong even from the source, stressing that patients provide wrong information to the nurses, and this information gets recorded without its being detected, and claiming that if nurses had the skills to check data accuracy, they should be able to pick up the errors. The manager further stressed that even when the information from the client is correct, they sometimes can't make meaningful sense of the data.

> *I don't think it is one thing. I think what happens in the facilities contributes ... they [clients] still sometimes bring wrong data, and then that wrong data is captured in the system. But also, correct data is captured and it says other things, and also if wrong data is brought, someone that is capturing should be able to see that this is abnormal. (AD71)*

5.3.2.3.3   Staff at different levels involved in several registers for one programme

Programme coordinators and managers of the PMTCT programme, on the other hand, highlighted challenges with how the programme is managed. The managers feel that one of the challenges for data quality is the fact that the programme is managed by different people at different levels, and involves multiple data-collection tools. Data for the PMTCT programme are extracted from three registers, which are managed by several staff; some of the registers are simultaneously used by nurses to record care provided to patients. When a nurse is busy with the register, the others will have to improvise and find other means of recording the information, such as recording the care provided on pieces of paper for onward

transmission to the registers. The challenge here is that sometimes nurses forget to capture this information onto the registers, or sometimes misplace the loose sheets, hence under-reporting the number of services provided.

> *There are issues at different levels of data collection and reporting ...different people on the ground are responsible for different registers and in fact for some registers, you need more than one provider. So for example the HCT register is done by four counsellors and they also need the nurses to provide some of the information. And so I think one of the problems is that they don't actually work in the registers, they have bits of paper and they put the various bits together in the register later on... but there's room for error obviously if one person's piece of paper gets [*sic*] missing... (BD20)*

Concerns about the lack of responsibility and non-cooperation between clinical staff at the facilities in terms of systems in place for data collection, and the fact that the registers have to be shared between several staff, were also raised as some of the challenges that may hinder the completeness of the data.

> *Sometimes there's a bit of a struggle between the health care workers ... as to who is responsible for the register ... you will get to a register where a certain section will be very poorly completed, and then it's usually a matter of the well-completed part, let's say the counsellor who's doing the testing, completing everything up until the point where you need CD4 counts and WHO staging, which the health care professional should complete. But now the counsellor's got the register in that room and I'm working in this room, or it's a matter of who's responsible and accountable. (BD13)*

5.3.2.3.4   Coordination issues (thus also quality data)

The issues around PMTCT programme coordination have been highlighted by participants as having a negative impact on data quality. These issues include the fact that at the facility level, there are different people who are responsible for different registers and some registers are simultaneously used by more than one provider. The issues around the staff have been discussed above; however the issues surrounding the coordination of the registers and organisational cooperation between the two authorities managing the health facilities in the Western Cape, in the context of the PMTCT programme, are discussed below.

5.3.2.3.4.1   Three data-collection tools

Apart from the issue of different staff managing the registers as discussed above, the challenges in respect of the complexity of the data collection tools have also been highlighted as a reason for poor-quality data. The PMTCT programme managers view the coordination of the multiple registers for one programme as a major challenge.

PMTCT is a fairly big programme ... apart from all the stationery and folders having to be filled in, there are three registers for one programme ... it is different staff completing the registers ... So often in your rural sites you will get to the register and it's completed perfectly. Whereas in the Metro, and specifically Khayelitsha, you will get to a register where a certain section will be very poorly completed, and then it's usually a matter of the well-completed part; let's say the counsellor who is doing the testing, completing everything up until the point where you need CD4 counts and WHO staging, which the health care professional should complete. So there are some issues literally on the ground. (BD13)

Another issue raised is with the complexity of the registers. Participants claim that the tools are not user friendly, and the PMTCT protocol is fairly complex, and sometimes difficult to understand. The managers claim that the lack of understanding of the data collection tools and the PMTCT guideline creates problems in terms of filling in the registers, and these problems affect data quality.

... the PMTCT protocol is fairly complex so if people ... don't understand the protocol ... this also creates a massive issue. For instance, the antenatal HCT register, you have the section at the end where you need to indicate whether the patient 'requires ART', whether you've 'referred for ART' or then alternately whether the patient 'initiated AZT prophylaxis'. Now what often happens if people don't understand the way the register is going to be interpreted by someone else; if the mom requires ART but now for that interim week while she's waiting and being counselled she receives AZT, they [nurses] will tick both, 'require ART', and 'referred for ART', but I [nurse] also 'gave AZT'. Because she [nurse] did give AZT but she shouldn't, it mustn't be ticked. That's not the idea of that column. So you find different interpretations here and there. (BD13)

5.3.2.3.4.2 Organisational issues: Cooperation between City and Metro

There are three different authorities managing the health facilities surveyed in this study. These authorities use different systems at the facility and district levels to collate data, which have to be aggregated at the provincial level and sent onward to the national level. In the Western Cape, the facilities are managed by two authorities with different systems: City of Cape Town (CoCT) and the Metro District Health Service (MDHS). In addition, some of the health facilities have dual authorities which make data collection difficult, and create an opportunity for data inconsistencies. The study found in some health facilities, the services delivered are provided by two authorities, and the data from both authorities have to be collated as one unit at the sub-district level, before they are captured onto the system for onward transmission to the national level. Participants report their experiences, and some challenges faced in getting data from other authorities. For instance, one provincial manager claim that:

... we have the City of Cape Town which is a part of our district, really, but they're under another authority, so it's a bit difficult to get things from them; so we need their buy in that they're going to provide us with information ... What happens with PMTCT is that the City facilities provide the baby follow-up form, or service, and we do the labour ward. Currently the City of Cape Town is not capturing the PMTCT on Sinjani ... They send it to us here at the district office, and we capture it here. (BD12)

However, attempts have been made to get the CoCT on board, and to improve the cooperation between the two authorities. Such attempts include having monthly sessions, and the development of standard operating procedures on how to coordinate the data collection processes between the two authorities, as noted by one of the participants.

We have a monthly session where the City people come together. Well we try to get the City people on board. We've developed an SOP (Standard Operating Procedure) now so they need to basically come on board. (BD12)

5.3.2.4   Reasons for poor quality data

When asked about their experience with producing data, participants agreed that the quality of data they produce is suboptimal; however they gave reasons which they believe are responsible for poor-quality data. These reasons have been categorised into human resources, equipment, validation issues, limitations of the information technology, and training.

5.3.2.4.1   Human resources: Staff are not skilled and equipped to record data

There was a general consensus that lack of manpower and basic capacity/competence for recording and validating data is one of the most burning issues. In this regard, facility managers strongly emphasised the following human resources issues as some of the reasons that may impede the quality of data: human error, staff attitude, lack of numeracy skills, insufficient feedback and supervision, lack of ownership, and staff turnover.

5.3.2.4.1.1   Human error in data collection

Human errors such as forgetfulness, absentmindedness, and carelessness, have been identified as one of the reasons for poor data quality. The study found that human errors influence the quality of data at the facility level. The participants claim that nurses at times are absent minded when carrying out their duties, and may forget to record the care given. Other times they mistakenly record wrong values. The views of some of the participants are presented below:

I don't think nurses tick every patient that comes in for care; sometimes they will just dish out the tablets for those who come for their doses and then maybe after four or five patients, they will remember to tick and suddenly they just tick twice. Sometimes they may tick less or tick more, so it's difficult to keep accurate stats. (AF49)

Sometimes they [nurses] forget what to put where, when they do data collection. Then there are also human errors of course, you count 10 people, and then write 11 by mistake ... (BF73)

5.3.2.4.1.2   Staff attitude

Staff attitude toward performing RHIS tasks, which is related to the issue of human error, has also been emphasised as a factor hindering the collection of good-quality data. Concerns have been raised about the nonchalant attitudes staff display when it comes to data collection. Participants claim that some staff wilfully don't tick off relevant data, and don't bother to fill in the registers, and when they do, they sometimes don't do it properly or comply with the guidelines.

... some clinicians either forget or wilfully don't tick off the relevant data. (BD18) ... it could be there is staff attitude, like someone saying 'it's not my job kind of thing, it's someone else's'. (BD66)

"The staff don't record properly ... They don't comply with the tally sheet ... And sometimes we don't get enough time to check thoroughly and then I sign them and the statistics goes [sic] to the next level and you find that there are mistakes which were overlooked ... sometimes other registers are not counted by mistake, which means we don't count everything that we have done for that month. (BF86)

5.3.2.4.1.3   Lack of feedback and limited supervision

Supervision and feedback are important issues related to human error and staff attitude issues discussed above. When staff have adequate supervision, and receive regular feedback from their supervisors regarding their outputs, chances are they will pay more attention to their job. This study has highlighted the importance of feedback to staff at the facility level. Participants argued that through feedback, staff were able to identify areas of their outputs that need improvement. Despite the importance of feedback, it is often not provided to staff at the facility level.

I don't think there's nearly enough feedback to people on the ground ... it's taken us many months ourselves to sort of work out how the data flow works ... I'm seeing more and more the importance of giving feedback ... but I don't think it happened very much at all. (BD20)

But then if you can interrogate the data and you go back and check you can see that there were flaws in the data ... and people can see where they are doing well and doing bad[ly] and where they need to make an improvement. (A58)

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In addition, the frequency and quality of supervisory visits were also highlighted as a reason for poor-quality data. One facility manager expressed her concerns about the quality of supervision they receive at the facility level. She argued that supervision is not always adequate, and suggested that supervisors should be more involved in their supervisory activities, rather than just checking a few folders that may not reflect the true nature of what is happening at the facility.

> *During the supervisory visits, sometimes the programme manager will pull a few folders to look at what we are doing, but it does not give the true reflection because two folders cannot give you the true picture ... because the folders might all be correct. (AF49)*

5.3.2.4.1.4 Work overload and staff turnover

Further reasons raised by participants for poor data quality are problems relating to work overload and staff turnover. Managers argue that it is extremely difficult to produce accurate data in environments where few staff are expected to do so much work. They highlight the challenges faced with having inadequate capacity and manpower to carry out tasks in an already overburdened health system.

> *It is difficult to keep accurate statistics, because the same person who is taking the statistics is the same person who has to give the tablets, it's the same person who has to find the folder, the same person who must listen to the entering patient, you see. So I don't think it gives the true reflection. (AF49)*

Factors associated with work overload at the facility level relate to issues of staff shortages and staff rotation, which managers believe are major factors influencing the quality of data produced, as well as skills shortages at the facility level. Managers assert that the high staff turnover experienced at both the sub-district and facility levels creates an artificial demand for training new staff; these shortages contribute to situations where data are left uncaptured for months, just because new staff often lack the skills and experience to perform HIS-related tasks.

> *In certain districts you have quite a high staff turnover which makes it very difficult, and even though we have a lot of people at district level, you can only train every X amount [*sic*] of weeks or months ... Again staff turnover, even at sub-district level with data capturers, there's often staff turnover; that is why for a month or two the data will be in shambles like now, and then it's maybe just a new person who had a totally different idea or didn't understand. (BD13)*

> *... Staff rotation, whereby you teach somebody, like certain names for the PMTCT programme, for example. Then now a time comes when that person has to work in the TB, and then somebody new, then that person is not into it. (AF58)*

Furthermore, managers argue that as a result of staff shortages, people not only multi-task, but are brought in to perform tasks they are neither qualified nor trained for. Some examples of such situations are described below:

> *... we have people that are using or collecting the data that are actually admin clerks who are appointed as admissions clerks, who deal with the patients and see them with regard to forms and that, but then they have information management as an added function onto their job description. (BD63)*

> *... majority of the facilities don't have information clerks and now you have to rely on the facility managers sometimes to provide the reports and they also have a lot that they need to do and sometimes the report comes late. It's not always on time and there are gaps and so on. (BD63)*

5.3.2.4.1.5 Lack of numeracy skills and skills for recording and analysis

The results of this study reveal that most clinicians, including data capturers, are unprepared and lack the necessary skills for data collection at the facility level. A major issue highlighted has to do with clinicians' lack of understanding of the definitions of some data elements and indicators. Participants claim that some of the clinicians haven't really had proper training on the definitions of the PMTCT data elements, and how the elements should be recorded as reflected in the PMTCT protocol, for example, what to tick off and when, claiming that some data elements are confusing; without proper training, clinicians and nurses are unlikely to accurately record the data.

> *The biggest problem is on the definitions ... some clinicians are not clear with the definitions on the routine monthly report data ... a lot of the times the clinicians and nurses are just expected to collect data. They haven't really been inducted into what are the elements, and what are the definitions. (BD19)*

> *... often they [clinicians and nurses] don't know what they should tick ... and some of the elements are really confusing, and they don't make sense. The staff have not been trained ... (BD66)*

A lack of numeracy skills was one of the categories that emerged from the data as a barrier to using information, and also the reason for poor data quality. This study revealed that despite the importance of numeracy skills in the data collection and analysis processes, the majority of the staff involved with data collection, such as clinicians, nurses, and data capturers, have inadequate numeracy skills; it is worrying to note that some of the staff lack basic arithmetic

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skills to count and calculate percentages. As one participant puts it, most staff are nervous of figures and have a 'numeracy mental block'.

> *I even asked the clinic nurses to come and learn arithmetic, you know the percentage, because we have to do percentages. I arranged with Damelin College because people couldn't count ... but they did the maths and they said they were bored ... I nearly went crazy. A child was weighing 4.5kg and when one is having diarrhoea we use the formula of 20ml per kg. Sisters couldn't calculate that; they would calculate with 5kg, make it to the nearest! You may be endangering the child's life by given him an overdose. (AD 87)*

> *I think that a lot of people are slightly nervous of figures. There's a kind of numeracy mental block ... (BD20)*

The issue of inadequate numeracy skills is not only limited to staff at the facility level, it cuts across the board; even managers at higher levels (sub-district and district) lack numeracy skills. One district manager revealed that inadequate numeracy skills were a main challenge for the collection of good quality data.

> *And then there're some of us who are not all that gifted with numeracy skills, but you know, I think I have a pretty good grasp of it. So I think those are the main challenges. (BD18)*

Another challenge, also related to skills, is that data capturers/support clerks are not sufficiently trained to perform their tasks. Even when training is provided, staff still don't get it right, because of the issues around staff shortages already discussed above.

> *At the SH clinic the problem was that the person in the baby clinic was not even a professional nurse. So it was a staff member who wasn't adequately qualified anyway to do the job, and he certainly didn't understand the register ... In the facilities the staff had never had any training on the use of registers ... and there was actually a new baby follow-up register, and they didn't fully understand how to use it ... The labour ward register is also slightly confusing ... (BD20)*

> *I give them training on how to record several times but you know because of this shortage of staff sometime people are just rushing things and then sometimes they think that recording is just waste of their time. (BF86)*

One district manager pointed out that a major reason why staff don't benefit from training is because of the calibre of the people trained in HIS tasks. She argued that most of the trainees are not even qualified to participate in the training in the first place. Citing an example of a kitchen staff member and a cleaner who were trained as data capturers, the manager expressed her fears:

... I was so upset when I learnt about people that were actually trained to be data capturers; one was working in the kitchen, the other one was working there as a cleaner, and I was worried that when anyone can just be pulled to come and do data capturing ... (AD87)

5.3.2.4.1.6   Lack of ownership of RHIS processes

Managers at the district level have also highlighted the issue around nurses not owning the processes of data collection, arguing that a reason for this could be their lack of understanding of the importance of data, and consequently their lack of commitment to accurate and timely recording. As expressed by one of the managers, the quality of data represents the output of the work nurses perform at the facility level, and if they don't take ownership, it simply means they are just working for their salaries, and not internalising the skills on-the-job training is providing.

The people on the ground [nurses], from their point of view do not understand the importance of the data ... which is the output of their effort, the work that they do down there ... it shows that the person is really not internalising the whole issue, he's just working for the month to come to an end. (AF58)

If I'm not willing, if I regard the job given to me as burdensome, then obviously at the end of the day I'm not going to ... I'll be negative. I'd say, this thing ... it is a barrier. (BF84)

5.3.2.4.2   Equipment: Lack of resources and equipment for recording

Lack of computers, and even paper-based resources such as registers and tally sheets for recording purposes, emerged as impacting on the quality of data produced at the facility level. The study has shown that some health facilities lack computers, and are even in short supply of basic data-recording resources such as registers, tally sheets, and stationery. One facility manager claims they have to make use of photocopied tally sheets, whenever they run short of supplies. Despite the use of photocopied tally sheets, they often run short of stationery for the photocopier, and have to wait for supplies from the head office before capturing the data.

They don't have a computer that they can use for the clinic: there is one but I am not sure if it's for the sister in charge ... I don't know but the data capturers don't have computers to capture all this information ... everything is done manually ... sometimes we run short of paper; we don't have paper for photocopying the tally sheets. So we find that we have to wait for them [head office] before we start doing the capturing. (AF69)

Also emerging from the data is the fact that most health facilities lack a proper structure in place for data collection; this challenge, a manager claims, emanates from the differences in the systems and structures of each health facility, and blames these on organisational factors.

... not having computers, not having enough data capturers, not all of us are being trained, not all of us have computer skills as well. There's no proper format [for data collection]. I should think that emanates from the fact that the systems and the structures of the different hospitals are not the same ... but I will blame it on the structural arrangement ... (BF84)

5.3.2.4.3   Validation issues

Validation refers to the degree to which a dimension accurately compares with another dimension. Data validation has emerged as a major issue contributing to the generation of poor data quality. The study shows that district-level staff are concerned about the lack of validation at facility level, which has had a ripple and snowballing effect on the extent of validation at district level. Managers argue that a major reason for the ripple effect is connected with the issues in respect of the lack of skills for validation at both facility and district levels.

5.3.2.4.3.1   Lack of skills for validating and analysing data

Despite the importance of data validation in ensuring good-quality data, the study shows that staff at both the district and facility levels lack the basic skill to validate data. This skill is not available in most of the facilities. Facility managers confirm the importance of having the skill to validate data; however they acknowledge not having this skill. One participant argues that if she, as a facility manager, does not have the skill to tell if data are correct or not, no one else in the facility will be able to detect if there are problems with the data.

I don't have skills to sit down and say that and be confident that this is what it is ... [there is] nobody with the skill in the facility. (AF49)

You know it's quite embarrassing actually ... confusing to look at that PMTCT document and validate it, especially when there are sometimes confusing figures ... since I cannot tell whether this is correct or not, my data capturers will never know what is right and what is wrong. (BF73)

5.3.2.4.3.2   Lack of validation at facility level

The study found insufficient data validation at facility level, which emanates from inadequate skills at the health facilities to validate data. Despite the importance of data validation in the data collection processes, participants claim data is just being sent onward to the sub-district and district levels without its being validated, creating a burden on the higher-level staff, who have to validate the data before capturing them onto the system. Another reason highlighted for insufficient data validation at the facility level is because of the deadlines for facilities to submit their data. The study shows that in an attempt to meet these deadlines, and as a result

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of work overload, facilities rush through the data-collection process, and the facility manager just signs off the data for onward transmission, without first verifying them.

> ... *at sub-district they validate facility-level data ... What we do here [sub-district level] is a support service to our staff in the facility, to our clinical staff, to our practitioners [regarding validation], that is all we do ... information is not being verified and validated before it is sent from facilities ... (BD18)*

> ... *because of the deadlines for facilities ... to submit the data, you find that the data from the facility go through the facility supervisor ... who just signs for it and sends it to the district without validating the data. That's not what we're supposed to do at the provincial level because that data is supposed to have already been checked at the facility level, sub-district and district level. But we do check it ... we do pick up that there are errors and mistakes in the data. So we do validate that data and then send monthly reports to the district offices and regional offices plus the central hospitals to correct that data. (BD17)*

5.3.2.4.4   Limitations of information technology

The information systems used for capturing data at the facility level have been highlighted as a factor contributing to incomplete data collection. Managers have emphasised the importance of having an electronic database for data capturing; however, they expressed their frustration and experience with data capturing, highlighting some of the limitations of the information systems. Facility managers argue that:

> *This DHIS database is good but the problems it presents is much [*sic*]... Pivot table information is too slow ... When you look at the data you find that there are mistakes; mistakes that show a lack of understanding of what the data is: the indicators and all that. Then those are the things you would think more training still needs to be done ... (BF73)*

> *The computer program shuts down at a certain age. For instance if the child comes at 1 year 4 months, when you want to enter it, we don't have a place to capture that. Because if the child receives the 18 months dose but is 6 years old, then that child health's column just closes; you cannot put anything there. (AF49)*

5.3.2.4.4.1   Different electronic systems in use

The multiplicity of information systems in use to capture facility-based data has also been identified as one of the reasons for poor-quality data. The two systems in question are the DHIS and Sinjani. It is expected that the data in these systems should concur; however that is not the case. Managers expressed their concerns about the limitations of these systems, which have resulted in many discrepancies in the data. Some of these limitations are attributed to differences in the data elements, in terms of definitions, and the wording of the elements. One provincial manager noted the challenges they encounter to ensure that the data from both systems are in agreement.

DHIS is supposed to be exactly the same as Sinjani. But it's not 100% the same. There are a lot of discrepancies. As I said to you, any changes that are done on DHIS, I am supposed to do the same changes on Sinjani. Sinjani has got its own limitations. For example, at the beginning of [the] financial year they normally change the elements. (BD17)

Another challenge that we are having, is the elements; there's this difference between Sinjani and DHIS elements ... the two information systems use different wordings, so that's a challenge we are facing. Because at the end of the day, I have to manually link those different facilities plus the different elements to each other when I'm doing the import. (BD17)

Another challenge with the system is that of the linkages of the data collection tools with the information systems. A manager claimed that they sometimes experienced challenges with the formula for calculating indicators, resulting in a manual computation of such indicators.

*It is disappointing that sometimes you will catch something – it is there on [the] capturing screen but on the pivot table it's not there ... with the formulas in the DHIS, you find that there's a new element and the formula is still using the old element and you try to find out what is the problem here? And some of the indicators, we calculate it manual [*sic*]. You find that the collection tools – they are not talking to the registers at the clinics. (AD83)*

5.3.2.4.5   Training for data collection and capturing/validation

Although the majority of the participants regarded training for recording and validation as necessary for improving data quality, the general agreement was that the structure, content and mode of delivery of such training should be based on adult learning principles which should be interactive and experiential in nature. They suggested that the preferred option should be on-the-job training that is relevant, participatory, and learner centred. However, the participants expressed their frustration about staff behaviour during training; one manager noted that people often don't listen during the training sections and are selective in what they want to learn.

I'm tired of training. I would prefer on-the-job training. I believe on-the-job training is more meaningful than a classroom session whereby they are just happy that they are out of their workplaces. Immediate support, even if it could be a central training but immediate support at a facility level to see that, because it is practice that will make you perfect ... I do think that it is very important to strengthen people's understanding of the reason why data is collected. (AD87)

I think training that is applied training, not theoretical training that says you use this register like this, but this is why you use this register. I don't know if applied training is the right word, but you know what I mean. (AD71)

My experience is that no matter how much training they have, people don't really listen; they only hear what they are expecting to hear ... Only when you start comparing and showing them that they are actually doing something different from the others ... (BD40)

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5.3.2.5   Other issues: Limitations of data-collection/recording instruments

Other challenges for poor data quality and inadequate use of information include issues relating to the limitation of the data-collection and recording instruments, such as the user-friendliness of the clinical SOPs, changes made to the data elements, and the non-provision for exceptional cases in the data-capturing software. The PMTCT Clinical Guideline has been developed to guide the implementation of the programme. This guideline presents a step-by-step process of how the programme should be implemented, and has recently been modified and improved to provide better care for mothers and their infants. One programme manager, however, expressed her fears about the lack of understanding of the Clinical Standard Operating Procedures (SOPs) available to staff. She is worried that irrespective of the availability of the SOPs, it is not user-friendly.

> *... the clinical staff aren't always clear [about]what they are supposed to do. So we've got different guidelines, we've got the PALSA Plus and we've got the national guidelines, but I think as a person who's done training and working with staff, I don't think either of them are that user friendly ... (BD20)*

The revision of the PMTCT clinical guideline in April 2012 has been identified as a major setback in the data-collection process, and has affected the quality of the PMTCT data. Changes made in the guideline were not immediately communicated to staff at the facility level, who were still providing care based on the old guideline. In addition, the data collection tools at the facility were not immediately updated to include the new indicators, and even when the new registers were developed, adequate training on how to fill in the registers was not provided; hence some data elements were not recorded during that period. A good example is the changes made to the CD4 count, which has huge implications, since the indictor is needed to determine the treatment option a woman should be on. The CD4 cell count was changed from ≤200 cells/μl to ≤350 cells/μl. As highlighted below, these changes affected the quality of data captured onto the DHIS.

> *We introduced in April, this register, the ANC register and then we are taking a step back because when I visited the clinics, I found that the 'WHO staging' is not recorded, l saw that the CD4 count is not recorded. So the numbers that they are feeding to the DHIS are obviously wrong numbers, so I need to go back now and correct from April and that is my problem there. (AD71)*

Another issue raised by most participants is that the information system and data collection tools do not allow for exceptional cases. There have been situations where data were not

captured because the cases do not fit into the existing structure. This issue relates to the data-collection tools not aligning with the information system, and therefore some data are lost.

> *An example ... mother defaults ART 2 weeks before labour ... look at the register, with the column saying whether she's on ART or not, you need to say 'no', because currently she's not on ART, even though she was. Then with your four steps for mothers who weren't on ART, you tick whether she had adequate AZT antenatal, then the three different drugs intra-partum. She won't have the antenatal AZT so that's 'no' and three 'yeses', but then the summary of the intra-partum care and antenatal care will be a 'no' because you've missed one of the four ... (BD13)*

5.4 Discussion and conclusions

Information use is a vital component of the information cycle model,[46] and is the end product of the data-collection processes. Data cannot be used unless it has been processed and converted into a usable and meaningful format through analysing, presenting, interpreting and then using the generated information for planning purposes and for making informed decisions about how best to utilise available resources to improve service delivery.[132] This study has shown a limited use of information at the facility level. Despite about 70% of the surveyed facilities having mechanisms and processes in place to promote information use, only about half of the facilities have evidence to show that information is being used for the day-to-day management of maternal and child health programmes. In spite of the availability of reports in almost all the facilities surveyed, only half claim to have used the information in the available reports for advocacy purposes; for mobilising resources, based on comparison by services; for adjusting personnel; and for reviewing strategies to achieve performance targets.

The qualitative study concurs with findings from the survey. Managers across the board confirm that information is selectively used at the district and provincial level; however the study revealed that information is not used for decision making and planning purposes, but for reporting and monitoring of programme outputs. Despite an increasing demand for data, and the investments and efforts made to collect routine facility-based data, the majority of decisions made by senior management, such as district and programme managers, in terms of planning and resource allocation for managing HIV programmes, and the day-to-day activities at the facility level, are not necessarily based on informed data. These findings support other studies on information use.[92,145,146] The study by Peersman et al.[146] highlights the extent to which information is not sufficiently used for planning, management, and

implementation of HIV programmes. The authors noted that more than half of the 120 countries surveyed globally, rated their performance in terms of data use as below average.

A major finding of this study is the inability of staff at both the facility and district levels to analyse, interpret and use data. This contradicts the expectations of the South African National Department of Health, outlined in the current District Health Management Information System (DHMIS) standard operating procedures (SOPs).[110] According to the SOPs, facility managers, and professional nurses are not only expected to use data, but also to have the skills to analyse and interpret data. The inability of personnel at the facility level to analyse, interpret, and use data would imply one of two things: either that the SOPs have not been enforced, or that basic trainings to use information are not provided to facility staff. These results support other studies[148,149,150,151] that highlights the inadequacies of managers to analyse, interpret, and use data. Burn and Shongwe's[148] telephone survey of 27 hospitals, highlight the insufficient use of information by hospital managers to manage services delivery at the hospital level. The authors attribute these inadequacies to the managers' lack of skills to use data. Since most managers lack the skills to analyse and interpret data, information should be packaged in a format that allows for easy interpretation, to encourage information use amongst managers.

This study has identified several barriers to the use of information for planning and management purposes; one of such barriers include the lack of trust in the quality of the information. Trust in this context refers to questioning the integrity of the data, i.e. the manner and processes in which the data was collected. A general consensus in this study is that most managers don't use information because they don't trust the data. This finding is consistent with studies by Solarsh and Goga[147] and Mate et al.[15] who argue that the lack of reliable data impede the tracking of progress on health service deliveries. Despite the lack of trust in the data, suggestions have been made to use poor data. Participants argue that working with poor data is one of the ways to improve data quality, since it is only in the process of analysing and making sense of the data that one is in a good position to give feedbacks to data producers on what the problem is, and how to improve on data quality. A number of reasons have been highlighted that influence the quality of data produced at the facility level which include: human errors, staff attitude towards data collection, the lack of ownership of the data collection processes, work overload, staff turnover, and most importantly, the fact that HIS personnel at the facility level are unprepared and lack skills and capacity in data demand and data use core competencies such as data analysis, and

interpretation. Also highlighted is the issues around capacity development, and inadequate equipment at the facility such as functional computers, and basic paper-based resources like registers, tally sheet, and stationeries.

Another significant finding of this study is the lack of a culture of information use at both the district and facility levels. A culture of information use has been defined as 'the capacity and control to promote values and beliefs among members of an organisation by collecting, analysing and using information to accomplish the organisation's goals and mission'.[59 (p 222),120] This study found insufficient information use culture at the facilities surveyed, and inadequate evidence of information use by senior management for planning purposes and decision making. Once there are no indications of a demand for information from senior management, and staff do not understand the usefulness of information, chances are facility managers wouldn't use information. This results support findings from other studies[44,46,56,91] that report on the culture of information use. Kamadjeu et al.[56] have highlighted leadership issues as one of the challenges faced with the adoption and sustainability of an electronic health care record in Cameroon. They observed a 50% dropout rate among users of the system, which was attributed to the non-buy in of the new technology by the new management staff, and hence did not promote a culture of use. This was also supported by Lorenzi et al.,[114] who argued that the success or failure of an organisation, irrespective of the management techniques, depends on the leadership. Taylor[119] have proposed three main factors for an effective development of a culture change. These factors include: Behaviours - of those we admire, or perceive as role models; Symbols - such as who gets promoted; and Systems - such as rewards, and punishments. Taylor argued that it is fruitless to try and change individuals' behaviour without first changing the culture of the environment in which they live. In other words, if a culture of information is promoted by top leadership, personnel are likely to emulate.[56,116]

Chapter 6
RHIS performance for PMTCT output indicators

6.1   Introduction

There are indications that the routine health information system (RHIS) used for collecting facility- based data in South Africa is less than optimal in terms of the quality of data it generates, and has been shown to be inadequate in tracking PMTCT process performance or outcomes.[15] However, literature has shown that quality and data use are closely linked.[104] The qualitative data collected in this study confirms the close relationship between data quality and data use (*Sub-section 5.3.2.3*). It has highlighted the inadequate use of information by managers for decision making, planning and improving health service delivery. One of the reasons given for the inadequate use of data is that the quality of such data is questionable and cannot be relied upon.

In the case of the district health management information system (DHMIS), the data are routinely collected at the facility level in paper format and captured monthly into an electronic format (Microsoft Excel) at the sub-district level, which is then imported into the DHMIS at the district level. Figure 6.1 illustrates the data collection and collation processes at the facility level. Despite the fact that each individual health care staff member is expected to validate the data before submission for onward collation, there are a number of opportunities for transcribing errors (OTEs), particularly when these tasks are performed in unconducive environments. It is important to note that the quality of data produced at this level is of vital importance in the health information system processes. Even though the DHIS software is equipped with an inbuilt validation mechanism to verify data captured onto the system, this has not necessarily resulted in the generation of good quality data.[53,90] The implication is that if the monthly reports are incorrect, chances are the entire health system would be misled when such information is used for decision making and for planning purposes.
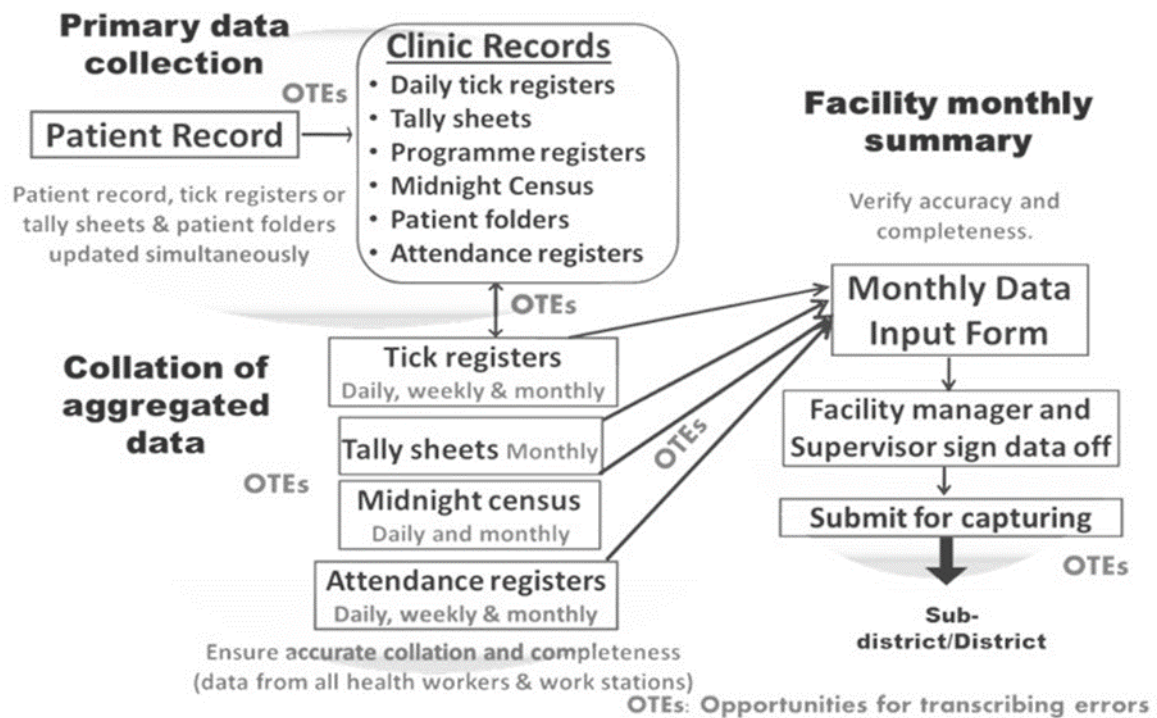
Figure 6.1: Data collection and collation at the health facility

Source: Adapted from DHIS standard operating procedures and guideline[d]

This chapter sets out to address the third objective of this study, which is to measure the performance of the routine health information system for process and output indicators in terms of data quality measured in terms of data accuracy, completeness, and timeliness at both the facility and district levels. Using the six selected data elements from the 20 PMTCT priority data elements, this chapter describes the data-quality issues in each of the three authorities at the facility and district levels, including the concordance between the registers and routine monthly report (RMR), and between the RMR and the DHIS. In addition, four-year trends in the six PMTCT data elements are investigated for data consistency. The determinants of, and factors associated with data accuracy at the facility level are also investigated and the chapter concludes with a discussion of the implications of the study results.

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[d] This diagram was adapted from the 2007 DHIS standard operating procedures and guidelines prepared by Venter, S. [unpublished]

6.2   Data sources

The data sources used in this chapter include:

- the review of PMTCT registers, patient records, and routine monthly reports at each of the health facilities in the two districts
- data from the District Health Information System (DHIS)[181] made available by the South African National Department of Health.
- qualitative study using semi-structured interviews with key informants
- observations in health facilities

The qualitative data sources were used for triangulation as well as further explanation of the findings from this study.

6.3   Data analyses

6.3.1   Data quality

Data quality was measured using two dimensions: data accuracy and data completeness. *Figure 6.2* is an excerpt of the questionnaire used to assess data quality and completeness at the facility level. The figure shows examples of data accuracy issues and incomplete data. For instance in April 2012, the value recorded in the register for the data element *Baby given Nevirapine prophylaxis less than 72 hours after delivery* was '30', but the value recorded for the same element in the routine monthly report (RMR) was '26'. This is an example of data inaccuracy. Likewise, for the data element *HIV-exposed babies initiated on co-trimoxazole prophylaxis around 6 weeks,* there were values recorded in the register for both January and April 2014 ('24' and '15' respectively), but these values were not captured in the RMR for both months, indicating a situation of incomplete data.

Given the differences in the DHMIS as have been highlighted in *Chapter 4*, the results of this study will be analysed by authority, and will require a cautious interpretation due to the small number of facilities in the MDHS (N=11).

Data Quality Example

FQ4	Using the outpatient register, fill in the following information for any two months (Month A and Month B). If the facility does not keep copies of the monthly report, obtain copies at the sub-district/district office. Compare the figures with the computer-generated reports.				
	Item	January 2012		April 2012	
		Value from register	Value from report	Value from register	Value from report
FQ4a	*Baby given Nevirapine within 72 hours after birth*	**21**	**21**	**30**	**26**
FQ4b	*Antenatal client HIV re-test at 32 weeks*	**-**	**-**	**-**	**-**
FQ4c	*Baby PCR test around 6 weeks*				
FQ4d	*HIV exposed babies initiated on Cotrimoxazole prophylaxis around 6 weeks*	**24**		**15**	
FQ4e	*Antenatal client HIV 1st test*				
FQ4f	*Antenatal client initiated on HAART*				

Data accuracy issue

Incomplete data

Source: Adapted from Aqil et al (2010)

Figure 6.2: Excerpt of data accuracy check and completeness questionnaire

6.3.1.1 Data accuracy

Data accuracy was assessed at the facility level by counting the number of events for each of the six PMTCT data elements that were reviewed in the registers/records for January 2012 and for April 2012. These were compared with the RMR that were sent by each facility to the district offices for the same period. Data are considered to be accurate if the same values in the register are recorded in the RMR for each of the data elements during the study period (*Figure 6.2)*. A percentage average of the difference between the register and the monthly report were derived for each data element reported in the two months under review, and the average over the data elements at each facility was obtained.

Since it is impossible to achieve 100% accuracy due to systematic and human errors, the average data accuracy are presented at three levels of tolerance: 0%, 10%, and 20%, within expected values for the six data elements analysed. In order to account for extreme errors in the dataset, an exception rate of +/- 20% tolerance level was selected for further analysis to determine factors associated with data accuracy; however, lower levels of tolerance were used for basic description of data accuracy at both the facility and district levels. Facilities with data elements above the usual range (outliers), and those with no data for the two-month review period, were identified and excluded from the analyses.

Accuracy was measured at the district level by comparing the six selected PMTCT data elements reported in the RMR with the corresponding values in the District Health Information System (DHIS) database. The average data accuracy was presented by authority and tolerance levels.

6.3.1.2 Data completeness

Data completeness was also measured at the facility level by assessing the completeness of the registers and monthly reports; assessing how many of the 20 PMTCT priority data elements were filled in compared with the total expected data elements. Data was complete if there was a value reported for each of the data elements in the monthly report for the months under review, and incomplete if the services were provided but either the register or the monthly report was left blank without a value. Completeness was measured at the district level by comparing the number of data elements reported in the RMR with the numbers captured on the DHMIS.

6.3.1.3 Secondary analysis of completeness and consistency

To explore the consistency and completeness of the routine health information systems (RHIS) in the study areas, we extracted sub-district level data from the DHIS, based on data collected monthly from primary health care facilities and district hospitals. These data were used to plot the annual number of cases reported for each data element in the three-year period preceding the survey (2008 – 2011), and during the study period. Also, the average absolute deviation from the mean was calculated for each year for the data elements.

6.4 Results

Findings from this study are presented and described below according to analyses type, and include: PMTCT data quality; quality assessment of the RHIS in the study sites; PMTCT data timeliness; factors associated with data accuracy; and triangulation with quality information.

6.4.1 PMTCT data quality

6.4.1.1 Facility level data quality

Figure 6.3 shows the performance of RHIS at the facility level, presented by tolerance levels. *Figure 6.3c* indicates that the actual (0% tolerance) average data quality at facility level is 71%, while data accuracy and completeness were 51% and 91% respectively. At the 20%

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tolerance level (Figure 6.3a), the average data quality is 86%, while data accuracy and completeness were 73% and 98% respectively.
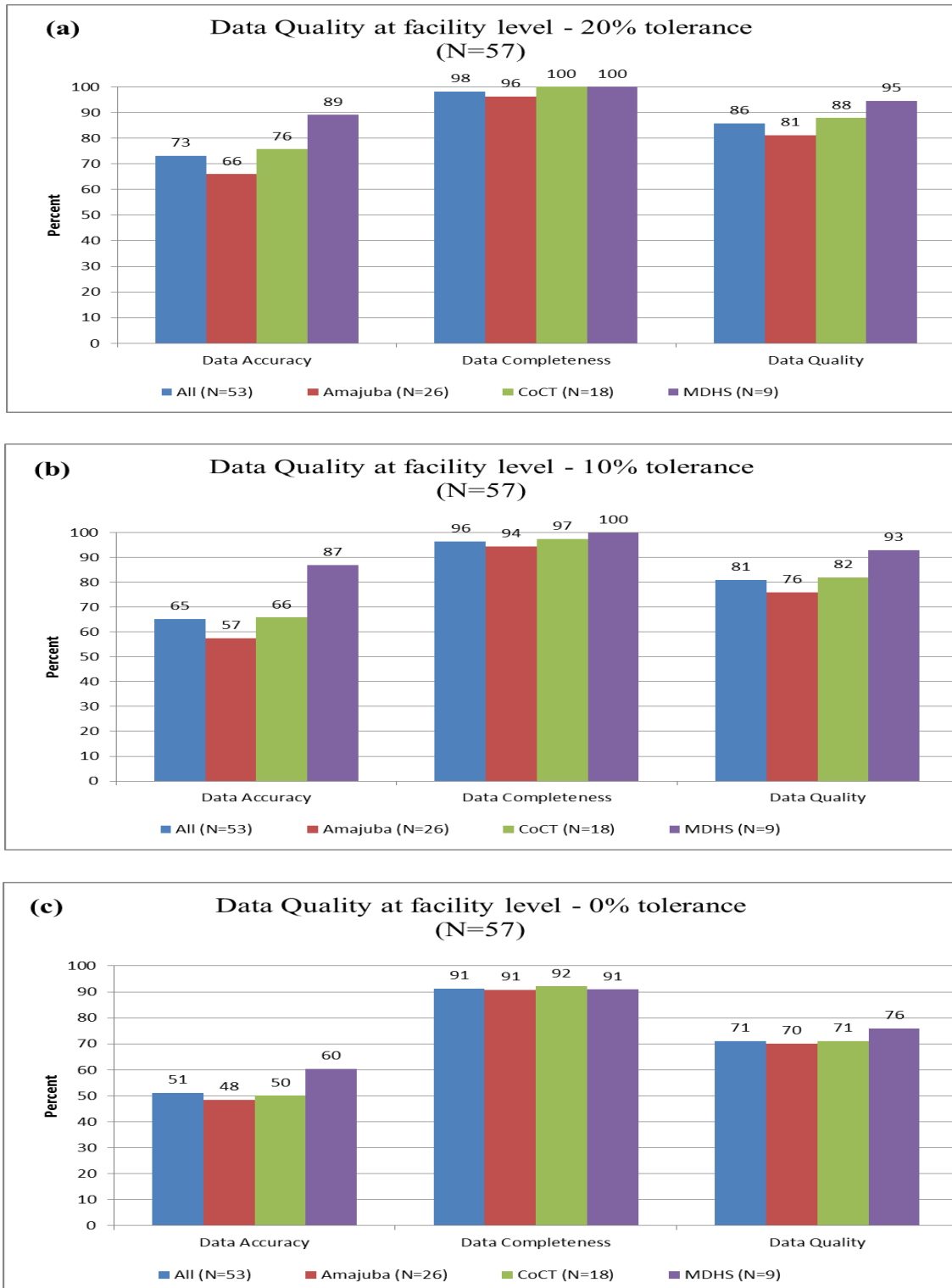
Figure 6.3: RHIS performance at facility level by Authority within specific tolerance levels

When compared by authority (at 20% tolerance level), the figure shows that the PMTCT data from facilities managed by the Amajuba district is less accurate (66%) compared with data

managed by CoCT (76%) and MDHS (89%); authority was shown in *Table 6.2* to be significantly correlated (R^2=0.4091, P<0.0024). Data seem to be generally complete in all the facilities surveyed with an overall average of 98%; MDHS-managed facilities have better quality data (95%) at the facility level compared with other authorities.

Figure 6.4 presents the quality of each of the six PMTCT data elements reviewed at the facility level by month and authority. The best reported data element for the period under review is *Baby given nevirapine prophylaxis less than 72 hours after delivery*, which increased from 87% in January 2012 to 93% in April 2012. CoCT facilities do not report on this data element since it is only collected at the MOUs, which are managed by MDHS. The worst reported element, *Baby PCR test around six weeks,* decreased from 69% in January 2012 to 65% in April 2012. In terms of authority, the figures show that facilities managed by MDHS have the best reported data across the reviewed PMTCT cascade; in contrast, the data show that facilities under the Amajuba district authority have some challenges with the quality of data generated. In addition to *Baby PCR test around six weeks,* the accuracy of the data element *Antenatal client HIV re-test at 32 weeks* also decreased in April compared with January 2012.
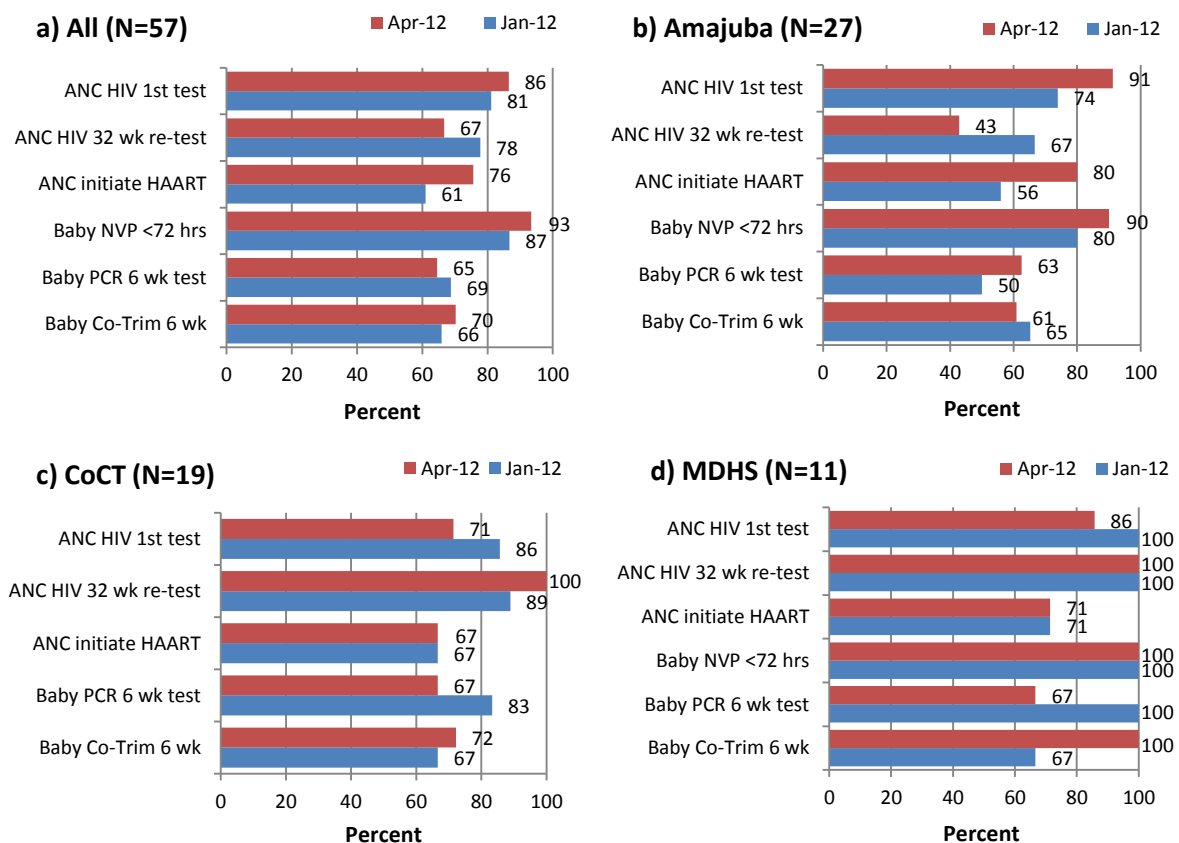
Figure 6.4: Quality of 6 PMTCT data elements at facility level by month and Authority - within 20% tolerance level

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6.4.1.2   District level data quality

When all six PMTCT data elements from the RMR were compared with values captured on the DHIS at the district level, the average data accuracy for the months of January and April 2012 at 0% tolerance level was 84% (*Figure 6.5c*). Data captured onto the DHIS in the CoCT district is less accurate compared with MDHS (85%) and Amajuba (87%). At the 20% tolerance level, there seem to be no difference in data accuracy by authority (Figure 6.5a).
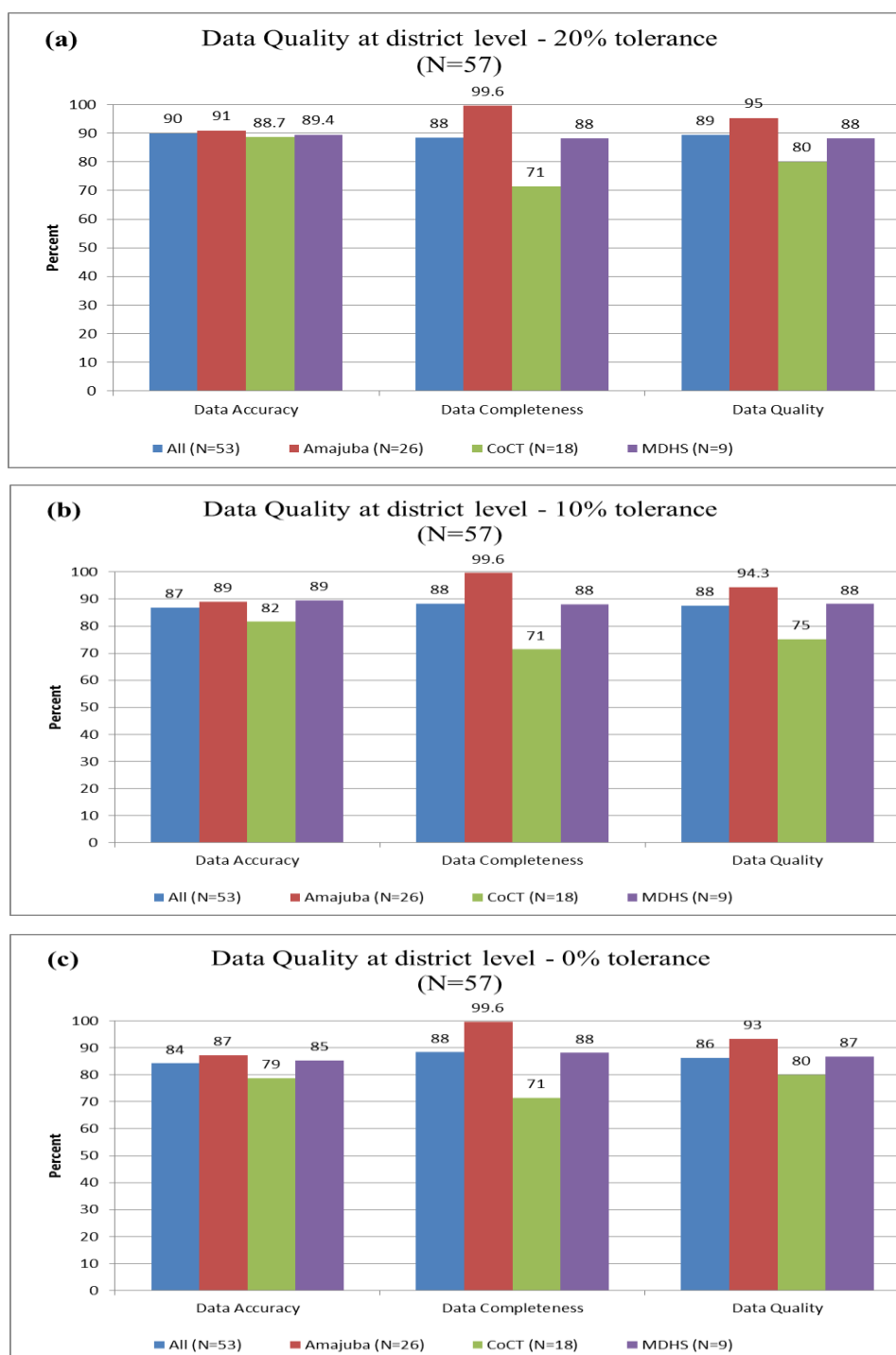
Figure 6.5: RHIS performance at district level by Authority - within 20% tolerance level

The quality of the six PMTCT data elements recorded in the RMR at the facility was also compared with values captured in the DHIS at the district level. *Table 6.1* highlights the quality of each of the data elements by month and authority, and also shows the percentage change over the two-month period. *Antenatal client HIV 1ˢᵗ test* was the best captured data element with a 16% change over the period. In contrast, the concordance for the element *Antenatal client initiated on HAART*, decreased by 8% during the same period. The study found some inconsistencies between the RMR and the DHMIS; there seem to be gaps in the reporting processes. The comparison show incomplete recording of the PMTCT data elements. For instance, apart from missing data, *Table 6.1* show that authorities in the Western Cape do not capture some data elements at the district and provincial level, even when these elements are routinely collected at the facility level. The data elements in question are *Baby PCR test around six weeks,* captured only in January, and *HIV-exposed babies initiated on co-trimoxazole prophylaxis around 6 weeks*, which was not captured at all by the MDHS.

Table 6.1: Quality of 6 PMTCT data elements at district level (DHIS) compared to data from RMR by month and Authority – within 20% tolerance level

Data element	Amajuba		COCT		MDHS		All		
	Jan *(%)*	April *(%)*	Jan *(%)*	April *(%)*	Jan *(%)*	April *(%)*	Jan *(%)*	April *(%)*	%Δ *
ANC HIV 1st test	84	100	88	100	85	100	85	100	18
ANC HIV 32 week re-test	83	83	100	100	100	100	90	89	-1
ANC initiate HAART	92	84	89	89	100	83	92	85	-8
Baby NVP <72 hours	100	100	-	-	80	100	94	100	6
Baby PCR test at 6 weeks	92	100	93	0	67	0	89	92	4
Baby Co-Trim 6 weeks	88	96	0	0	0	0	88	96	9

*Percentage change in each data element over the two-month period (January and April 2012)

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6.4.1.3   Comparing PMTCT register with routine monthly report (RMR)

Using a scatter plot, the six PMTCT data elements from the registers in all 57 clinics were compared with the routine monthly report (RMR) sent to the sub-district offices for the months of January and April 2012. In addition, a histogram was used to assess the distribution of the difference between the register and the RMR (*Appendix R*). *Figure 6.6* presents the best and worst reported PMTCT data elements reviewed by months; it reveals that some values are not within the confidence intervals of each other, especially with the data element *Antenatal client initiated on HAART* for January (R^2=0.675). This indicator was also shown to be the least correlated (R^2=0.94).

The correlation for *Baby given Nevirapine prophylaxis less than 72 hours after delivery* for April (R^2=0.9998) was stronger than for the other data elements. There is considerable variation between values from the two records for some of the data elements. Correlation for *Baby PCR test around six weeks* in the month of April (R^2=0.86) is lower than the month of January (R^2=0.97), implying a decrease in the accuracy of the indicator.
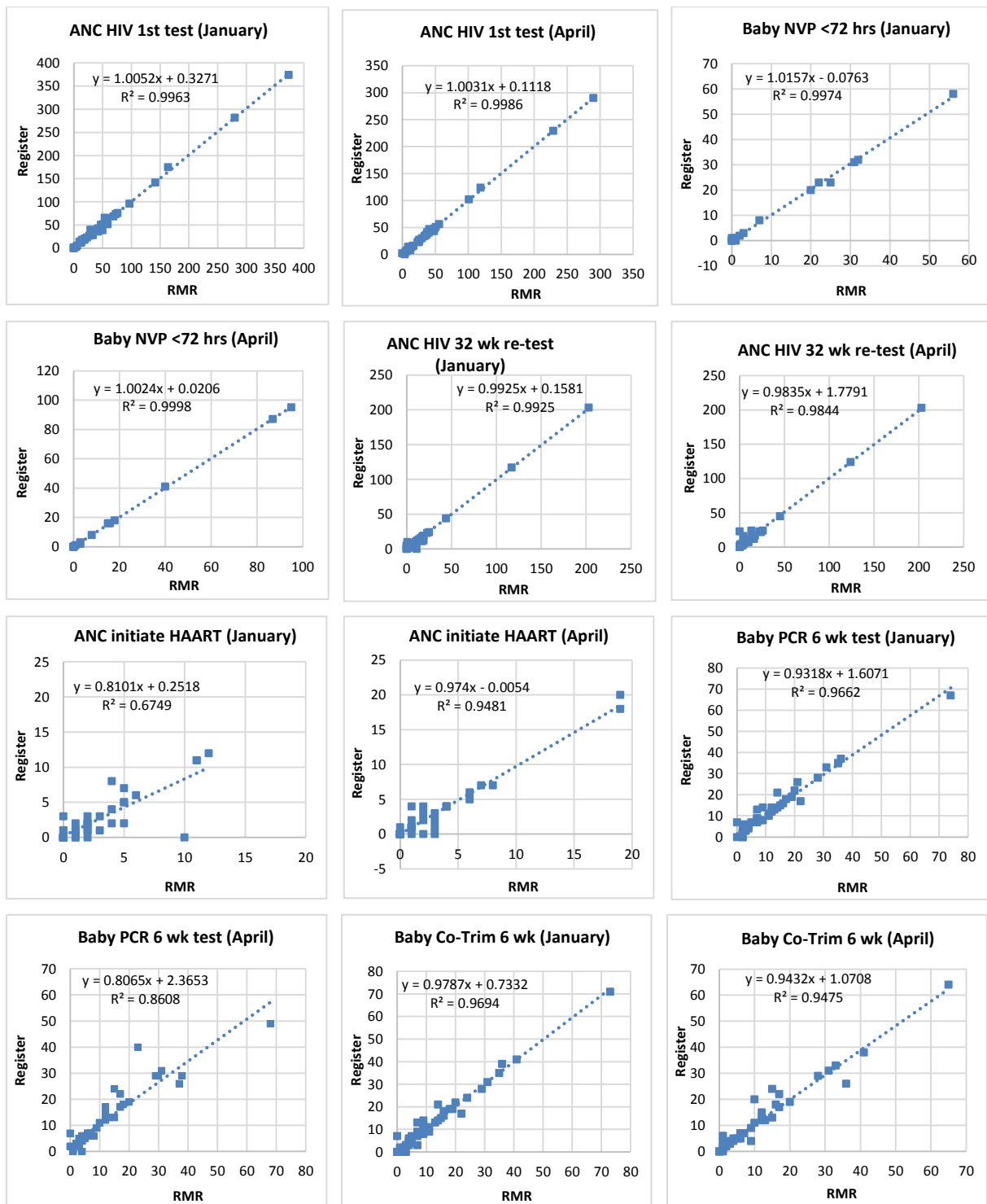
Figure 6.6: Comparing PMTCT register and RMR for selected data elements by months

6.4.2   Quality assessment of RHIS in KZN and WC

6.4.2.1 Trends in six selected PMTCT data elements

The PMTCT data elements have been erratically reported in some of the sub-districts since 2009. While *Figure 6.6a* indicates that the number of routinely reported cases for *Antenatal client HIV 1ˢᵗ test* in Dannhauser and eMadlangeni sub-districts (Amajuba district) have been

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fairly regular over the period 2009–2012, *Figure 6.6c*, *d* and *e* show fluctuations in the number reported for Newcastle and Khayelitsha sub-districts which could be attributed to poor recording especially in 2010 and 2011 for Newcastle and Khayelitsha respectively. In relation to the other two sub-districts, Eastern, Dannhauser and eMadlangeni sub-districts seem to have fairly smooth trend curves across all six PMTCT data elements. Another highlight from *Figure 6.6a* and *Figure 6.6e* is that the number of routinely reported cases of antenatal clients eligible for HIV testing who were tested for the first time during their current pregnancy and *Baby PCR test around six weeks* have decreased steadily since 2009.
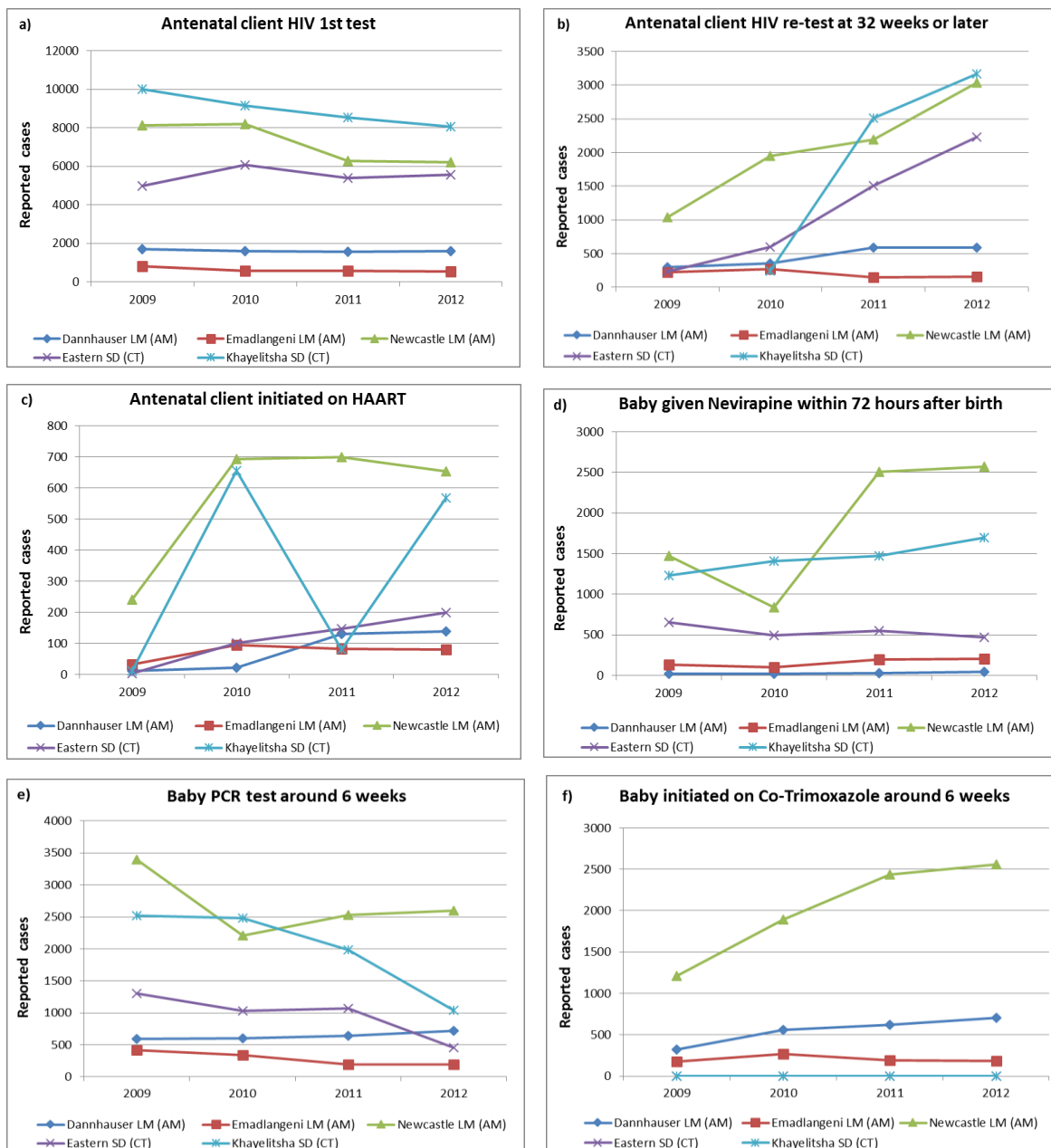
Figure 6.7: Trends in six selected PMTCT data elements by sub-district and Authority (2009-2012)

6.4.2.2   Consistency of the six selected PMTCT data elements

To explore the consistency of the PMTCT data, the average absolute deviation of reported cases for the six PMTCT data elements in the DHIS was calculated for the period 2009 – 2012 and divided by the mean value for that period to provide a standardised absolute deviation. A rule of thumb is that the standardised deviation should be less than 20% for the data to be considered as consistent. *Figure 6.8* indicates that the variability in the number of reported cases has steadily increased each year for the data element *Antenatal client HIV 1st test, and* decreased for *Baby initiated on Cotrimoxazole around six weeks*. The variation for *Antenatal client initiated on HAART* is above 20% of the average data for each of the four years reviewed. Furthermore, the standardised deviation for *Baby PCR test around six weeks* in the study year was high at 32%. This is due to incomplete data observed for Khayelitsha and Eastern Sub-districts for the period July to December 2012.
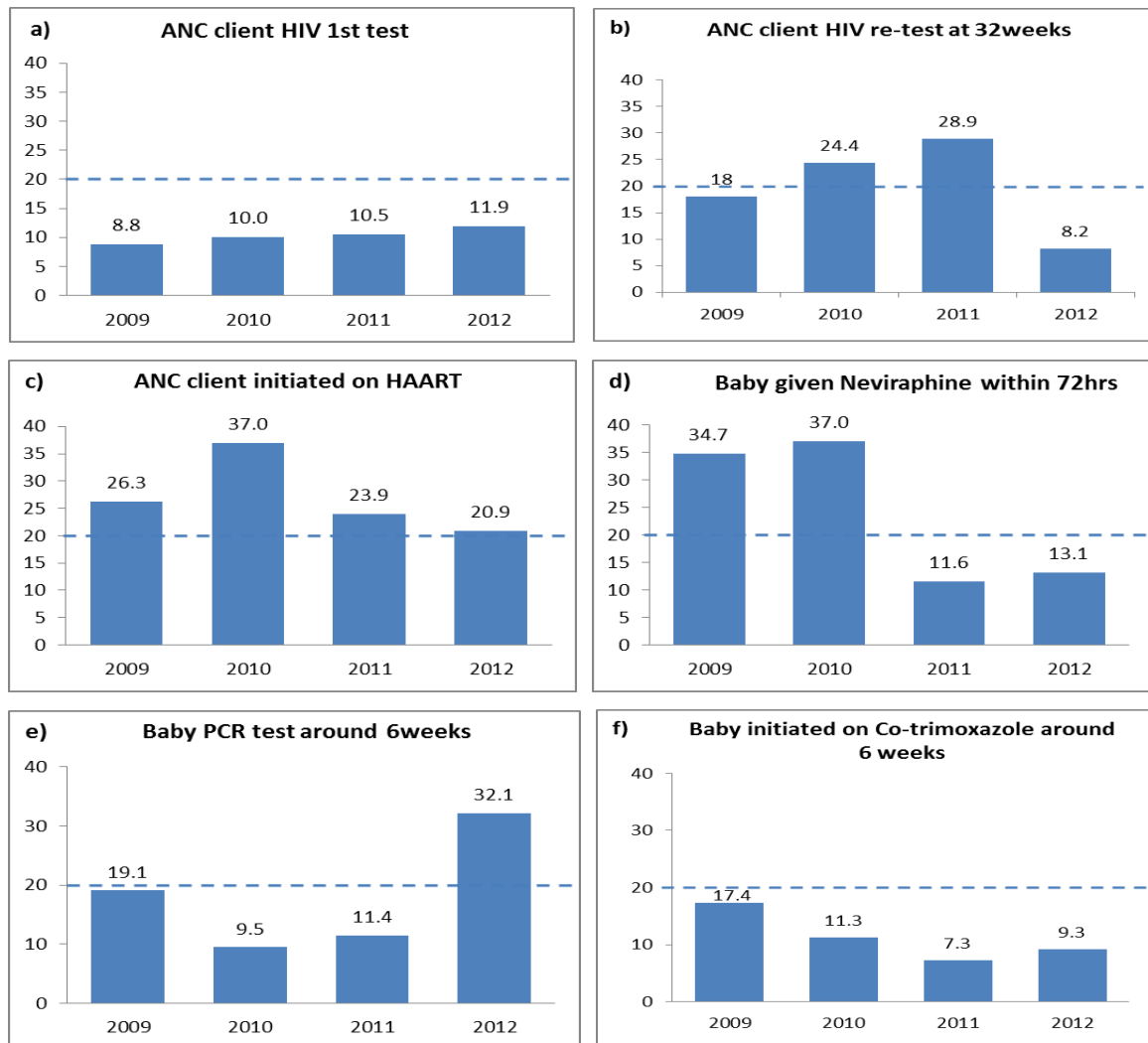
Figure 6.8: Standardised absolute deviation of number of reporting for 6 PMTCT data elements by year (2009-2012)

6.4.3   PMTCT data timeliness

One of the sub-objectives of this study was to assess the timeliness of data submitted by facilities to the sub-district offices. During the pilot, we found that sub-district offices do not keep records of facilities that fail to submit their routine monthly reports (RMR) by the specified deadline of the 5th of every month for CoCT-managed facilities, the 7th of the month for provincial facilities, and the 1st of each month for Amajuba-managed facilities. Hence the indicator 'timeliness of the PMTCT data in terms of the proportion of facilities that submitted RMR by the specified deadline' could not be ascertained. Even though the indicator 'data timeliness' is an important indicator for calculating data quality, our inability to ascertain this indicator using quantitative approach has minimal impact on the outcome of the results, since the in-depth interviews study revealed that a majority of the facilities send through their RMR before the due date, and that the sub-district/district health information officers ensured that all facility data are captured and signed off before the data are sent to the district/provincial offices.

6.4.4   Factors associated with data accuracy

To determine factors that may be associated with data accuracy at the facility level, we ran a correlation analysis to establish the associations between the dependent variable (data accuracy at 20% tolerance) and each of the independent variables, based on the PRISM framework (*Appendix S*). *Table 6.2* presents the association between data accuracy and selected independent variables with the corresponding R^2. The figure shows that two variables: Authority (R^2=0.41, P<0.002), and Feedback (R^2=0.31, P<0.003) were positively and significantly associated with data accuracy; in contrast Data display (R^2=0.41, P<0.002), RHIS Finance (R^2=-0.27, P=0.0459) and the use of SOPs (R^2=-0.30, P=0.032) were negatively correlated with data accuracy; however there was no association between job category and data accuracy, and between information use and data accuracy, thus validating the fourth hypothesis

After conducting the correlation analysis (*Table 6.2*), we conducted further investigations to determine the extent to which Authority, Feedback, Data display, RHIS Finance and Use of SOPs would statistically predict data accuracy (*Table 6.3*). To identify the best model, we ran a regression analysis and fitted ten different models for each of the variables identified to be associated with data accuracy. Authority (Amajuba, CoCT, and MDHS) was used as the base model (*Model 1*), with Amajuba as the reference category. This model show that authority

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was statistically associated with data accuracy at 0.01 significance level, and that MDHS-managed facility have better data accuracy compared to CoCT and Amajuba district. Other factors shown to be associated with data accuracy such as organisational factors, and RHIS processes were added to *Model 1*. For instance, in addition to Authority, *Model 2* and *3* contain RHIS processes: Feedback and Data display respectively, while *Model 4* and *5* contain organisational factors such as the presence of RHIS-related expense register, and the presence of a copy of RHIS standard operating procedures. *Model 6* and *7* on the other hand contain only organisational factors and RHIS processes respectively. *Model 6* show a negative relationship between organisational factors and data accuracy, thus refuting the third hypothesis.

Table 6.2: Associations between data accuracy, selected facility and HIS personnel variables

	Data accuracy	Info use	Authority	Feed back	Data display	RHIS Finance	Use of SOPs	Job category	Education level
Data accuracy	1.0000								
Information use	-0.0820 (0.5593)	1.0000							
Authority	**0.4091*** (0.0024)	-0.2557 (0.0549)	1.0000						
RHIS processes Feedback	**0.3057*** (0.0026)	0.2027 (0.1306)	0.2100 (0.1169)	1.0000					
Data display	**-0.3324*** (0.0150)	**0.4845*** (0.0001)	**-0.6448*** (0.0000)	0.0241 (0.8587)	1.0000				
Organisational factors RHIS Finance	**-0.2713*** (0.0459)	-0.1520 (0.2589)	-0.2577 (0.0529)	**-0.4004*** (0.0002)	0.0340 (0.8018)	1.0000			
Use of SOPs	**-0.2956*** (0.0316)	**0.2858*** (0.0312)	**-0.4697*** (0.0002)	-0.1601 (0.2341)	**0.2830*** (0.0329)	0.1419 (0.2925)	1.0000		
HIS Personnel Job category	-0.1305 (0.3518)	0.1977 (0.1404)	-0.0040 (0.9597)	-0.1950 (0.1461)	**0.3758*** (0.0040)	**0.2846*** (.0319)	0.1660 (0.2171)	1.0000	
Education level	-0.0556 (0.6923)	-0.0243 (0.8575)	0.0000 (1.0000)	-0.0200 (0.8825)	0.0571 (0.6732)	0.0539 (0.6907)	0.1251 (0.354)	**0.3559*** (0.0000)	1.0000

* Statistically significant at *p* = 0.05

We considered the fit by assessing the R^2 and the P-values. A close observation of *Table 6.3*, which presents the results of the models reveals that being in a particular organisational authority, in this case MDHS (*P=0.003*), has a strong positive influence on the accuracy of data generated at the facility level, even having adjusted for feedback in *Model 2*. The models consistently indicate that MDHS-managed facilities have better data accuracy compared with CoCT and the Amajuba district facilities.

Model 7 suggested that the difference by authority might be explained by organisational factors, i.e. the presence of expense registers indicating RHIS finance management, and the presence of RHIS standard operating procedures indicating RHIS management. However, only 14% of the variation in data accuracy could be accounted for by these two indicators alone. As indicated in the table, Feedback emerged as the sole predictor of data accuracy, after controlling for authority and data display (*Model 8*). Feedback was statistically significant at 0.05 level and the model accounts for about 25% of the variation in data accuracy at the facility level. Model 10 suggest that all the factors are associated and could account for 27% of variation in data accuracy but none are statistically significant due to small sample size.

Table 6.3: Regression models for data accuracy (20% tolerance) at facility level

	Independent variables	(1) Data Accuracy	(2) Data Accuracy	(3) Data Accuracy	(4) Data Accuracy	(5) Data Accuracy	(6) Data Accuracy	(7) Data Accuracy	(8) Data Accuracy	(9) Data Accuracy	(10) Data Accuracy
Authority	Amajuba [†]										
	City of Cape Town (CoCT)	9.73 (5.88)	8.14 (5.82)	6.62 (7.26)	7.72 (5.96)	8.14 (6.15)			2.42 (7.31)	6.23 (6.22)	0.46 (7.61)
	Metro district health services (MDHS)	23.11*** (7.42)	20.61*** (7.39)	18.82* (9.46)	21.10*** (7.45)	19.67** (8.35)			12.67 (9.62)	17.85** (8.35)	9.42 (10.36)
Organisational factors	Finance *(Presence of RHIS-related Expense register)*				-17.42 (11.63)			-21.05* (11.67)		-17.14 (11.67)	-9.77 (12.97)
	Use of quality/ performance standards *(Presence of a copy of RHIS standard operating procedures)*					-6.65 (7.37)		-13.40** (6.65)		-6.36 (7.29)	-5.62 (7.24)
RHIS processes	Feedback process		16.26* (9.02)				22.50** (8.78)		19.36** (9.28)		15.26 (10.50)
	Data display process			-5.31 (7.21)			-14.22*** (5.14)		-9.25 (7.22)		-9.06 (7.29)
	Constant	65.96*** (3.76)	52.21*** (8.47)	70.25*** (6.94)	67.97*** (3.95)	72.36*** (8.03)	59.52*** (8.60)	85.00*** (5.87)	57.05*** (9.23)	74.06*** (8.02)	66.89*** (13.13)
	Observations	53	53	53	53	53	53	53	53	53	53
	R-squared	**0.17**	**0.22**	**0.18**	**0.21**	**0.18**	**0.21**	**0.14**	**0.25**	**0.22**	**0.27**

† indicates reference category, *** indicates statistical significance at the 0.01 level, ** indicates statistical significance at the 0.05 level, and * indicates statistical significance at the 0.10 level. Standard errors are in parenthesis

6.4.5   Triangulation with qualitative information

Several approaches were applied to triangulate the results from this study such as providing feedbacks to key informants of key results for validation and interpretation. In addition, observations made during the survey were compared with the interviews and results from the qualitative analysis for similar findings. Information from personal observations at the 57 facilities visited during the survey and semi-structured interviews with key informants confirm the findings reported above. For instance the author observed some discrepancies on how data elements are captured from the RMRs onto Sinjani. Some data elements such as *Baby PCR test around six weeks,* and *HIV-exposed babies initiated on co-trimoxazole prophylaxis around 6 weeks* discussed in *Sub-section 6.4.1.2* are recorded in the register but are not reported in Sinjani.

The poor quality of the PMTCT data reported in this chapter could be explained by findings from the qualitative study (*Chapter 5*). All 22 participants who were interviewed in this study, were concerned about the quality of data collected at the facility level. They were from different levels of the organisational structures reflecting the observation that data accuracy is an issue at facility and district levels. There was also a general consensus that lack of manpower and basic capacity/competence for recording and validating data at the facility level is one of the most burning issues. The qualitative results highlights extensive behavioural and organisational factors influencing the quality of PMTCT data in this setting. These factors which include the lack of core RHIS competences such as skills for data collection and data validation, and limited supervisory visits, will be examined extensively in *Chapter 7*.

6.5   Discussion of findings

This investigation reveals major gaps in the reporting of the PMTCT programme data at both the facility and district levels. Only two of the six data elements assessed (i.e. *Baby given Nevirapine prophylaxis less than 72 hours after delivery* and *Antenatal client HIV 1st test*) were above 80% accurate, even after allowing for tolerance level within +/-20% of the expected values. The District Health Barometer,[182] which reports on selected data from the DHIS, has also identified data quality issues. It reiterates the problems involved in data collection[182 (p 66)] and agrees 'the data underlying the PMTCT programme is less than optimal'.

The average PMTCT data accuracy (0% tolerance) over the two-month period in this study was 51%, which is below the data accuracy for similar studies that have used the PRISM tools[59] in Africa (Côte d'Ivoire,[123] Uganda[127,128] and South Africa[e]) and other low/medium-income countries such as Haiti[126] and Pakistan.[120] It confirms findings from another study that investigated the accuracy of PMTCT data in three large, high HIV prevalence districts in KwaZulu-Natal, the same province where our study was conducted; the study found that the PMTCT routine statistics were neither complete nor accurate; they were therefore not a viable means to track process performance or outcomes for PMTCT.[15] The similarity between both studies, apart from the fact that they were conducted in the same province, is that three of the data elements reviewed were similar (*Baby given Nevirapine prophylaxis less than 72 hours after delivery, Baby PCR test around six weeks,* and *Antenatal client HIV 1st test).* Even though the studies were conducted five years apart, our results show an improvement in PMTCT data accuracy which can be attributed to concerted efforts by donor agencies such as the President's Emergency Plan for AIDS Relief (PEPFAR) and Department for International Development (DFID), [67] and the consistent focus on PMTCT in national policies[183,184] to improve the quality of data for monitoring PMTCT programmes.

Another finding of this study is the discrepancies observed between the registers and the routine monthly reports (RMR), and between the RMR and the DHIS database. The study found the congruency between the RMR and the DHIS to be better than that between the register and the RMR, indicating that the PMTCT data accuracy was better at the district level compared with the facility level, with an average data accuracy of about 90% within +/- 20% of the expected values. These results confirm findings from Mate et al.[15] that suggest that the primary point of departure for accurate transfer of data is during the tallying and collation process at the facility level, between the registers and the routine monthly report; hence training should be focused on the nurses and data capturers who collect the data rather than health information officers at the district and provincial levels.

Values for some of the selected data elements are not within the confidence intervals of each other. The worst reported data elements between the register and the RMR was *Antenatal client initiated on HAART* for January (R^2=0.68), which happens to be the element with the

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[e] Measure Evaluation. RHIS Course, Pretoria University, South Africa. Measure Evaluation, United States Agency for International Development (USAID), Fieldwork during RHIS Course, 2005.

lowest correlation (R^2=0.94) when the RMR was compared with the DHIS; in contrast the correlation for *Baby given Nevirapine prophylaxis less than 72 hours after delivery* for April (R^2=0.9998) was stronger than for the other data elements. This findings is disturbing when one considers the estimated coverage of 75% reported for antenatal clients initiated on Highly Active Antiretroviral Therapy (HAART)[7] in 2012. This findings suggest that the estimates may not be reliable. Also several studies[9,12,75] have indicated that the mother-to-child transmission rate in South Africa has declined to <3% nationally. It is obvious from our findings that the success of the PMTCT programme was not driven by routinely collected data (DHMIS); this raises the question of the relevance of routine data for management purposes. The success of the PMTCT programme cannot be farfetched; unlike other maternal and child health programmes, such as the expanded programme on immunisation (EPI), the PMTCT programme has received overwhelming support from donor agencies and other stakeholders since its implementation in South Africa.[67,183,184]

Despite the above, concerns have been raised about the excessive burden of healthcare providers in terms of the multiple registers they have to fill in at the facility level, and the fact that some data elements for calculating indicators needed at the national level are not often captured, despite the fact that they are collected at the facility level and included in the PMTCT guideline. This study shows that the data elements *Baby PCR test around six weeks,* and *HIV exposed babies initiated on Cotrimoxazole prophylaxis around 6 weeks,* were not captured onto the DHIS database at the district level in the Western Cape, and not reported at the national level. The issue here is that the data elements are included in the PMTCT guideline; not reporting the data elements could mean one of two things - either they are not needed, in which case they should be removed from the PMTCT guideline, or that the indicators are under reported at the national level.

As has been found elsewhere,[171,125] it is expected that capturing of data at the district level would be 100% accurate since more experienced and skilled health information personnel function at this level. Unlike the studies in Mexico and China, which also assessed the strengths and weaknesses of their national health information systems for better monitoring and evaluation of health information system performance, and found data accuracy at the district level to be 100%, our study suggests that effort is still needed to improve the quality of reporting at the district and facility levels. The reasons given for the 100% data accuracy at the district level in Mexico and China has to do with the type of routine health information systems in place. The systems allow for automatic collation and generation of reports at the

district offices, of data entered at each of the facilities, thereby avoiding the issues relating to manual collation and reporting of data. In South Africa, the City of Cape Town (CoCT) uses a similar system called the Patient Record and Health Management Information System (PREHMIS) to routinely collect patient information at all its clinics. Patients' records are scanned at the facility level where the care was given and the data is transmitted directly to a database at the district office where it is exported onto the DHIS. However not all facilities in the Western Cape have this technology; even in the facilities using the system, not all services delivered are captured. For instance, PMTCT data are still being captured manually using paper-based registers. The strengths and weakness of the PREHMIS have been discussed in *Chapter 4*.

While PMTCT coverage may have increased over the period 2009–2012, the fluctuations in the reporting of the PMTCT data elements raise concerns about the reliability of the information. *Figure 6.7* shows the trend in reporting for selected data elements for the period 2009–2012; it indicates an increase in the number of *Baby given nevirapine prophylaxis less than 72 hours after delivery*, and a steady decrease in the proportion of *Baby PCR test around six weeks*, and *Antenatal client HIV 1ˢᵗ test*, since 2009. The decrease in the number of reports could be an indication of reporting issues over the four-year period. However, the annual variation in the DHIS data suggests major gaps in the quality of data at the sub-district level (*Figure 6.8*). This variation could be ascribed to several reasons, some of which are discussed below and include, among others, the use of multiple registers for data collection, inadequate training on HIS tasks, and structural issues. Nonetheless, one thing remains certain, the variation reflects the breakdown in data flow from the facilities to the district, and the inaccuracy of the PMTCT data. The results confirm findings from the study in Kenya[40] and KwaZulu-Natal[15] that identified concerns about the validity of the routine data for monitoring PMTCT.

Discrepancies in the PMTCT data have been ascribed to the multiplicity of data collection tools for monitoring the programme. All the 20 PMTCT priority data elements reported at the national level are derived from three main registers – the Antenatal care (ANC) register, Maternity/Labour ward register, and the Baby follow-up register. These registers are not necessarily available in one facility, but depend on the type of services offered at the facility. The registers are kept by multiple care providers, who frequently forget to record the provision of services or even tick off the drugs administered to patients. A recent PMTCT data accuracy study in Kenya found that nurses admitted they sometimes forgot to record the

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care provided to patients, despite having provided such care.[40] Other major challenges affecting the accuracy of PMTCT data are lack of manpower and basic capacity/competence for recording and validating data; these issues have been discussed elsewhere in *Chapter 5*.

One of the indicators for data quality, timeliness of the data which measures the proportion of facilities that submitted their routine monthly report (RMR) to the sub-district/district level by a stipulated deadline, could not be ascertain since no structure was in place at the sub-district level to collect such information. However, the in-depth interviews revealed that majority of the facilities submit their RMR by the due date, and that health information officers at the sub-district and district levels made sure data from all facilities RMRs were captured onto the system, before they are transmitted to the district level.

It is intriguing to note the variations in data accuracy in each of the authorities managing the facilities generating the data. Considering the fact that the Amajuba district has a higher prevalence of HIV compared with other study sites, it is worrying to note that the quality of PMTCT data in the Amajuba district (KZN) is worse than that in the other study sites. This finding is consistent with other studies that have examined the quality of data from routine health information systems.[38,39,40,42,43,136] An attempt was made to predict factors associated with data accuracy. After controlling for other factors, the study indicated that having a feedback process in place at the facility level was found to be a predictor of data accuracy, explaining about 25% of the variation in data accuracy at the facility level. Even though there was a difference in the authorities, with MDHS having a higher coefficient, this was not statistically significant. This result is not surprising since feedback has been found in the literature to play an important role in the information cycle. Studies by Muschel[28] and English et al.[48] have attributed poor data quality, and insufficient skills to analyse, interpret and use data, to lack of feedback mechanism between the different levels of the health system. Mphatswe et al. also show that a feedback training intervention could be used to improve the quality of routinely collected data in South Africa.[141] Hence, timely feedback mechanism is a crucial part of the supervisory process, and is important for enhancing data quality, especially when audits are done.[28,48,53] It is expected that when feedback is given from the district level to the facility level, it comes in the form of an audit of work already done, based on the fact that the work has been checked, and this could either be positive or negative feedback, which is expected to improve performance. This has implications on management functions such as supervision and planning of activities at the facility level. Results from this study have consistently shown that MDHS-managed facilities are performing better than other facilities

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in all indicators assessed. It is not conclusive at this stage what the provincial facilities are doing to improve data accuracy; however, behavioural and organisational determinants affecting the routine health information systems' performance are analysed in more detail in *Chapter 7*.

6.6   Conclusions

This chapter has highlighted serious data accuracy concerns in the routine data used to monitor PMTCT programmes coverage and has shown that the data is neither viable for planning or monitoring purposes. While the accuracy appeared to be better in the MDHS, there was none-the-less room for improvement. Despite the poor quality of the PMTCT data, studies[9,12,98] have shown that MTCT rate in South Africa has declined. The reported success of the PMTCT programme must be ascribed to other factors. The improvement may be related to concerted efforts from donor agencies and stakeholders like PEPFAR and the Department for International Development (DFID), through the development of action plans,[67] and the consistent focus on PMTCT in national policies.[183,184] Unfortunately such vertical approaches have a negative effect on RHIS. In the longer term it is important that a country has a good and functional routine health information system.

The study has shown that feedback processes at the facility level are essential for improving data accuracy. Due to small sample size, it was not possible to draw firm conclusions. However, the analysis of the data indicated that organisational factors such as the financial management and use of quality standards may be important as well as other RHIS processes such as data display. The analysis also indicated that better performance observed in MDHS could not be explained by feedback processes alone (*Table 6.3, Model 2*). Furthermore, there are other factors that this study did not consider that might explain the variation in data accuracy. We therefore recommend that further studies need to be conducted to explore the factors that might influence data accuracy at the facility level.

Chapter 7

Behavioural and organisational determinants

7.1 Introduction

Most studies on the evaluation of health information systems' (HIS) performance primarily focus on technical and organisational issues or clinical processes[50,51,52,53] and generally fail to explain the determinants of HIS successes or failure in different settings. Very few studies have examined the people aspect of HIS, and these only focus on the availability of human resources[45] and not on competence and motivation, nor on use of data for decision making and improving services.

One of the challenges of routine health information systems (RHIS) in low- and middle-income countries revolves around nurses, who are faced with the dilemma of seeing patients and compiling monthly statistics. A major concern is that clinic personnel, such as nurses, have multiple responsibilities, including primary clinical responsibilities, which may influence the time they allocate for data collection. Clinic staff may value the care of patients over data collection; hence data collection may be completed many days after the event has occurred, and this lag-time may impact on the quality of the statistics they produce.

Another concern is that at the facility level, there are multiple registers and tally sheets that need to be collated, summarised and sent to the sub-district level.[48] Training is not usually provided for clinic staff involved in data collection processes, who often have, have very limited data-quality checking skills and do not understand the value of the data being collected; as such data captured onto the RHIS may be of low quality. Studies have shown that data from the RHIS are inaccurate, and data collection methods are not complete.[15,16,39,54,55]

In the case of the District Health Information System (DHIS), the data are collected at facility level in paper format and captured in electronic format (Microsoft Excel) at the sub-district level, and then imported into the DHIS at district level. Consequently, there are a number of opportunities for transcribing errors, particularly when these tasks are performed in un-conducive environments, like the spaces the nurses work in.

This chapter describes the experience in two health districts, using a modified version of the Performance of Routine Information System Management's (PRISM) Organisational and Behavioural Tool (OBAT), and Management Assessment Tool (MAT)[154] to assess the behavioural and organisational factors affecting the routine health information systems (RHIS) performance in maternal and child health HIV programmes.

7.2 Data sources

Data were collected from 161 health information personnel in 57 health facilities, three sub-district offices and two district offices between July and November 2012, using a modified version of the PRISM's self-administered Organisational and behavioural Tool (OBAT) and Management Assessment Tool (MAT). The facility manager/deputy manager, and at least two personnel involved in data capturing in each of the 57 health facility were selected to participate in the self-administered health information personnel survey. Behavioural factors were measured in terms of knowledge of checking data quality, knowledge of RHIS rationale, problem-solving skills, competence in RHIS tasks, confidence levels for RHIS tasks, and motivation. Organisational factors were measured in terms of promotion of a culture of information based on the following indicators: emphasis on data quality, use of information, evidence-based decision making, feedback from staff and community, sense of responsibility, empowerment and accountability, promoting problem solving, and perceived reward from the Department of Health.

In addition, management indicators were measured using the MAT, which was completed by facility managers from 57 health facilities. The indicators measured include RHIS governance, use of quality performance standards, planning, training, availability of finance, and support for supervision. Refer to *Chapter 3, Sub-sections 3.6.1.3, 3.6.1.4* and *Sub-sections 3.6.4.6* for more details on the methodology. Similarly, individual interviews with key informants were conducted using a semi-structured questionnaire to elicit information on organisational determinants. RHIS processes were measured via observations at all the 57 facilities, including reviews of registers, tally sheets, and monthly reports for the six PMTCT priority data elements under review. Indicators assessed included data collection, data transmission, data processing, data analyses, data display, data checks and feedback.

7.3   Data analysis

Data were double-captured into the PRISM's customised Data Entry and Analysis Tool (DEAT) and exported into Microsoft Excel, where they were validated using the Microsoft Excel Comparison tool. The validation processes have been discussed elsewhere (*Chapter 3, Sub-section 3.6.3*).

Univariate analyses were done using simple descriptive statistics like frequency distribution to describe the background characteristics of the respondents. Bivariate analysis was done by cross-tabulating each of the eight background characteristics (age, education, job category, place of work, authority, HIS training, gender, and years employed) with the behavioural and organisational factors. Bar charts were also used to display bivariate analyses of key behavioural factors (RHIS competence and confidence levels) and some organisational factors (governance, planning, training, supervision, use of quality/performance standards, and finance).

The association between background characteristics and levels of behavioural factors (knowledge of RHIS rationale, knowledge of checking data quality, problem-solving skills, competence in RHIS tasks, confidence levels for RHIS tasks, and motivation) and organisational factors (promotion of culture of information use) were evaluated using a χ^2-test. Pairwise correlation analyses were used to examine the associations between these factors. Multiple linear regression analysis was also conducted to investigate the extent to which respondents' background characteristics (age, education, job category, place of work, etc.) would predict behavioural factors, and to determine whether other behavioural factors would predict RHIS competence.

These analyses were done in STATA, allowing for the clustering within clinics. A comparison between the districts was undertaken as well as an analysis to assess whether management support affects the behavioural factors around health information. In addition to the above analyses, information from key informants on organisational determinants affecting the District Health Management Information Systems' performance were collated (*Section 3.7*).

7.4   Results

The findings of this objective, which is to assess the behavioural and organisational determinants affecting the District Health Management Information System's performance, are presented and described below in several sections; these sections include Background characteristics, Behavioural determinants, Organisational determinants, Multiple regression analyses results, and Organisational barriers. The chapter concludes with a discussion on the findings of the study.

7.4.1   Background characteristics

The background characteristics of respondents under study are based on 161 health information personnel. A total of 182 responses were expected from the 57 health facilities and two district offices. However, 6 facility managers and 15 data capturers were unable to take the assessment, resulting in a response rate of 88.5%. To enable us have a better understanding, as well as make a critical analysis and interpretation of the results, background characteristics such as age, gender, educational attainment, place of work, authority, province, job category, HIS training in the last six months, and years of employment of the respondents were considered. Also key behavioural and organisational determinants such as knowledge of RHIS rationales, knowledge of checking data quality, problem solving for RHIS tasks, competence in RHIS tasks, confidence levels for RHIS tasks, motivation, RHIS governance, use of quality performance standards, planning, training, availability of finance, and supervision were considered.

Table 7.1 shows the percentage distribution of respondents' background characteristics by province. The table shows that 71 (45%) of the 161 responses were from KwaZulu-Natal (KZN), while the Western Cape (WC) accounted for 90 (55%) of the responses. The respondents range from 20 to above 55 years of age with half of them in the 20–39 age groups. Fifty-five percent of respondents in KZN are below 40 years compared with 49% in the WC. In terms of education, 34% claim they completed high school, while 58% of the respondents claim they have a diploma or higher degree. Of those who claim to have a diploma or higher degree, about two-thirds are in KZN, compared with 53% in the WC.

Approximately 35% of the respondents are data capturers and health information officers, while 46% are facility managers (FM)/deputy facility managers/operation managers (OM), most of whom are nurses. However, there seem to be more data clerks and data capturers in

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KZN (51%) compared with the WC (33%). In terms of education, 93% of all personnel surveyed work at the facility level, and females account for 77% of the total respondents. While 58% claim they have had no training in health information system-related tasks in the last six months preceding the survey, almost half of them claim they have been employed for more than five years and 18% have been on the job for less than a year before the survey. Whereas 55% of the respondents in KZN claim to have been employed more than five years, the table shows that only 44% have been on the job for more than five years in the Western Cape.

Table 7.1 shows that 44% of the respondents are from facilities managed by the Amajuba district authority in KZN, while 32% and 24% of the respondents work in facilities managed by the City of Cape Town (CoCT) and Metro district authorities respectively.

Table 7.1: Percentage distribution of respondents' background characteristics by province

Background characteristics of RHIS personnel by province					
Variable	**KwaZulu-Natal**		**Western Cape**		**Overall** N=161
	n=71	**%**	**n=90**	**%**	**%**
Age					
20-24	10	14.1	8	8.9	11
25-29	13	18.3	18	20.0	19
30-34	10	14.1	6	6.7	10
35-39	6	8.5	12	13.3	11
40-44	11	15.5	12	13.3	14
45-49	7	9.9	12	13.3	12
50-54	7	9.9	8	8.9	9
> 55	6	8.5	13	14.4	12
Missing	1	1.4	1	1.1	1
Gender n=161					
Male	16	22.5	21	23.3	23
Female	55	77.5	69	76.7	77
Level of education n=161					
<= Grade 10	1	1.4	6	6.7	4
Matric	22	31.0	32	35.6	34
Diploma	35	49.3	28	31.1	39
Bachelor	11	15.5	13	15.9	15
Postgraduate	2	2.8	5	5.6	4
Missing	0	0.0	6	6.7	4
Place of work n=161					
Facility	67	94.4	83	92.2	4
Sub-district	-	-	5	5.6	3
District	4	5.6	2	2.2	93
Job category n=161					
Clerks	8	11.3	24	26.7	20
Data Capturer	28	39.4	5	5.6	21
Health Information Officer	2	2.8	20	22.2	14
Clinical/Managers [*]	33	46.5	41	45.6	46
Years of employment n=161					
<=1	16	22.5	13	14.4	18
1-2	2	2.8	5	5.6	4
2-3	3	4.2	13	14.4	10
3-5	11	15.5	19	21.1	19
>5	39	54.9	40	44.4	49
HIS training in past 6 months n=161					
No	44	62.0	50	55.6	58
Yes	27	38.0	40	44.4	42
Authority n=161					
Amajuba	71	100	-	-	44
CoCT	-	-	52	57.8	32
Metro	-	-	38	42.2	24

[*]Facility Manager (FM), Operation Manager (OM), Nurses, HIV/AIDS, STI & TB (HAST) Programme Manager (PM).

7.4.2   Behavioural determinants

Behavioural factors are important determinants of the routine health information systems because they influence the quality of the information generated by the system. These factors are categorised into two groups – perceptions and actual skills. Perceptions are measured in terms of level of knowledge of the routine health information system (RHIS) rationale, knowledge of checking data quality, confidence level for RHIS tasks, and motivation; while actual skills are measured in terms of problem-solving skills and competence in RHIS tasks, which include calculating indicators, plotting data, interpreting data and using data for management.

7.4.2.1   Components of behavioural determinants

The indicator 'Knowledge of RHIS rationale' is derived from questions asking respondents to describe at least three reasons for collecting monthly data on diseases, PMTCT, and why population data of the target area are needed. For the indicator 'Knowledge of checking data quality', respondents were asked to describe at least three ways of checking data quality. The elements for confidence and competence have already been discussed elsewhere in *Chapter 3*, *Sub-section 3.6.1.4*. The indicator 'Motivation' comprises a cocktail of questions relating to perceived motivation (*Table 7.2*).

Respondents were given a case scenario on data quality issues and asked to define what the problem was and were also requested to solve the problem; these elements were used to calculate the indicator 'Problem solving skills'.

Table 7.2*:* Excerpt of questions on motivation

	Strongly disagree	Somewhat disagree	Disagree	Neither disagree nor agree	Agree	Somewhat agree	Strongly agree
Personal							
BC1. Collecting information which is not used for decision making discourages me	1	2	3	4	5	6	7
BC2. Collecting information makes me feel bored	1	2	3	4	5	6	7
BC3. Collecting information is meaningful to me	1	2	3	4	5	6	7
BC4. Collecting information gives me the feeling that data is needed for monitoring facility performance	1	2	3	4	5	6	7
BC5. Collecting information gives me the feeling that it is forced on me	1	2	3	4	5	6	7
BC6. Collecting information is appreciated by co-workers and superiors	1	2	3	4	5	6	7

7.4.2.2 Behavioural determinant profile

Figure 7.1 presents the overall average scores for each behavioural factor and by province. The overall levels of confidence (69%) among respondents were not commensurate with the overall levels of competence (30%); and the average levels of knowledge of RHIS rationale and knowledge of checking data quality were 22% and 36% respectively. Motivation and confidence levels were high across all participants at 74% and 69% respectively. Respondents in KZN seem to have a better knowledge of checking data quality (41%), perform better in problem-solving skills (27%), and are more confident in performing RHIS tasks compared with respondents in the Western Cape. Since there is not much difference between both provinces for the remaining results, these analyses are reported in aggregated format.

Behavioural factors (N=161)
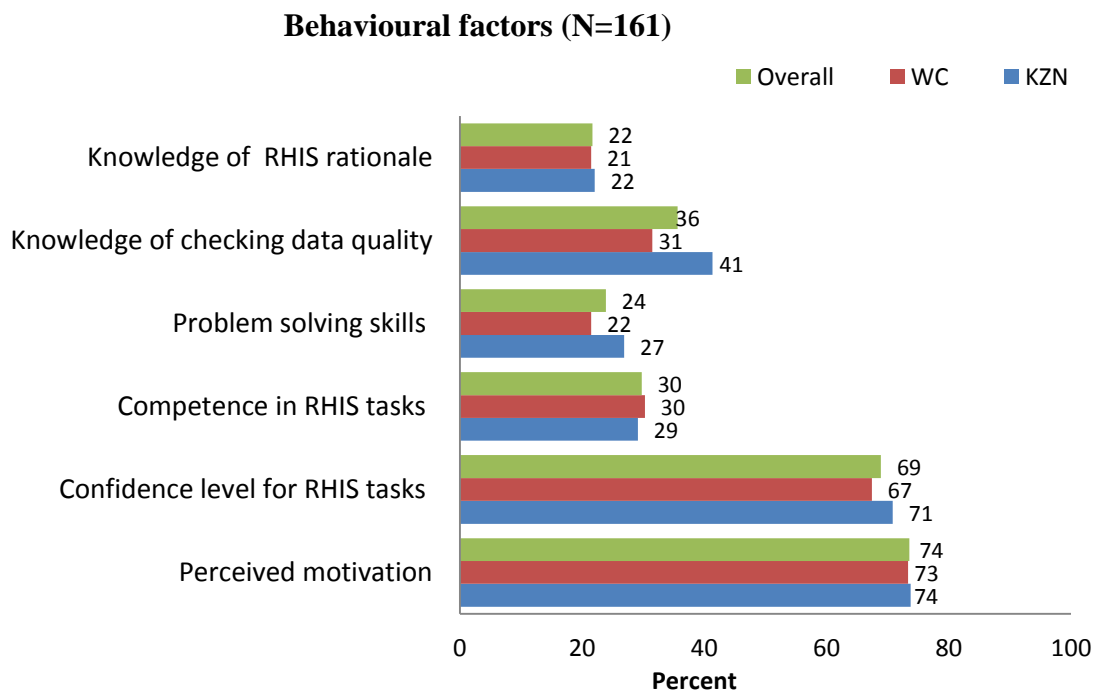
Figure 7.1: Average scores for each behavioural factor by province

7.4.2.2.1 Skills assessed in terms of confidence and competence

Figure 7.2 shows elements assessed for confidence and competence levels for RHIS tasks. Sixty-one percent of respondents reported they can interpret findings but the assessment indicates that only 14% could do so. In addition, 69% reported that they can use information to identify actions but the competency assessment found that only 14% could actually do so.

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Confidence and Competence levels for RHIS tasks (N=161)
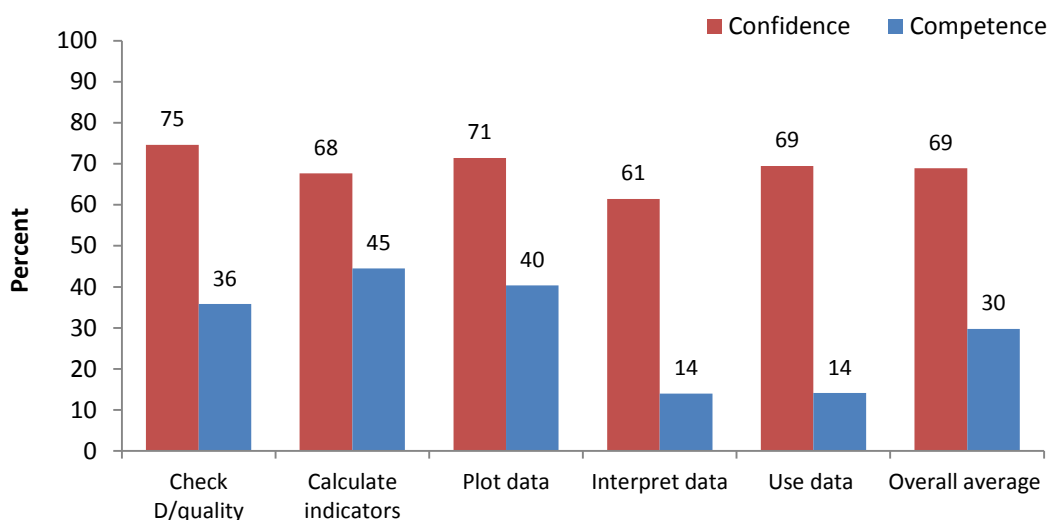
Figure 7.2: Skills assessed in terms of confidence and competence levels for RHIS tasks

Respondents from KwaZulu-Natal seem to perform better in plotting data (42%) compared with those from the Western Cape (39%) (*Figure 7.3*), while those from the Western Cape perform better in calculating indicators (49%), and interpreting and using data (16%) than for respondents from KwaZulu-Natal (38% and 11% respectively).

Competence skills assessed (N=161)
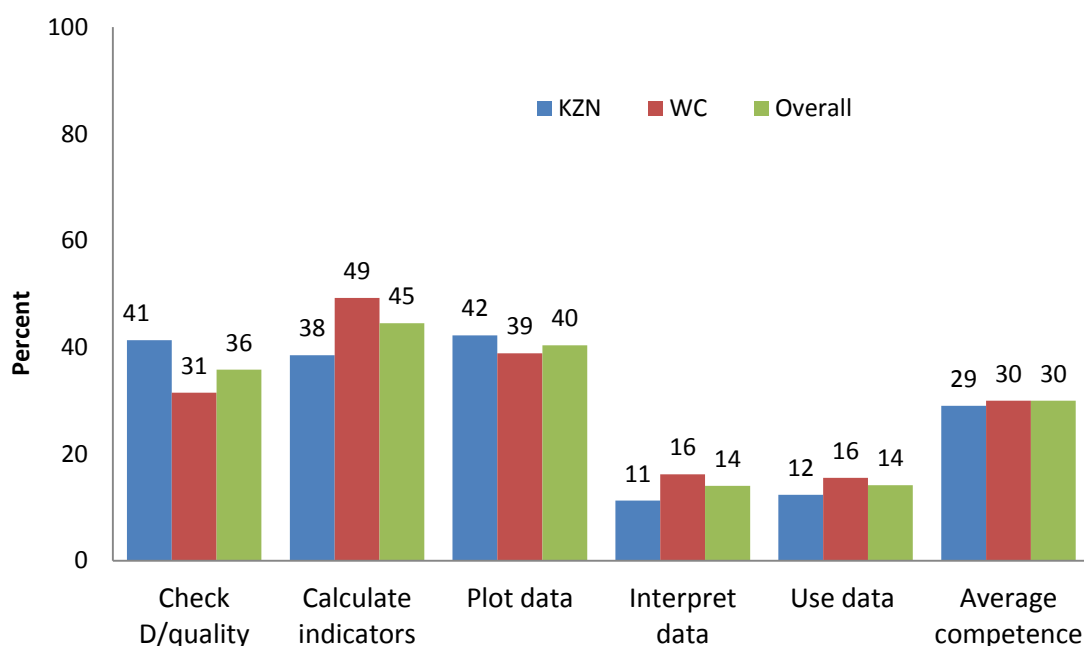
Figure 7.3: Skills assessed in terms of competence levels for RHIS tasks by province

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7.4.2.2.2   Associations between behavioural factors and background characteristics

The association between respondents' background characteristics and corresponding levels of key behavioural factors of RHIS performance were evaluated using a χ^2-test (*Table 7.3*) and a pairwise correlation with a significance level of p=0.05 (*Table 7.4*). The number and percentage of respondents according to characteristic are shown in columns (b) and (c) respectively in *Table 7.3*, which shows that competence is positively associated with education (P=0.015) and job category (P=0.002). In contrast, confidence levels were similar across all categories with the exception of gender (P=0.050). Other behavioural factors like knowledge of checking data quality were found to be positively associated with education (P=0.011), job category (P<0.001), and province (P=0.005); knowledge of RHIS rationale was also found to be associated with education (P<0.001), job category (P=0.007), and years employed (P=0.050). Similarly, problem-solving skills were associated with education (P=0.020), job category (P=0.001), and place of work (P=0.002). Motivation, on the other hand, was not associated with any background characteristics.

Table 7.4 presents the association between behavioural factors and background characteristics with the corresponding R squares. The table shows that competence is significantly correlated with confidence levels for RHIS tasks (R^2=0.35, P<0.001), knowledge of RHIS rationale (R^2=0.49, P<0.001), knowledge of checking data quality (R^2=0.58, P<0.001), problem-solving skills (R^2=0.39, P<0.001), and negatively correlated with promotion of culture of information use (R^2=-0.16, P=0.049). There is no association between competence and motivation; however motivation was positively associated with confidence (R^2=0.22, P=0.005), knowledge of RHIS rationale (R^2=0.21, P=0.007) and promotion of culture of information use (R^2=0.43, P<0.001). On the other hand, confidence levels for RHIS tasks was negatively associated with gender (R^2=-0.25, P=0.002), and positively associated with educational level (R^2=0.16, P=0.043).

Job category is shown in *Table 7.4* to be positively associated with education level, gender, years of employment, age, knowledge of RHIS rationale, knowledge of checking data quality, competence, and problem-solving skills. Thus further analysis has been done stratified by job category (*Figure 7.4* and *Figure 7.5*).

Table 7.3: Percentage distribution of respondents' background characteristics by behavioural determinants of RHIS performance

Background characteristics	N 161 (b)	% (c)	Behavioural factors					
			RHIS Confidence (%)	RHIS Competence (%)	Knowledge of checking data quality (%)	Knowledge of RHIS rationale (%)	Motivation (%)	Problem-solving skills (%)
Education								
<=Grade 10	7	4	57.6	2.9	14.3	11.1	78.2	12.1
Matric	54	34	67.6	25.6	27.8	17.3	72.3	15.6
Diploma	63	39	67.7	30.7	39.7	22.8	74.0	25.6
Bachelor	24	15	77.6	39.3	50.0	31.0	75.5	39.6
Postgraduate	7	4	79.1	58.7	47.6	31.8	70.1	42.9
Missing	6	4	59.7	17.0	22.2	14.8	70.6	9.17
P-value			*0.294*	*0.015*	*0.011*	*<0.001*	*0.164*	*0.020*
HIS training in last 6 months								
No	94	58	66.8	27.9	33.7	20.7	72.0	21.6
Yes	67	42	71.9	32.4	38.8	23.2	75.6	27.1
P-value			*0.658*	*0.912*	*0.684*	*0.937*	*0.117*	*0.222*
Job category								
Clerk	32	20	61.2	13.0	15.6	16.0	70.4	10.6
Data capturer	33	21	71.1	27.0	42.4	17.5	73.3	22.3
Health information officer	22	14	78.9	38.2	34.9	17.2	75.1	19.3
Clinical/Manager*	74	46	68.3	35.8	41.9	27.5	74.5	31.7
P-value			*0.072*	*0.002*	*<0.001*	*0.007*	*0.706*	*0.001*
Gender								
Male	37	23	80.9	34.7	39.6	19.8	74.5	27.7
Female	124	77	65.4	28.3	34.7	22.3	73.3	22.7
P-value			*0.050*	*0.167*	*0.393*	*0.332*	*0.390*	*0.646*
Age								
20-24	18	11	78.9	29.5	44.4	17.9	72.6	24.7
25-29	31	19	69.1	26.4	30.1	19.4	73.5	19.0
30-34	16	10	72.9	26.0	33.3	17.4	74.0	28.4
35-39	18	11	69.2	25.5	35.2	25.3	75.4	20.6
40-44	23	14	66.7	37.1	36.2	25.1	73.9	22.6
45-49	19	12	66.3	28.1	45.6	20.5	70.3	17.9
50-54	15	9	62.7	27.3	33.3	23.0	74.0	25.3
>55	19	12	69.0	35.4	33.3	25.7	73.7	39.2
Missing	2	1	38.5	24.8	16.7	22.2	83.3	0.0
P-value			*0.182*	*0.093*	*0.579*	*0.539*	*0.187*	*0.369*
Years of employment								
<1	29	18	70.7	25.0	39.1	17.6	73.8	18.8
1-2	7	4	74.3	17.4	23.8	7.9	71.1	2.9
2-3	16	10	67.4	26.9	27.1	21.5	73.7	16.9
3-5	30	19	74.0	36.6	38.9	21.9	74.7	28.8
>5	79	49	66.2	30.6	36.3	24.5	73.2	27.2
P-value			*0.458*	*0.886*	*0.904*	*0.050*	*0.773*	*0.075*
Place of work								
District office	6	4	80.7	51.9	55.6	29.6	75.0	29.2
Sub-district office	5	3	79.2	33.3	33.3	26.7	77.6	54.0
Facility	150	93	68.1	28.8	35.1	21.3	73.3	22.7
P-value			*0.426*	*0.133*	*0.555*	*0.055*	*0.915*	*0.002*
Authority								
Amajuba	71	44	70.8	29.1	41.3	22.1	73.8	26.9
CoCT	52	32	62.7	26.4	31.4	22.7	73.4	20.3
Metro	38	24	73.9	35.6	31.5	19.9	73.3	23.2
P-value			*0.273*	*0.284*	*0.446*	*0.761*	*0.788*	*0.580*
Province								
KwaZulu-Natal	71	44	70.8	29.1	41.3	22.1	73.8	26.9
Western Cape	90	56	67.4	30.3	31.5	21.5	73.3	21.5
P-value			*0.983*	*0.329*	*0.005*	*0.008*	*0.190*	*0.407*

*Facility Manager (FM), Operation Manager (OM), Nurses, HIV/AIDS, STI & TB (HAST) Programme Manager (PM).

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Table 7.4: Associations between competence and other behavioural and organisational factors

	Competence	Confidence	Know of checking D. quality	Know of RHIS rationale	Motivation	Problem solving skills	Promotion of culture of info use	Age	Gender	Education	HIS training	Authority	Years employed	Job category	Place of work	Province
Competence	1.0000															
Confidence	**0.3500*** (0.0000)	1.0000														
Knowledge of checking D. quality	**0.5821*** (0.0000)	**0.3413*** (0.0000)	1.0000													
Knowledge of RHIS rationale	**0.4874*** (0.0000)	**0.3022*** (0.0001)	**0.4426*** (0.0000)	1.0000												
Motivation	0.1325 (0.0939)	**0.2214*** (0.0048)	0.1022 (0.1968)	**0.2122*** (0.0069)	1.0000											
Problem-solving skills	**0.3849*** (0.0000)	**0.3290*** (0.0000)	**0.2858*** (0.0002)	**0.3609*** (0.0000)	0.0956 (0.2278)	1.0000										
Promotion of culture of info use	**-0.1556*** (0.0487)	**0.1945*** (0.0134)	0.1087 (0.1700)	**0.1599*** (0.0428)	**0.4332*** (0.0000)	0.0445 (0.5751)	1.0000									
Age	0.0872 (0.2745)	-0.1122 (0.1590)	-0.0003 (0.9973)	0.1470 (0.0644)	-0.0075 (0.9250)	0.1151 (0.1487)	0.0614 (0.4423)	1.0000								
Gender	-0.1143 (0.1486)	**-0.2488*** (0.0015)	-0.0705 (0.3743)	0.0690 (0.3841)	-0.0428 (0.5895)	-0.0763 (0.3360)	0.0690 (0.3847)	**0.3964*** (0.0000)	1.0000							
Education	**0.3737*** (0.0000)	**0.1626*** (0.0432)	**0.2982*** (0.0002)	**0.3519*** (0.0000)	0.0027 (0.9737)	**0.3294*** (0.0000)	-0.1045 (0.1958)	**0.2938*** (0.0002)	0.0547 (0.4988)	1.0000						
HIS training	0.0916 (0.2476)	0.0961 (0.2251)	0.0852 (0.2827)	0.0822 (0.3000)	0.1499 (0.0577)	0.0990 (0.2115)	0.0021 (0.9789)	-0.1235 (0.1210)	-0.1378 (0.0812)	-0.0434 (0.5915)	1.0000					
Authority	0.0874 (0.2702)	0.0156 (0.8441)	-0.1451 (0.0663)	-0.0481 (0.5445)	-0.0187 (0.8136)	-0.0689 (0.3849)	-0.0696 (0.3801)	0.0187 (0.8149)	-0.1220 (0.1232)	-0.0712 (0.3785)	0.0907 (0.2528)	1.0000				
Years employed	0.1206 (0.1274)	-0.0653 (0.4104)	0.0084 (0.9159)	**0.2065*** (0.0086)	-0.0070 (0.9300)	**0.1648*** (0.0367)	-0.0003 (0.9967)	**0.7090*** (0.0000)	**0.2444*** (0.0018)	**0.3259*** (0.0000)	-0.0263 (0.7405)	-0.0704 (0.3747)	1.0000			
Job category	**0.3518*** (0.0000)	0.0747 (0.3463)	**0.2664*** (0.0006)	**0.3182*** (0.0000)	0.1237 (0.1180)	**0.2800*** (0.0003)	0.0379 (0.6335)	**0.5406*** (0.0000)	**0.2303*** (0.0033)	**0.4972*** (0.0000)	-0.0570 (0.4725)	0.0928 (0.2416)	**0.4260*** (0.0000)	1.0000		
Place of work	**-0.1808*** (0.0217)	-0.1108 (0.1617)	-0.1145 (0.1481)	-0.1187 (0.1336)	-0.0488 (0.5383)	-0.1182 (0.1353)	0.0553 (0.4857)	0.0157 (0.8446)	-0.1044 (0.1875)	-0.0897 (0.2670)	-0.0897 (0.2579)	-0.0092 (0.9079)	-0.0100 (0.8996)	-0.0180 (0.8208)	1.0000	
Province	0.0239 (0.7631)	-0.0650 (0.4124)	**-0.1648*** (0.0367)	-0.0191 (0.8099)	-0.0186 (0.8144)	-0.0980 (0.2159)	-0.0633 (0.4251)	0.1002 (0.2087)	-0.0094 (0.9056)	-0.0675 (0.4039)	0.0646 (0.4153)	**0.8861*** (0.0000)	-0.0062 (0.9377)	0.0089 (0.9104)	0.0153 (0.8471)	1.0000

* Statistically significant at $p = 0.05$

When the average scores for each behavioural factor were assessed by job category (*Figure 7.4*), clinical/managers were seen to have a better understanding of RHIS rationale (27%) and a greater ability to solve problems (32%) than others. Also clinical/managers and data capturers have a better knowledge of checking data quality (42%) compared with others.
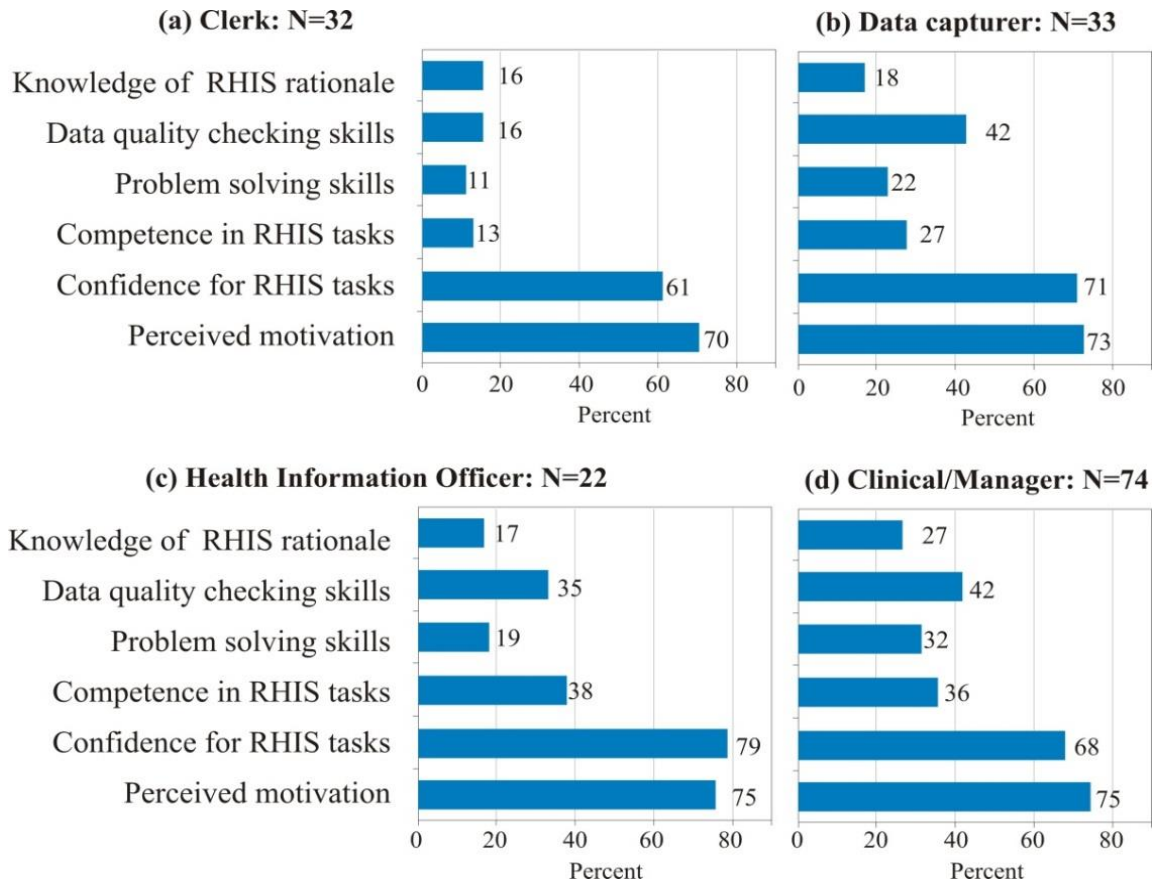
Figure 7.4: Behavioural factors by job category

Figure 7.5 shows that across all elements, respondents in all job categories reported higher confidence levels compared with displayed competence levels. Data capturers and clerks displayed the least competence across all elements. Competencies for interpreting data and data use were low across all job categories. Health information officers and clinical staff/managers displayed higher skills in calculating indicators and plotting data.

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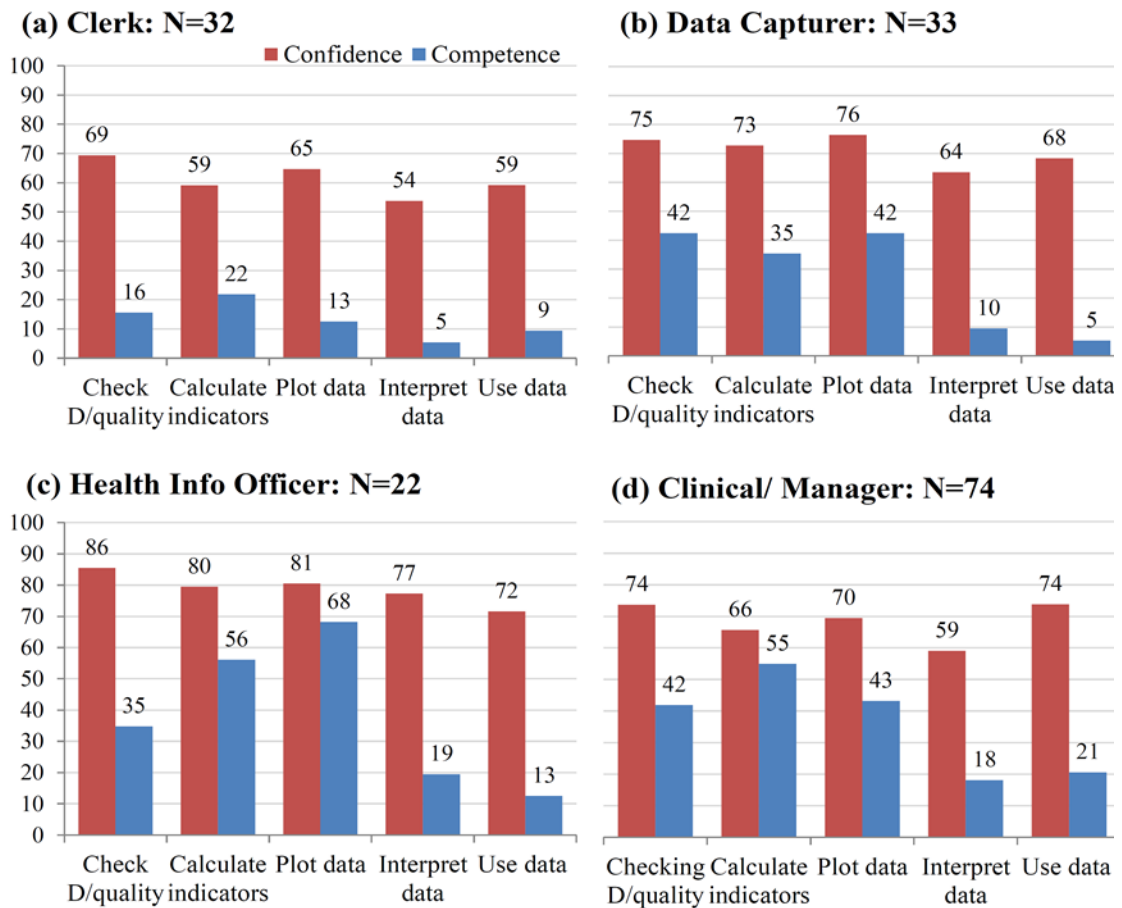
Figure 7.5: Average confidence and competence levels for RHIS tasks by job category

7.4.2.3   Differences in behavioural determinants across districts

The attempts made in *Section 7.4.1* to analyse the effects of selected demographic variables on some of the behavioural factors revealed that in the bivariate analyses, competence is positively associated with education, and job category, while RHIS confidence is not associated with any of the background characteristics except for gender (*Table 7.4*). However, the exact strength of each variable could only be determined if the effects of the confounding variables were controlled; hence the need for further investigation to determine the extent to which the background characteristics of the respondents (i.e. age, gender, educational level, job category, place of work, authority, HIS training in the last six months, and years of employment) would predict some of the behavioural and organisational factors, including competence levels for RHIS tasks. This was done using a multiple regression model. The variables which were retained in the regression with their analysis are presented in the following section.

7.4.2.3.1 Competence levels for RHIS tasks

Using multiple linear regression analysis, education, job category, knowledge of RHIS rationale (P=0.011), problem-solving skills (P=0.041), and knowledge of checking data quality (P<0.001) were found to be predictors of competence levels for RHIS tasks, after adjusting for authority, and place of work and confidence levels (*Table 7.5*). Overall, 52% of the variation in competence can be explained by the regression model. There is a positive linear relationship between education and job category with competence, controlling for job category, education and authority, respectively, hence refuting the null hypothesis that background characteristics is not directly correlated with RHIS competence. The findings show that the higher the respondents' educational level, the better is their competence level for RHIS tasks. Also the job category of the respondents influences their performance in RHIS tasks. However, there is no significant difference between each authority in terms of respondents' RHIS competence levels.

Table 7.5: Multiple regression of competence levels for RHIS tasks

Background characteristic	Coefficient (B)	S E	t	P>t	[95% Confidence Interval]	
Education						
<=Grade 10 (R.C.)*	0.00	-	-	-	-	-
Matric	15.13	7.38	2.05	*0.042*	0.536	29.716
Diploma	14.21	7.31	1.95	*0.054*	-0.234	28.663
Bachelor	12.40	8.11	1.53	*0.129*	-3.636	28.429
Postgraduate	28.13	9.91	2.84	*0.005*	8.529	47.725
Job category						
Clerk (R.C.)	0.00	-	-	-	-	-
Data capturer	3.08	5.31	0.58	*0.065*	-7.423	13.591
Health information officer	12.02	6.71	1.79	*0.009*	-1.253	25.300
Clinical/Manager	7.463	4.94	1.51	*0.043*	-2.310	17.235
Confidence	0.07	0.06	1.15	*0.251*	-0.052	0.196
Knowledge of RHIS rationale	0.29	0.11	2.58	*0.011*	0.068	0.516
Problem-solving skills	0.12	0.06	2.06	*0.041*	-0.008	0.248
Knowledge of checking data quality	0.30	0.06	5.27	*0.000*	0.190	0.418
Place of work						
District office (R.C.)*	0.00	-	-	-	-	-
Sub-district office	-17.80	11.43	-1.56	*0.122*	-40.393	4.796
Facility	-10.26	7.66	-1.34	*0.182*	-25.405	4.880
Authority						
Amajuba (R.C.)	0.00	-	-	-	-	-
CoCT	5.53	3.84	1.44	*0.152*	-2.061	13.123
Metro	5.56	4.44	1.25	*0.213*	-3.225	14.349
Constants	-8.083	11.27	-0.72	0.475	-30.374	14.208
* Variables with blank coefficients are the reference categories (R.C.)					$R^2 = 0.522$	

7.4.2.3.2   Knowledge of RHIS rationale

The bivariate analysis shows that only three of the background characteristics were associated with 'Knowledge of RHIS rationale'; however after controlling for job category, years of employment, and authority, only education predicted 'Knowledge of RHIS rationale' (*Table 7.6*). The table also shows that only 19% of the variation in the variable 'Knowledge of RHIS rationale' can be explained by the model. Respondents with either a bachelor's degree or postgraduate degree are more likely to know the reason for collecting data compared with other categories. There are no significant differences between authorities.

Table 7.6*:* Multiple regression of knowledge of RHIS rationale

Background characteristic	Coefficient (B)	S E	t	P>t	[95% Confidence Interval]	
Education						
<=Grade 10 (R.C.)*	0.00	-	-	-	-	-
Matric	0.33	0.23	1.44	*0.151*	-0.12	0.79
Diploma	0.37	0.23	1.63	*0.104*	-0.08	0.82
Bachelor	0.66	0.25	2.69	***0.008***	0.18	1.15
Postgraduate	0.71	0.30	2.35	***0.020***	0.11	1.31
Job category						
Clerk (R.C.)	0.00	-	-	-	-	-
Data capturer	-0.12	0.17	-0.68	*0.500*	-0.46	0.23
Health information officer	-0.02	0.20	-0.12	*0.908*	-0.41	0.37
Clinical/Manager	0.18	0.15	1.16	*0.248*	-0.13	0.49
Years of employment						
<1 (R.C.)	0.00	-	-	-	-	-
1-2	-0.23	0.25	-0.9	*0.372*	-0.72	0.27
2-3	0.23	0.17	1.35	*0.181*	-0.11	0.58
3-5	0.09	0.15	0.61	*0.542*	-0.21	0.40
>5	0.07	0.17	0.42	*0.675*	-0.26	0.40
Authority						
Amajuba (R.C.)	0.00	-	-	-	-	-
CoCT	-0.01	0.12	-0.08	*0.933*	-0.25	0.23
Metro	-0.09	0.14	-0.62	*0.539*	-0.36	0.19
Constants	-0.15	0.28	-0.53	*0.598*	-0.71	0.41
*Variables with blank coefficients are the reference categories (R.C.)						$R^2 = 0.187$

7.4.2.3.3   Problem-solving skills

There is an association between 'problem solving skills' and three of the background characteristics – education, years of employment, and job category. However when each of the background characteristics was controlled for in a multiple regression model, none of the variables was found to predict 'problem-solving skills' (*Table 7.7*).

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Table 7.7: Multiple regression of problem solving skills

Background characteristic	Coefficient (B)	S E	t	P>t	[95% Confidence Interval]	
Education						
<=Grade 10 (R.C.)*	0.00	-	-	-	-	-
Matric	3.25	11.47	0.28	*0.777*	-19.429	25.929
Diploma	8.72	11.25	0.77	*0.440*	-13.522	30.956
Bachelor	21.43	12.19	1.76	*0.081*	-2.679	45.537
Postgraduate	23.49	14.99	1.57	*0.119*	-6.149	53.131
Job category						
Clerk (R.C.)	0.00	-	-	-	-	-
Data capturer	4.92	8.57	0.57	*0.567*	-12.014	21.853
Health information officer	2.31	9.72	0.24	*0.812*	-16.902	21.522
Clinical/Manager	8.82	7.65	1.15	*0.251*	-6.313	23.948
Years of employment						
<1 (R.C.)	0.00	-	-	-	-	-
1-2	-15.01	12.48	-1.2	*0.231*	-39.683	9.665
2-3	1.75	8.63	0.2	*0.840*	-15.309	18.805
3-5	6.93	7.66	0.9	*0.367*	-8.217	22.076
>5	2.34	8.19	0.29	*0.776*	-13.845	18.519
Authority						
Amajuba (R.C.)	0.00	-	-	-	-	-
CoCT	-4.48	5.92	-0.76	*0.450*	-16.187	7.219
Metro	-1.331	6.87	-0.19	*0.847*	-14.915	12.253
Constants	9.504	14.10	0.67	*0.501*	-18.372	37.380

*Variables with blank coefficients are the reference categories (R.C.) $R^2 = 0.155$

7.4.2.3.4   Knowledge of checking data quality

Two of the background characteristics, education and job category, were found to be associated with knowledge of checking data quality; however after controlling for education and authority, job category was found to be a predictor of knowledge of checking data quality, with an R^2 of 0.171 (*Table 7.8*). Health information officers are more likely to have more knowledge on how to check data quality compared with other job categories, followed by data capturers.

Table 7.8: Multiple regression of knowledge of checking data quality

Background characteristic	Coefficient (B)	S E	t	P>t	[95% Confidence Interval]	
Education						
<=Grade 10 (R.C.)*	0.00	-	-	-	-	-
Matric	6.89	11.85	0.58	*0.562*	-16.528	30.300
Diploma	15.62	11.67	1.34	*0.183*	-7.447	38.696
Bachelor	24.33	12.75	1.91	*0.058*	-0.871	49.524
Postgraduate	25.29	15.63	1.62	*0.108*	-5.607	56.184
Job category						
Clerk (R.C.)	0.00	-	-	-	-	-
Data capturer	23.97	8.23	2.91	***0.004***	7.711	40.233
Health information officer	25.77	10.19	2.53	***0.013***	5.629	45.919
Clinical/Manager	18.07	7.64	2.37	***0.019***	2.973	33.175
Authority						
Amajuba (R.C.)	0.00	-	-	-	-	-
CoCT	-0.42	5.96	-0.07	*0.944*	-12.207	11.361
Metro	-11.02	7.12	-1.55	*0.124*	-25.102	3.052
Constants	8.417	12.266	0.69	*0.494*	-15.826	32.660
*Variables with blank coefficients are the reference categories (R.C.)						$R^2 = 0.171$

7.4.2.3.5   Confidence levels for RHIS tasks

Table 7.9 shows that only Gender is a predictor of confidence levels for RHIS tasks after adjusting for education and authority, with a predictive value of 11%. Females are 14 times less likely to be confident about RHIS tasks compared to their male counterpart. There are no significant differences between authorities in terms of respondents' confidence levels for RHIS tasks.

Table 7.9: Multiple regression of confidence levels for RHIS tasks

Background characteristic	Coefficient (B)	S E	t	P>t	[95% Confidence Interval]	
Education						
<=Grade 10 (R.C.)*	0.00	-	-	-	-	-
Matric	2.26	10.36	0.22	*0.828*	-18.215	22.730
Diploma	5.66	10.17	0.56	*0.579*	-14.438	25.756
Bachelor	14.75	10.90	1.35	*0.178*	-6.792	36.302
Postgraduate	15.75	13.68	1.15	*0.252*	-11.294	42.788
Gender						
Male (R.C.)*	0.00	-	-	-	-	-
Female	-14.75	5.02	-2.94	***0.004***	-24.670	-4.836
Authority						
	0.00	-	-	-	-	-
Amajuba (R.C.)	-5.49	4.76	-1.15	*0.251*	-	3.922
CoCT	1.35	5.43	0.25	*0.804*	14.907	12.078
Metro					-9.379	
Constants	76.05	11.23	6.77	*0.000*	53.855	98.254
* Variables with blank coefficients are the reference categories (R.C.)						$R^2 = 0.1085$

7.4.3   Organisational determinants

Several studies have highlighted the importance of organisational factors in determining the performance of routine health information systems.[56,57,58,109] The PRISM framework postulates that RHIS performance is affected directly or indirectly by organisational factors through behavioural factors, and these factors have been defined 'as all those factors that are related to organisational structure, resources, procedures, support services, and culture to develop, manage and improve RHIS processes and performance'.[59 (p 221)] These factors were measured in terms of the promotion of culture of information, using values that relate to organisational processes such as emphasis on data quality, use of information, evidence-based decision making, feedback from staff and community, sense of responsibility, empowerment and accountability, promoting problem solving, and perceived reward from the Department of Health. In addition, management functions at the facility were also measured. These indicators include RHIS governance, use of quality performance standards, planning, training, availability of finance, and supervision.

7.4.4.1   Promotion of culture of information

The promotion of a culture of information has been defined as 'the capacity and control to promote values and beliefs among members of an organisation for collection, analysis and use of information to accomplish its goals and missions'[171 (p 31)] *Figure 7.6* shows respondents' average perceptions of the Department of Health in terms of promoting a culture of information use at the facility level to be 71%. The average elements assessed for perceived promotion of a culture of information are also shown. Perceived emphasis on data quality and the promotion of problem solving is high at 78% and 73% respectively. Perceived information use is also high at 73%; evidence-based decision making, feedback from staff and community, sense of responsibility, empowerment, and accountability are all rated above average.

When assessed by job category, the responses were almost similar across the board; and respondents in all job categories agree that the Department of Health puts greater emphasis on data quality.

Promotion of culture of information use (N=161)
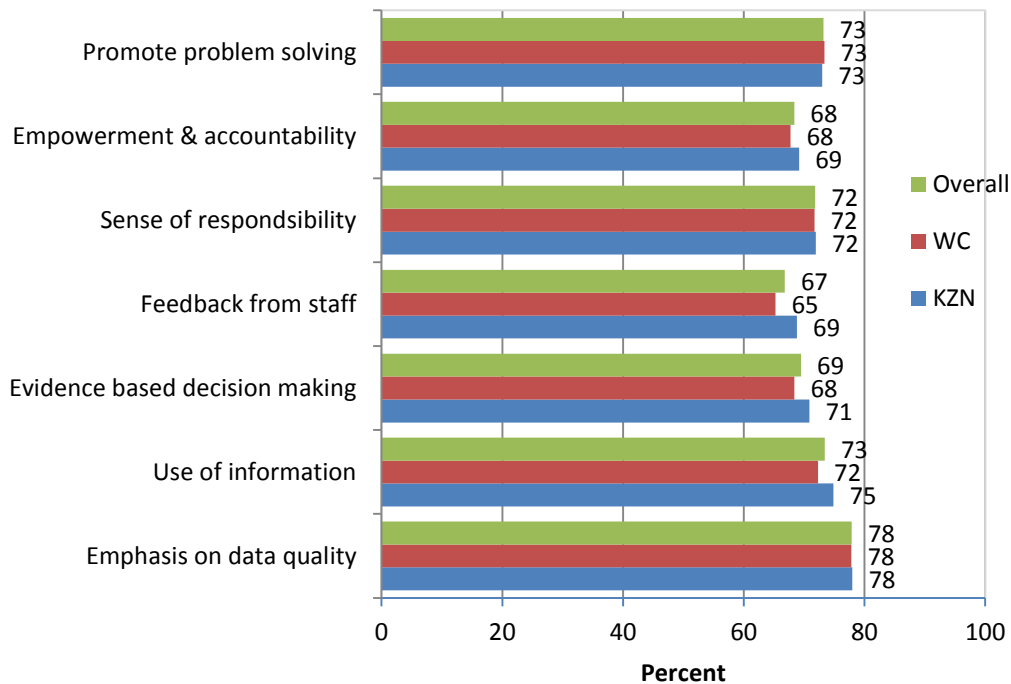
Figure 7.6: Percentage of perceived promotion of culture of information use at facility level

7.4.4.2   Association between organisational factors and background characteristics

The association between respondents' background characteristics and the promotion of a culture of information use was evaluated using a χ^2-test (*Table 7.10*) and multiple regression analysis (*Table 7.11*). The analysis in *Table 7.10* shows a positive association between education and the promotion of information use (P=0.003); however when further analysis was done, controlling for authority, education was retained in the model, accounting for 5% of the variation in the promotion of information use. There are no significant differences between the three authorities.

Table 7.10: Percentage distribution of respondents' background characteristics by organisational determinants of RHIS performance

Background characteristics		N 161 (b)	% (c)	Organisational factors Promotion of culture of information use (%)
Education				
<=Grade 10		7	4	79.3
Matric		54	34	71.2
Diploma		63	39	71.3
Bachelor		24	15	71.2
Postgraduate		7	4	66.9
Missing		6	4	76.1
	P-value			*0.003*
HIS training in last 6 months				
No		94	58	71.6
Yes		67	42	71.6
	P-value			*0.838*
Job category				
Clerk		32	20	71.3
Data capturer		33	21	71.2
Health information officer (HIO)		22	14	70.0
Clinical/Manager*		74	46	72.3
	P-value			*0.461*
Gender				
Male		37	23	70.1
Female		124	77	72.0
	P-value			*0.812*
Age				
20-24		18	11	72.1
25-29		31	19	70.2
30-34		16	10	73.6
35-39		18	11	71.3
40-44		23	14	68.4
45-49		19	12	72.5
50-54		15	9	72.2
above 55		19	12	74.7
Missing		2	1	67.8
	P-value			*0.353*
Years of employment				
<1		29	18	77.3
1-2		7	4	65.3
2-3		16	10	69.2
3-5		30	19	72.0
>5		79	49	71.8
	P-value			*0.423*
Place of work				
District office		6	4	66.3
Sub-district office		5	3	76.1
Facility		150	93	71.6
	P-value			*0.621*
Authority				
Amajuba		71	44	72.4
CoCT		52	32	71.3
Metro		38	24	70.4
	P-value			*0.544*
Province				
KwaZulu Natal		71	44	72.4
Western Cape		90	56	70.9
	P-value			*0.463*

*Facility Manager (FM), Operation Manager (OM), Nurses, HIV/AIDS, STI & TB (HAST) Programme Manager

Table 7.11: Multiple regression of promotion of culture of use of information

Background characteristic	Coefficient (B)	S E	t	P>t	[95% Confidence Interval]	
Education						
<=Grade 10 (R.C.)*	0.00	-	-	-	-	-
Matric	-0.32	0.22	-1.45	0.148	-0.752	0.115
Diploma	-0.42	0.22	-1.95	**0.053**	-0.850	0.006
Bachelor	-0.51	0.23	-2.22	**0.028**	-0.971	-0.056
Postgraduate	-0.55	0.29	-1.88	0.062	-1.127	0.028
Authority						
Amajuba (R.C.)	0.00	-	-	-	-	-
CoCT	-0.02	0.10	-0.2	0.843	-0.220	0.180
Metro	-0.08	0.12	-0.68	0.500	-0.305	0.150
Constants	2.74	0.22	12.63	0.000	2.311	3.168

*Variables with blank coefficients are the reference categories (R.C.) $R^2 = 0.045$

7.4.4.3 Management functions

The availability of routine health information systems (RHIS) resources, including human resources and equipment have been discussed in *Chapter 4*, *Sub-section 4.4.1*. This section reports on the rest of the organisational factors.

Management functions as defined by Aqil et al.[171] [(p 29)] is 'the presence of mechanisms for effectively managing RHIS functions and resources for better performance'. *Table 7.12* shows the percentage distribution of RHIS management functions at the facility, and the elements used to derive the indicators. Governance is measured by the presence of an RHIS mission statement and a district health management organisational chart RHIS-related functions. Planning, on the other hand, is measured by the presence of an RHIS situation analysis report, and RHIS targets. Use of quality/performance standard was assessed by the presence of a copy of RHIS Standard Operating Protocol: Performance Improvement Tools.

Training was measured through the presence of a training manual and a training schedule for planned training. The availability of an RHIS supervisory checklist, a schedule for supervisory visits, and supervisory reports was used to assess RHIS supervision at the facility. Finally the level of RHIS finance was assessed by measuring the presence of an RHIS-related expense register, and monthly/quarterly financial report.

Table 7.12: Presence of management functions at the facility by authority

Management functions	Amajuba n=27 (%)	CoCT n=19 (%)	MDHS n=27 (%)	p-value
RHIS governance				
MATG1- *Display of RHIS Mission statement*	4	0	0	*0.568*
MATG3 - *Presence of district health management organisational chart, showing functions related to RHIS/health information.*	41	47	36	*0.825*
RHIS Planning				
MATP1 - *Presence of RHIS situation analysis*	63	16	27	***0.004***
MATP3 - *Presence of RHIS targets at facility*	70	74	91	*0.401*
Use of quality/performance standards				
MATQ2 - *Presence of a copy of RHIS standard operating procedures (SOP)*	78	21	73	***<0.001***
MATQ3 - *Presence of performance improvement tools (flow chart, control chart etc.) at the facility*	85	42	64	***0.009***
RHIS Training				
MATT1 - *Presence of RHIS training manual*	56	16	100	***<0.001***
MATT3 - *Presence of schedule for planned training*	26	47	55	*0.157*
RHIS Supervision				
MATS1 - *Presence of RHIS supervisory checklist*	89	11	91	***<0.001***
MATS2 - *Presence of schedule for RHIS supervisory visit*	44	42	64	*0.479*
MATS3 - *Presence of supervisory reports*	67	32	55	*0.063*
RHIS Finance				
MATF1 - *Presence of RHIS-related expense register*	7	0	0	*0.316*
MATF3 - *Presence of RHIS monthly/quarterly financial report*	15	0	0	*0.092*

Figure 7.7 presents the levels of routine health information system (RHIS) support and critical management functions at the facility categorised by authority. Most RHIS management functions are not in place at facility level. Support for supervision (54%), planning (58%), and use of quality/performance standard (62%) are above average; in contrast support for training (45%), criteria for RHIS governance (22%), and finances (5%) are below average. In terms of authority, there are consistencies between the Amajuba and

Metro district health services (MDHS) managed facilities for some management functions. However, management indicators are low for the City of Cape Town (CoCT) managed facilities, compared with Amajuba and MDHS facilities. It is evident that there are very few CoCT managed facilities with a RHIS standard operating protocols (SOP).

Criteria for RHIS finance are low across the board; only 11% of facilities managed by the Amajuba district reported having these criteria in place. It is evident that this function is managed centrally at the provincial level.
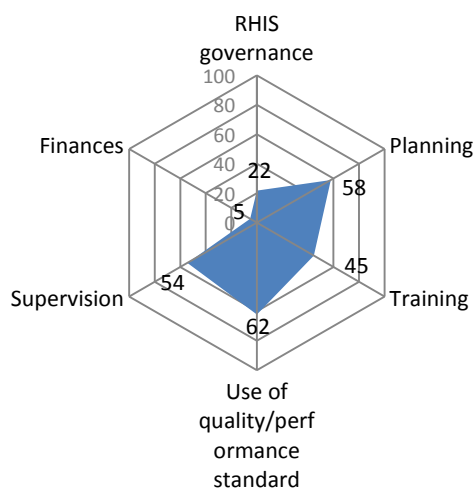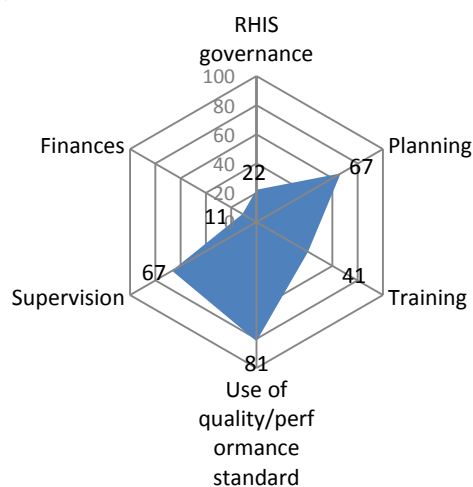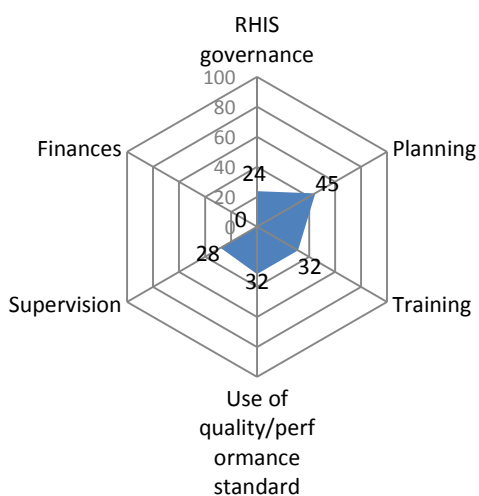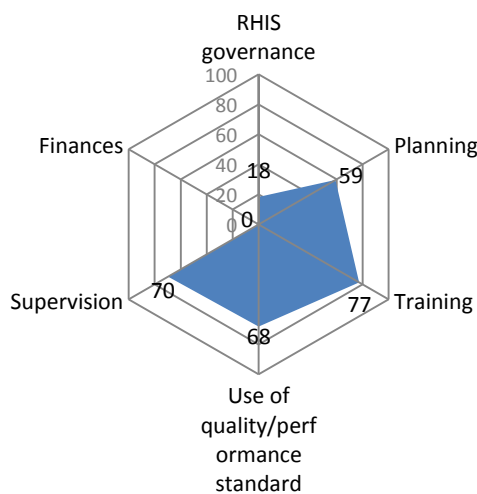
Figure 7.7: Levels of support and critical functions of management in RHIS at facility level

7.4.3.3.1 RHIS supervision

Figure 7.7 has shown that 54% of the facilities visited had a supervisory support system in place. In terms of actual supervisory visits from the sub-district or district offices, facility managers were asked if they had had any supervisory visits from the district office in the last three months preceding the survey. A cocktail of elements (*Table 7.13*) was used to calculate the indicator percentage of facilities reporting good quality RHIS supervision.

Table 7.13: Excerpt of RHIS supervision questionnaire

	Supervision by the district health office			
FU21	How many times did the sub-district/district supervisor visit your facility during the last three months? *(tick the answer)*	0. 1. 2 3. 4. >4.		If zero, go to FU26
FU22	Did you observe a supervisor having a checklist to assess data quality?	1.Yes	0.No	
FU23	Did the supervisor check the data quality?	1.Yes	0.No	
FU24	Did the district supervisor discuss your facility's performance based on the use of RHIS information when he/she visited your facility?	1.Yes	0.No	
FU25	Did the supervisor help you make a decision based on using information from the RHIS?	1.Yes	0.No	
FU26	Did the supervisor send a report/feedback/note on the last two supervisory visits?	1.Yes	0.No	

Eighty-two percent of the MDHS facility managers claim they observed a supervisor's having a checklist to assess data quality during the last three months preceding the survey; they also claim the supervisors helped in making decisions based on RHIS information.

In 91% of the MDHS-managed facilities, supervisors discussed the facility's performance based on the use of RHIS information during their visit. In all, 78% of the MDHS facilities reported good quality RHIS supervision compared with the overall average of 64%. In 91% of the MDHS managed facilities, supervisors discussed the facility's performance based on the use of RHIS information during their visit. In all, 78% of the MDHS facilities reported good quality RHIS supervision compared to the overall average of 64%.

a) Overall - (N=57)
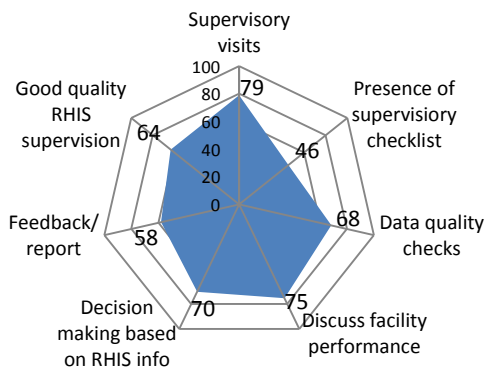
b) Amajuba - KZN (N=27)
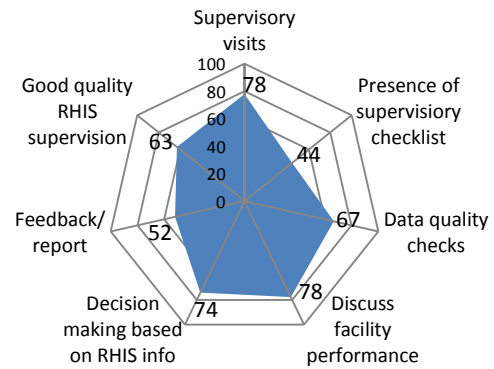
c) CoCT- WC (N=19)
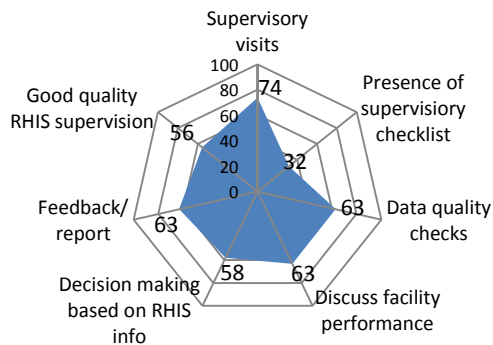
d) MDHS - WC (N=11)
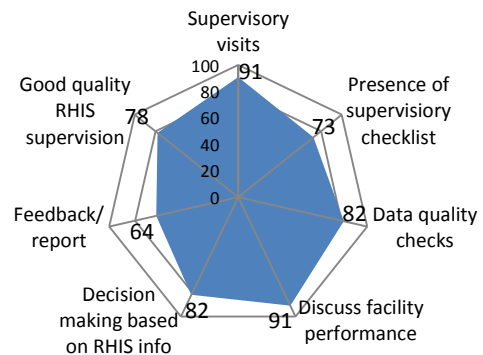
Figure 7.8: Levels of RHIS supervisory support at facility level

7.4.4   RHIS processes

The routine health information system (RHIS) processes are crucial in the production of quality data and use of information. The Health Metrics Network (HMN)[103] has identified six major components of a strong health information system. Information production is an aspect of the 'Processes' component of the health information system. As indicated in *Figure 7.9*, the processes measured include the availability of a data-collection manual at the facility, whether or not data-processing procedures or tally sheets exist in the facility; whether the facility calculates indicators for various services for the facility catchment areas, and compares these indicators with national targets, among type of services, and over time (data analysis); and whether the facility receives any feedback report from the district office on its performance using RHIS information. Data display was derived by observing whether the facility displayed updated information on maternal and child health services, facility

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utilisation, disease surveillance, a map of the catchment area, and summary of demographic information such as population by target groups.
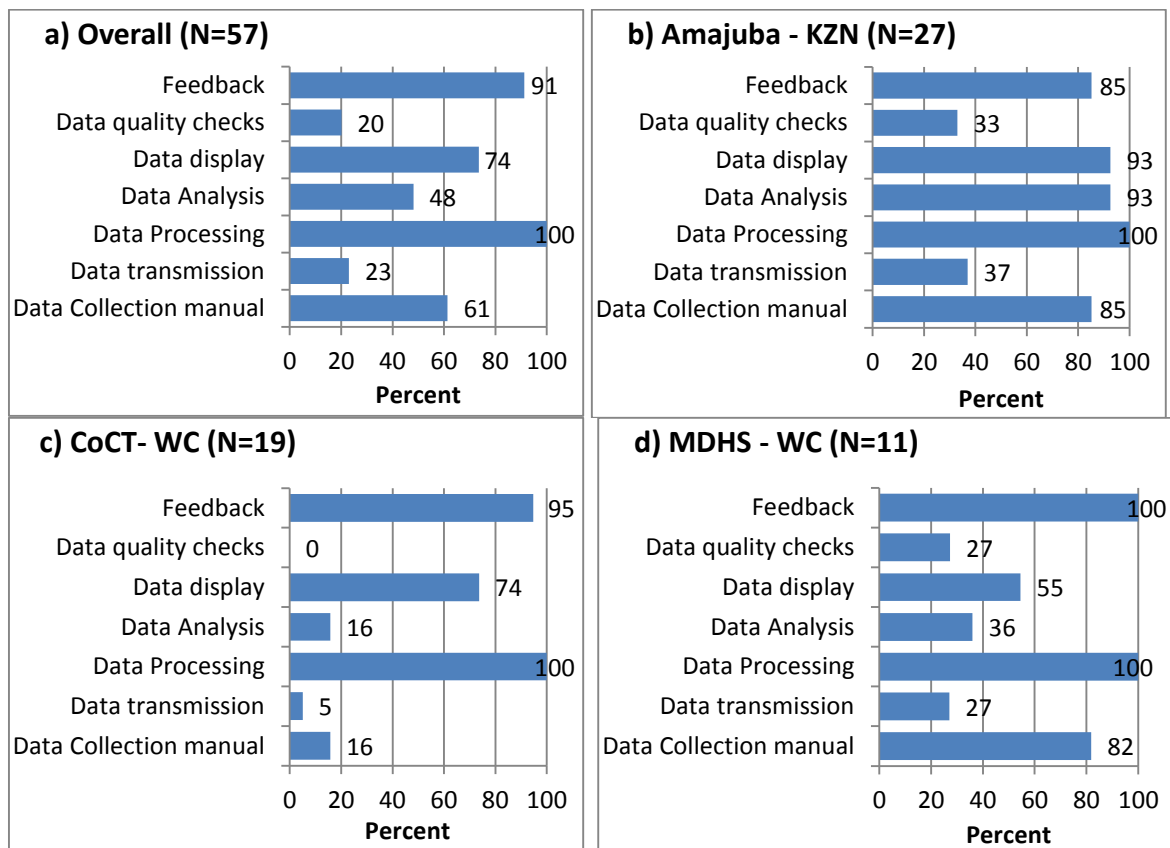
Figure 7.9: Levels of supervisory checks of RHIS processes at facility

Data quality checks and data transmission were each measured by calculating the average of two data elements. For data quality checks, the average response on whether or not the facility manager received a directive from the district office in the last three months preceding the survey to check the accuracy of data at least once in three months, and whether the facility managers received notification that there would be consequences if they did not check the accuracy of data, were derived. Likewise, the average response on whether the facility managers received directives to submit the monthly report by a declared deadline, and whether they received any notification of consequences for not meeting the deadline, was used to calculate the indicator data transmission.

Figure 7.9 shows that some processes are in place at the facility level, but there seems to be an issue with the processes for data quality checks, data analysis, data transmission and data display. Most facilities managed by the City of Cape Town (CoCT) lack some RHIS

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processes, particularly data quality checks, data analysis, data transmission and a data collection manual; however data analysis takes place at the district level (*Figure 7.10*).
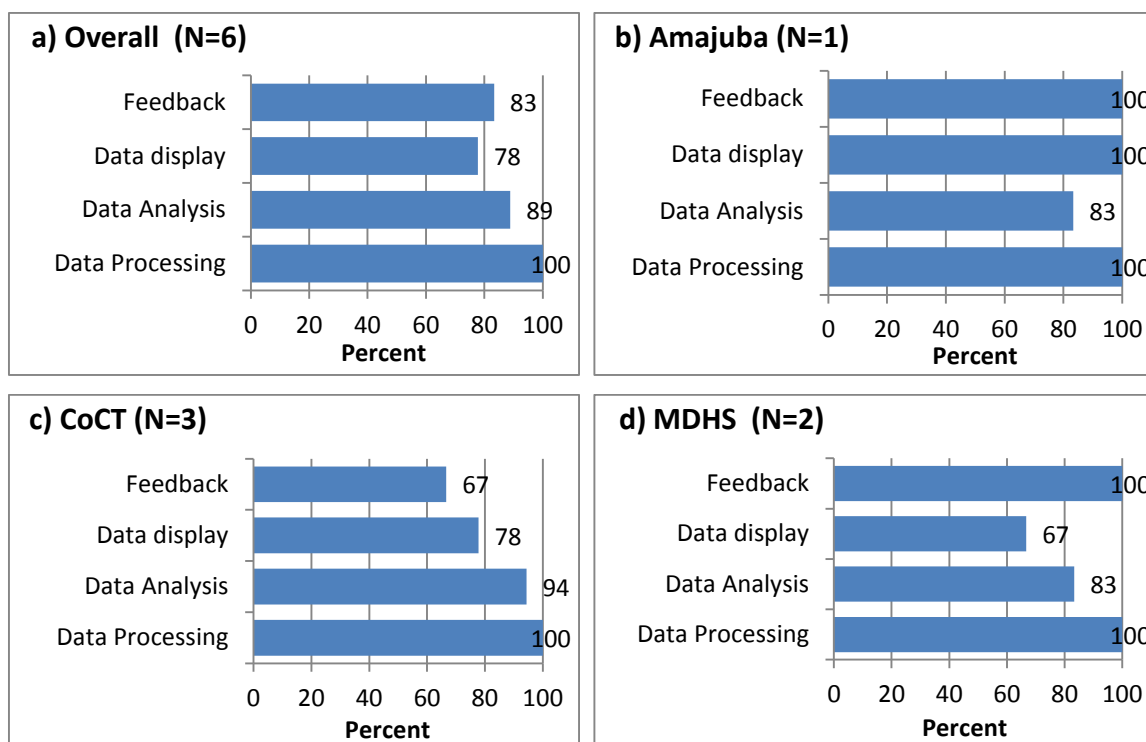
Figure 7.10: Levels of supervisory checks of RHIS processes at district

7.4.4.1 Significance levels and association between RHIS processes

To determine whether the results presented in *Figure 7.9* are statistically significant and whether there are differences between authorities in terms of the routine health information system (RHIS) processes, a Pearson's Chi-Square (χ^2) test of association and a pairwise correlation were conducted. *Table 7.14* shows the summary statistics for the association between RHIS processes with the corresponding R squares.

The table shows that the process for data quality checks is positively associated with processes in the data collection manual ($R^2=0.38$, $P=0.004$), data transmission ($R^2=0.83$, $P<0.001$), data analysis ($R^2=0.63$, $P<0.001$) and data display ($R^2=0.27$, $P=0.039$). Also data analysis is positively associated with data display ($R^2=0.41$, $P=0.002$). In contrast, there are no associations between mechanism for data processing and other routine health information system (RHIS) processes; the same is true for feedback.

Table 7.14: Associations between supervisory checking of RHIS processes at facility level

	Data collection manual	Data transmission	Data processing	Data analysis	Data display	Data quality checks	Feedback
Data collection manual	1.0000						
Data transmission	**0.3148*** (0.0171)	1.0000					
Data processing	0.1685 (0.2101)	0.1563 (0.2457)	1.0000				
Data analysis	**0.4827*** (0.0001)	**0.4432*** (0.0006)	0.1312 (0.3305)	1.0000			
Data display	**0.2882*** (0.0297)	0.2435 (0.0680)	0.0826 (0.5415)	**0.4104*** (0.0015)	1.0000		
Data quality checks	**0.3773*** (0.0038)	**0.8310*** (0.0000)	0.1256 (0.3520)	**0.6301*** (0.0000)	**0.2736*** (0.0394)	1.0000	
Feedback	0.0089 (0.9474)	0.1195 (0.3761)	-0.0414 (0.7596)	-0.2509 (0.0597)	0.0691 (0.6094)	0.0541 (0.6893)	1.0000
* Statistically significant at $p = 0.05$							

The percentage distribution and the p-values for each of the RHIS processes at the facility categorised by authority are presented in *Table 7.15*. The table shows that all the indicators assessed were significant at 0.05, except for 'data processing' (P=*0.119)* and 'feedback' (P=*0.275)*. Facilities managed by the Amajuba district seem to perform better in terms of having RHIS processes in place compared with those managed by the City of Cape Town (CoCT) and the Metro district Health services (MDHS). A total of 5.2% of the facilities managed by the Amajuba district have all the routine health information system (RHIS) processes in place compared to 2.7% in the City of Cape Town and 4% in the Metro District Health service (MDHS) managed facilities.

Table 7.15: Percentage distribution of supervisory checks of RHIS processes at the facility by authority

RHIS processes	Amajuba n=27 (%)	CoCT n=19 (%)	MDHS n=11 (%)	p-value
Data collection manual	85	16	82	**<0.001***
Data transmission				
Full instructions	37	5	27	
Partial instructions	48	26	46	**0.004***
Data processing	100	100	100	*0.119*
Data analysis	93	16	36	**<0.001***
Data display	93	74	55	**<0.001***
Data quality checks				
Full instructions	33	0	27	
Partial instructions	48	5	36	**<0.001***
Feedback	85	95	100	*0.275*
Facilities with all RHIS processes	**5.2**	**2.7**	**4.0**	*0.023**

* Statistically significant at $p = 0.05$

Mechanisms for data processing and feedback are high across the board; however processes for data-quality checks and data transmission are lacking in most of the facilities surveyed; some facilities are not encouraged to analyse and display data. *Figure 7.9* shows that only one fifth and 23% of all the facilities surveyed have a reminder mechanism for checking data quality, and for meeting deadlines for submitting monthly reports (data transmission), respectively. When compared by authorities (*Table 7.15*), only 27% of the facilities managed by MDHS and a third of those managed by the Amajuba district have full instructions to check data accuracy; however only 5% of the facilities managed by the City of Cape Town (CoCT) have partial instructions in place to check data quality. In terms of data transmission, 37% of the Amajuba-managed facilities, 27% (MDHS) and 5% (CoCT) have full instructions in place.

The availability of a data collection manual at the facility is an essential RHIS process, since it contains guidelines on how to collect and manage data. About 60% of the facilities surveyed had a data collection manual; however only 16% of the facilities managed by the City of Cape (CoCT) had a data collection manual.

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About 48% and 74% of the facilities surveyed claimed they analyse and display updated data respectively (*Figure 7.9*). Further analysis categorised by authority shows that facilities managed by the Amajuba district seem to perform better in terms of analysing (93%) and displaying updated data (93%), compared with COCT and MDHS facilities (*Table 7.15*).

In terms of the types of analyses conducted at the facilities, *Figure 7.11* shows that almost half of the facilities surveyed claim they conduct trend analysis in the facility, 33% calculate indicators and make comparisons against national targets, and 18% compare among services rendered. However, facilities managed by the CoCT seem not to have data analysis processes in place.

a) All (N=57)

Comparison over time	47
Comparison among services	18
Comparison against targets	33
Calculate indicators	33

Percent

b) Amajuba (N=27)

Comparison over time	81
Comparison among services	30
Comparison against targets	70
Calculate indicators	56

Percent

c) CoCT (N=19)

Comparison over time	5
Comparison among services	0
Comparison against targets	0
Calculate indicators	16

Percent

d) MDHS (N=11)

Comparison over time	36
Comparison among services	18
Comparison against targets	0
Calculate indicators	9

Percent

Figure 7.11: Types of Analyses conducted at the facilities by authority

7.4.5   Organisational barriers: insights from qualitative triangulation

Observations and information from the semi-structured interviews reveal some differences between the facilities managed by the Amajuba district authority, CoCT authority and those managed by the provincial (MDHS) authority. In the Western Cape, the provincial (MDHS) facilities appear to have a more formal structure for Health Information than the CoCT-managed facilities. The MDHS facilities have designated health information officers (HIOs) at each facility and all facilities have Health Information procedure manuals and standard operating procedures (SOPs). These patterns were observed in the survey results presented in *Sub-sections 7.4.4.3* and *7.4.4.* In contrast, many of the data clerks/data capturers in the CoCT facilities function as receptionists, and many have limited or no computer or health information training.

Another challenge resulting from multiple authorities is with the information systems software. CoCT-managed facilities use a clinical software called the Patient Record and Health Management Information System (PREHMIS), while the MDHS facilities use Clinicom and PHCIS (Primary Health Care Information System). CoCT sub-district offices capture their data twice – once onto Sinjani, which is the Western Cape provincial capturing system, and a second time onto the District Health Information System (DHIS), which is the national data-capturing system, while the MDHS sub-district only captures their data onto the DHIS. The information entered onto the DHIS does not go past the CoCT district office. It appears to be used within CoCT for feedback and planning. What is in Sinjani is what ends up at the provincial office. At the provincial office all the data are exported out of Sinjani onto the DHIS to submit at national level.

Within CoCT there are also some differences between facilities in the Eastern and those in Khayelitsha sub-districts. All the Khayelitsha facilities are running old versions of PREHMIS, while there is only one facility in the Eastern sub-district that has not been upgraded to the new PREHMIS software. In the Eastern sub-district, there is often one facility manager for two facilities. All Khayelitsha sub-district facilities have their own facility managers.

There are also communication problems between CoCT and MDHS, even at the district level. Some Metro facilities do not give data to CoCT. Data are sent to the sub-structure and captured directly onto Sinjani. The data should be identical but there seem to be some

differences, possibly just due to capturing errors. However, any updates or changes made to the Baby Follow-Up Microsoft Excel templates are expected to be sent to both CoCT and MDHS Information Management (IM). Often the Information Management directorate at the MDHS do not receive the updates, so the incorrect data is captured onto Sinjani.

7.5   Discussion

7.5.1   Behavioural determinants

The results of this evaluation highlight the need for improved routine health information system (RHIS) knowledge and skills among personnel working with health information. Although the personnel are reasonably motivated, they lack sufficient RHIS knowledge and skills. Low levels of knowledge of RHIS rationale, knowledge of checking data quality, and problem-solving skills were observed. Particularly low levels of skills to interpret data or use data were observed, even among health information officers, clinical staff and facility and programme managers. The study shows that personnel confidence and motivation are relatively high but this is not reflected in their competence in RHIS tasks. There was no correlation between motivation and competence and only a slight positive correlation between confidence and competence. However, the study found large differences between RHIS competence and confidence levels for RHIS-related tasks. These disparities consistent across all observed elements, and across all job categories.

Competence was found to have a positive relationship with education and job category, implying that the more education one has, the more competent such person is in performing RHIS-related tasks. This positive linear relationship is also true for job category, which has been found to be associated with education, indicating that levels of education may be associated with the level at which competencies may be acquired. The study found that the higher the education, the higher the job category level; it reveal that three years or more of post-matriculation education is necessary to meet the required standard to perform RHIS-related tasks. Hence, in-service training should be focused more on nurses and data capturers at the facility level rather than health information officers as is the focus of current training. Despite high levels of motivation, findings from this study show that data quality was poor. This refutes Lorenzi et al.[114] which cited motivation as an important determinant of HIS successes or failures. It is apparent that factors other than motivation are at play in this setting.

Poor RHIS skills at ground level can result in poor-quality data being collected at the facility level. The study has shown that the average competence level for RHIS tasks is low at 30%. If information personnel at facility level are adequately equipped with the necessary skills, and know the importance of the data they collect, chances are it will impact on data quality, since greater attention will be given to data error detection at the onset of the data collection process. Unfortunately this is not the case in this study, which shows the average ability of health personnel to check data quality to be only 36%. This finding is consistent with studies conducted in other settings.[53,59,92,123,124,125,126,127,128]

The lack of knowledge about of RHIS rationale is disturbing. This evaluation found the average knowledge of RHIS rationale to be 22%, indicating a lack of understanding of the importance of health information. Similarly, more than half of the respondents claim they had no RHIS-related training in the last six months prior to the survey. It is expected that training, will be positively correlated with competence; however, this did not impact on competence in RHIS-related tasks. This finding refutes a recent study[141] which used a data collection and feedback training intervention to improve the quality of routinely collected data.

The difference between the studies could be attributed to the content and nature of the training. While the study by Mphatswe et al.[141] used specific training on the importance of health data, and giving feedback, the importance of reviewing monthly data, and conducting data audits, this study was only interested in knowing whether or not respondents had had any RHIS-related training in the last six months preceding the survey, and was not interested in ascertaining the content nor the type of such training which could either be Didactic that tends to provide knowledge, or experiential learning in the workplace, which improves actual practise (competence). Irrespective of these, one would expect someone who claims to have had RHIS-related training to be competent in RHIS-related tasks. There is perhaps a need to reassess the content of RHIS training to include components that would strengthen data interpretation and data use at all levels of the health information system.

Most health facilities have clerks or data capturers to compile their monthly data. The average level of RHIS tasks competence in these two categories was 13% and 27% respectively, and the highest level was found in information officers, but this was only 38%. This finding illustrates that low RHIS competence is not limited to the lower levels of the health system. The lowest levels were among the clerks. It is not clear whether the evaluation is appropriate for them. Perhaps there needs to be some discussion about whether the tool is

appropriate for all levels of personnel. The key skills that the clerks would require are meticulous attention to detail, good organisational and administrative skills, and accuracy.

The study has highlighted the deficiencies in numeracy skills among personnel involved with data collection at both the facility and district levels; these deficiencies can be attributed partly to inadequate numeracy skills in nursing training, and the low pass rate in numeracy-related subjects in high school. Nurses are the ones responsible for completing the registers from which all routine health data are derived. This evaluation found an average RHIS competence level of 36% among nurses, corroborating findings from past studies that have identified nurses' inadequacies in numeracy skills.[129,130,131] The studies in the United Kingdom and Australia investigated both undergraduate and qualified nurses. These studies found that nurses lack the necessary numeric skills to solve basic mathematical problems that are needed to perform daily clinical functions that include drug administration and compiling daily statistics from patients' registers/records. One of the studies[130] examined the curriculum of undergraduate nursing students in Australia and discovered that mathematics is not a prerequisite for entry into the nursing degree programme, and that nursing students are not trained in numeracy skills during their degree programme.

This problem is not unique to nursing training, but has been identified as a cause for concern by the South African Minister for Basic Education, who acknowledged the annual low pass rate of learners in numeracy-related subjects.[185] This notwithstanding, numeracy training should be made mandatory for all nurses; skills in basic mathematics should be considered a prerequisite for all prospective nursing students. In addition, basic numeracy skills should be considered a compulsory requirement when recruiting health information personnel. Regular on-the-job RHIS training, tailored to meet the needs of information personnel, should also be encouraged.

7.5.2   Organisational determinants

Several organisational determinants have been identified that are vital in strengthening routine health information system (RHIS) performance; these include management functions like governance, training, planning, support for supervision, the use of quality/performance standards, and the promotion of a culture of information use in the organisation. Respondents' perceptions of the national Department of Health in terms of promoting problem solving are high at 73%, but this is not reflected in respondents' average

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performance in solving RHIS problems (24%). It is very likely that the Department of Health promotes problem solving, but this has not trickled down to health information personnel at the facility level.

Support for RHIS supervision is a vital determinant of RHIS performance, given that it not only provides a platform for in-service training, but also helps to identify where there are bottlenecks with the implementation of activities devised to improve RHIS performance, especially with the quality of data being generated. The study has shown that support for RHIS supervision is low. Only 54% of the facilities visited had a supervisory support structure in place, and 64% of the facilities reported having received good quality RHIS supervision. This has serious implications for the quality of data generated by the RHIS, and is consistent with other studies such as Doherty et al.[13] and Ferguson et al.[40] Ferguson et al.,[40] argued that weaknesses in training, and supervision given to clinic staff at the facility level, led to data inaccuracies and substantial overestimation of the PMTCT programme coverage in Kenya.

Planning and training, two critical functions needed for the management of a routine health information system, are also lacking in most of the facilities surveyed. The study has shown that the overall support for RHIS planning and training at the facility level is minimal. Apparently there are no systems in place for planned training, and most facilities do not have an RHIS training manual, implying that training is done haphazardly. This finding is consistent with other studies[46,48,50,122] and results presented in *Table 7.1* and *Table 7.3*, where more than half of the respondents claim they had no RHIS-related training in the six months preceding the survey.

It is interesting to note that the use of quality/performance standard tools was the highest reported management function, indicating the presence of copies of RHIS standard operating procedures and the presence of performance improvement tools at the facilities. What is not clear though is whether these tools are used by the facility managers to improve the quality of data collected at each facility. In spite of the overall presence of quality/performance standard improvement tools, two-thirds of the facilities managed by the CoCT claim they do not have these tools in place.

Another finding of this study is the differences observed between organisational structures, which were found to be statistically significant. All 57 facilities surveyed fall under the

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management of three organisational structures and these influence the way the facilities operate. The study show that facilities managed by the City of Cape Town (CoCT) seem to score lower than those managed by the Amajuba district (KZN) and the Metro district health services (MDHS), in almost all the elements assessed for organisational determinants, including RHIS processes. In terms of overall management functions, which include support for training, supervision, planning, and the use of quality performance standards, the study shows a better performance among facilities managed by the Metro district health services (MDHS); and confirm results presented in *Section 6.4.4* (*Chapter 6*), that show organisational structures (authority) to be positive associated with data accuracy, with MDHS-managed facilities having better quality data.

The findings discussed in this section are consistent with other studies on organisational factors influencing the successful implementation of a functional health information system.[56,113,114,115,116,118] Southon et al.,[115] in their study, showed how organisational factors led to the failure of implementing a health information system in Australia, even when the same system was successfully implemented in other countries.[115] This failure was attributed to differences in the type of organisational configuration present in the study site. In contrast, Yusof et al.,[116] proposing the HOT-Fit framework, argued that organisational factors such as effective leadership and top management support played an important role in the successful acceptance and adoption of a new technology in the UK.

In this study, the 57 facilities under review are managed by three different organisational authorities with different structures, using different health information systems for reporting the delivery of routine primary health care services at the facility level. The District Health Information System (DHIS) is used by the Amajuba district (KZN), while the City of Cape Town (CoCT) in the Western Cape uses the Patient Record and Health Management Information System (PREHMIS). The other system used in the Western Cape by the Cape Metro District Health Services for reporting the delivery of routine primary health care services at the facility level is the Primary Health Care Information System (PHCIS). Both systems in the Western Cape feed into Sinjani, a web-based application. The results presented in this study should therefore be interpreted with caution, since these may be attributed to differences in organisational structures.

7.5.3   RHIS processes

The routine health information system (RHIS) processes are crucial in the production of quality data and use of information. As indicated in the analyses, some processes are in place at the facility level, such as mechanisms for data processing and feedback; however, there seems to be an issue with the processes for data-quality checks, data transmission, and data analysis. The analyses show that facilities managed by the City of Cape Town (CoCT) are worse off in terms of overall RHIS processes. Of particular interest are processes for checking data quality, which surprisingly are not in place at these facilities; other processes not in place are processes for data analysis and data transmission, and data collection manuals. It is not clear why these gaps exist.

For facility managers to effectively utilise evidence-based data for daily planning and management of primary health care delivery, data generated from the facilities must be processed into a usable format, through analysing and making meaningful sense of the data. It is evident from this study that data analysis is not encouraged at the facility level, specifically in facilities managed by the City of Cape Town (CoCT) and the Cape Metro District Health Services (MDHS). This study has shown that processes for data analysis are not in place in most facilities; unlike in facilities managed by the Amajuba district, where analyses are done in above 90% of the facilities surveyed. Processes for data analysis are in place at the district level in both the CoCT and MDHS, where most of the analyses are done. Trend analyses and calculation of indicators comparing against district and provincial targets are shown to be the main types of analyses done at the facility levels.

Mechanisms for checking data quality are also lacking at the facility level. Only one-fifth of the facilities surveyed claim to have received directives from the district offices to check data accuracy with instructions that there would be consequences if facility managers did not check the quality of data generated. This implies that less emphasis is placed on data- quality checks at the facility level. No wonder there is a lack of skills and knowledge of checking data quality among health information personnel at the facility level; these inadequacies and the absence of mechanisms for checking data quality at facility level, are indications that data are generated and transmitted to the district level without proper quality checks, hence encouraging the production of poor-quality data.

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In the study by Mate et al.[15] who examined the quality of routine PMTCT data, transcription errors were observed mostly between patient registers and the routine monthly summary reports, thereby causing a breakdown in the data management processes. If data-quality checking mechanisms were in place at the facility level, chances are that transcription errors would be detected and corrected before the transmission of such data to the next level.

Processes for data transmission are also not encouraged at facility level. The study shows that facility managers are not given specific deadlines to submit their monthly summary reports, and there are no consequences for failure to meet such deadlines. The implication of this is that facilities may choose whether or not to submit their monthly summary reports on time. This may impact on the quality of data retrieved at the district level, which may be incomplete and late. This result is consistent with the findings of Mate et al., [15 (p 5)] where they observed that data were not 'frequently transmitted by clinics to the district offices for capturing into the DHIS'.

7.6   Conclusions

Personnel appear to be reasonably motivated and feel confident about RHIS tasks, but lack skills and knowledge about RHIS and its use. The investigation reveals a considerable deficiency in respondents' competence to use and interpret information. Since education has been shown to be correlated with competence, and that there is an internal consistency in the PRISM tool going by the gradient in educational level, it is striking to note that three years or more of post-matriculation education are necessary to meet the required standard to perform RHIS tasks. Hence basic numeracy skills should be a mandatory requirement when recruiting health information personnel, as well as clinical and health facility, and programme managers. Institutional capacity to train personnel on data collection processes and data use and interpretation should also be encouraged, and support for management functions should be put in place at the facility level.

This study has also highlighted the differences in performance of facilities managed by various organisational authorities. It is evident that organisational structures influence behavioural determinants, RHIS processes, and RHIS performance. For instance, the study show that MDHS-managed facilities performed better in almost all the indicators reviewed in this study compared with the other authorities. However, Amajuba district have more RHIS

processes in place at the facility level, and is more likely to follow the DHMIS SOPs and performance improvement tools.

Chapter 8

Summary of discussions

8.1 Introduction

The previous chapters have documented the processes followed to address the research questions, study hypotheses, and study objectives, which include well defined scientific techniques, the use of empirical evidence, and the implementation of appropriate research tools. Associations between the dependent variable (RHIS performance) and different independent variables such as respondents' background characteristics, human factors, institutional factors, and RHIS processes were tested. Factors influencing data accuracy, and factors associated with behavioural and organisational determinants were also predicted. However, this chapter will provide an overview of each of the chapters, summarising the discussions on the key findings presented in previous chapters, and presents a review of what has been achieved. It further discusses how the research questions were addressed, and highlights the study contributions to knowledge. In addition, the study significance and study limitations are presented. Finally, this chapter also discusses the policy implications of the findings, and proposes recommendations and suggestions for future research.

8.2 Key findings

The goal of this study was to evaluate the availability, quality and use of process and output indicators for monitoring and evaluating HIV interventions in maternal, newborn and child health, and to identify the information challenges in monitoring PMTCT programmes in KwaZulu-Natal (KZN) and the Western Cape (WC).

A comparative analytical and observational study was undertaken, using a multi-method approach which included: a self-administered survey of health information personnel to assess confidence and competence levels for RHIS tasks, problem-solving and data-quality checking skills, knowledge of RHIS rationale, and motivation; an assessment of the routine PMTCT data by comparing information collected from registers, routine monthly reports, and the DHMIS to assess data quality, completeness, accuracy, and data use; a secondary analysis of routine PMTCT data from the DHMIS; and a facility survey of RHIS processes and

resources. In addition, in-depth interviews with key informants and observations in health facilities were conducted. Data were collected from 57 health facilities in a convenience selection of two health districts, each incorporating one of the eighteen priority sub-districts identified by the NDoH as the most deprived, having the highest burden of HIV, with the poorest health status, and poor access to health care and health service delivery. All public sector health facilities, 27 in the Amajuba district (KZN) and 30 in Khayelitsha and the Eastern sub-districts (WC), were included in the study. Data were also collected from 161 health information personnel in the 57 health facilities, three sub-districts, and two district offices.

The performance of routine information system management (PRISM) framework[59] that emphasises the relationship between technical, organisational and behavioural determinants of the RHIS performance provided the theoretical basis for this study. It was applied to understand the inputs, processes and outputs of the RHIS in each study site. The PRISM tools were also used to assess data quality, completeness, accuracy, data flow, and data use at different levels of the health department to inform decision making for PMTCT programmes. Behavioural and organisational determinants of RHIS performance were also assessed.

8.2.1   Mapping the RHIS – Gap analysis

The mapping of the RHIS in the study sites highlighted that both districts use the DHMIS but that different systems are in place. There are however, very clear data flows from the facilities to the provincial level, based on registers from which the data elements needed for PMTCT are derived. While the mapping identified clear channels for upward flow of data, there was less evidence about the process of generating and using information. Tools are available for generating reports at different levels but these processes did not emerge as clearly as the data reporting. Gaps were identified with the RHIS including challenges associated with RHIS equipment (computers, printers, calculators and telephones), data collection tools, software, personnel, and organisational issues. An important finding was that information tools and resources necessary for monitoring PMTCT programmes were sometimes either not available, or out of order. It is unacceptable to have stock-outs of essential data collection tools such as registers and tally sheets at the source of data collection. Differences in resource distribution were also identified in the study sites, which suggest that facilities managed by the Amajuba district have fewer resources compared with those managed by the City of Cape Town (CoCT) and Metro District Health Services

(MDHS). The Amajuba district has some way to go to meet the national standard of internet connectivity, for example.

This study has shown that personnel are not sufficiently trained in RHIS-related tasks, and that training is not provided for clinic staff involved in data collection processes. Clinic staff often have very limited data-quality checking skills, do not understand the value of the data being collected and lack sufficient understanding of the full picture of the PMTCT programme. The issues around inadequate training, and why training does not have the desired effect, will be discussed in detail later in this chapter.

Process indicators are not available to programme managers, despite the importance of these indicators.[19,20,21,22] This study was unable to find an information system that captures data on PMTCT process indicators, such as the number of facilities that provide ART, and number of health personnel trained to deliver PMTCT services. In addition, the PMTCT clinical guidelines[65] have highlighted 20 PMTCT priority data elements needed at the national level for the management of the PMTCT programme. Some of these indicators are output indicators, which can be routinely collected at all health facilities. This study has shown that some data elements are poorly reported in terms of quality, while others such as *Baby PCR test around six weeks* and *Baby initiated on co-trimoxazole around six weeks,* are not reported at the national level in the Western Cape, even though they are routinely collected at facility level. The latter is problematic, because the data elements in question are included in the PMTCT guideline; not reporting the data elements could mean one of two things – either they are not needed, in which case they should be removed from the PMTCT guideline, or that the indicators are under reported at the national level, which could present some challenges for planning purposes.

Other challenges identified with the RHIS include: insufficient analysis process at the facility level; and the multiplicity of registers used to monitor the PMTCT programme. With the PMTCT programme being significantly, comprising three main data collection tools, the Antenatal, Labour and Postnatal (Baby) registers, multiple staff at different levels have to complete the different registers. These registers are not necessarily available at one facility, but depend on the type of services offered at the facility. They are kept by multiple care providers, who often forget to record the provision of services or tick the drugs being administered to patients, leading to a case of underreporting the PMTCT data. This finding confirms a recent PMTCT data accuracy study in Kenya, which reported that nurses admitted

that they sometimes forgot to record the care provided to patients, despite having provided such care.[40]

Differences were also observed in terms of the RHIS used in the study sites. Multiple routine health information systems were identified at the facility level such as the Patient Record and Health Management Information System (PREHMIS), Primary Health Care Information System (PHCIS), DHIS, Cradle, and Clinicom. The DHIS was the major information system used at the facility level in the Amajuba district, and is also used at the district and provincial levels in the WC, while the PREHMIS and the PHCIS are used by the CoCT and MDHS authorities respectively. The Division of Revenue Acts (DoRA) is a reporting requirement that uses the DHIS for reporting PMTCT indicators in both provinces. The lack of uniformity in the standards of reporting and the data flow for the PMTCT programme at the facility level was another information gap that was identified, because each study site had its own unique reporting system(s). Unlike in the Amajuba district where all the three PMTCT service registers follow the same flow path, the labour ward register in the WC does not flow through the CoCT since the register is completed at the MOUs which are managed by the MDHS. Information from the three registers are made available and collated at the provincial level. In addition, there are facilities managed by both the CoCT and MDHS, with different routine health information systems. Data collected at these facilities flow directly to the provincial level where they are merged, which could further result in the duplication of possible errors.

The RHIS at the district level of the study sites (DHIS and Sinjani) were compared in terms of structure, functionality and standards. The study shows that both systems have strengths and weaknesses. One of the strengths of Sinjani is that it is web-based and information captured onto the system is immediately available to anyone with access to the database. However, the system uses slightly different terminology for the data elements, therefore some of the data elements do not align with the national indicator data set (NIDS) required by the National Department of Health (NDoH). The DHIS, on the other hand, is used in all nine provinces and is the standard and national reporting system in South Africa. The DHIS is user friendly, more flexible, and can more easily be manipulated than Sinjani. Unlike Sinjani, the DHIS has the capacity to generate multiple report types, graphs and tables, which can be customised to suit the needs at sub-district, district, provincial, and national levels of the NDoH.

8.2.2   Use of and barriers to use of health information

Chapter 5 investigated the use of data and barriers to using health information to monitor PMTCT programmes. A major finding was the inability of staff at both the facility and district levels to analyse, interpret and use data. Despite the inclusion of data analysis, interpretation, and use of information in the district health management information system (DHMIS) standard operating procedures,[110] as key responsibilities of facility and programme managers, these activities have not been enforced. There are still limitations in managers' ability to use information for planning, managing and decision making. This implies that either the SOPs have not been enforced, or that basic training to use information is not provided to facility staff. These results support other studies[148,149,150,151] that highlights the inadequacies of managers to analyse, interpret, and use data. In Burn and Shongwe's[148] study, they highlighted the insufficient use of information by hospital managers to manage service delivery at the hospital level. These inadequacies were attributed to managers' lack of skills to use data.

Another key finding is that despite about 70% of the surveyed facilities having mechanisms and processes in place to promote information use, only about half of the facilities have evidence to show that information is being used for planning and management of maternal and child health programmes. The in-depth interview revealed that information is selectively used at the district and provincial levels for reporting and monitoring programme outputs, but not for decision making and planning purposes. It is very fascinating to note that the majority of decisions made by senior management (district and programme managers), in terms of planning and resource allocation for managing HIV programmes, and the day-to-day activities at the facility level, are not necessarily based on informed data. These findings support other studies on information use.[92,145,146]

Significant differences were observed for each organisational structure in terms of information use at the facility level. This study has shown that the average information use at the facility level in the Amajuba district is 63%, compared with CoCT (49%) and MDHS (39%). Despite the poor accuracy of PMTCT data in the Amajuba district (66%), the data is reportedly being used for planning at the facility level. However, the study shows that the MDHS authority has more mechanisms in place to promote the use of RHIS information at the district level, compared with other authorities. A number of factors were cited for the non-use of information: these include the inability of managers to analyse, interpret, and use

data; and the lack of a culture of information use at both the district and facility levels. This study found insufficient information use culture at the facilities surveyed and inadequate evidence of information use by senior management for planning purposes and decision making. Once there are no indications of a demand for information from senior management, and they do not understand the usefulness of information, chances are facility managers would not use the information. This results support findings from other studies[44,46,56,91] that focus on the culture of information use.

This research has also cited the lack of trust in the data, i.e. a situation where the integrity of the data is questionable, as a barrier to the use of information. The lack of trust is affected by human- and technical-related factors such as a lack of core competencies for data collection, skills/staff shortages, and staff attitudes towards RHIS tasks, work overload, and shortages of basic paper-based resources like registers, tally sheets, and stationery. These findings support the propositions by Nutley and Reynolds[132] to strengthen managers' capacity to use information. In order to improve the use of information for decision making, a culture of information use at both the district and facility levels needs to be promoted. Capacity in data use core competencies such as data analysis, interpretation, synthesis, and presentation, and efforts to improve data quality should be strengthened. In addition, concerted efforts would be needed by the national NDoH to successfully implement the DHMIS standard operating procedures.[110]

8.2.3   Assessing data quality

The third objective of this study was to describe the data quality issues at the facility and district levels. Data quality was measured in terms of data accuracy, and completeness. Trends in the PMTCT data elements, and factors associated with data accuracy at the facility level, were also highlighted in *Chapter 6*. Owing to structural issues, timeliness of the RHIS data could not be ascertained from the survey. However, the in-depth interviews revealed that health information officers at both the sub-district and district levels ensured that all data from the facilities were captured and signed off before being sent to the district or provincial offices. In future it may be useful for district information offices to keep monthly records of the submission dates for facility RMRs.

This investigation suggests that the quality of data to monitor PMTCT programme outputs at facility and district levels need attention. It found the average PMTCT data accuracy (0%

tolerance) over the two-month period at the facility level at 51%, which is below the data accuracy for similar studies that have used the PRISM tools[59] in Africa (Côte d'Ivoire,[123] Uganda[127,128] and South Africa[e]) and other low/medium-income countries such as Haiti[126] and Pakistan.[120] The results indicate that the data are neither viable for planning nor monitoring purposes. Discrepancies were observed between information on the PMTCT registers and the routine monthly report (RMR), and to a lesser extent, between the RMR and DHIS database, indicating better reporting of the PMTCT data accuracy at the district level (84%) compared to the facility level. The study shows that the problem of data capturing is worst at the facility level than it is at district level. These results confirm findings from Mate et al.[15] that suggest that the primary point of departure for accurate transfer of data is during the tallying and collation process at the facility level, between the registers and the routine monthly report.

The inconsistencies of the DHIS in the reporting of PMTCT data over a four-year period was also indicative of data quality concerns, and the excessive burden of healthcare providers in terms of the number of data elements collected at the facility level.[53] These discrepancies in the PMTCT data have been ascribed to several factors such as inadequate RHIS resources (personnel and equipment), insufficient skills to perform RHIS tasks, the weakness of the RHIS in terms of processes in place for data collection, and the multiplicity of data collection tools kept by multiple care givers at the facility level, who often forgot to record the services provided or even tick off the drugs disbursed (*Chapter 5*). Feedback processes at the facility level have been an essential indicator for improving data accuracy.

8.2.4   Behavioural and organisational determinants

In *Chapter 7*, behavioural and organisational determinants of the routine health information systems (RHIS) performance were presented. These determinants include key indicators like staff knowledge of the reasons for establishing RHIS, their ability to solve RHIS-related problems, their skills in checking data quality, staff competence in RHIS-related tasks, motivation, their confidence levels for RHIS tasks, and the promotion of the use of information. The major finding of this study was that despite being highly motivated and confident about performing RHIS-related tasks, personnel lack basic core competence to perform such tasks. The investigation also revealed a considerable deficiency in personnel's competence to analyse, interpret and use information. Based on a competency assessment

involving numeracy and basic data analysis skills, as well as the ability to interpret or know how to use information, the average competence score was 30% (Figure 7.3).

Another finding of this study is that education, job category, and the organisational authorities that manage the health facilities where staff member performed their tasks, were correlated with competence, and hence influenced staff performance. Education, on the other hand, had a positive relationship with job category, implying that levels of education may be associated with the level at which RHIS competencies are acquired. Furthermore, the findings reveal that three years or more of post-matriculation education is necessary to meet the required standard to perform RHIS-related tasks. Therefore, in-service training should be focused on nurses and data capturers at the facility level. It is expected that training will be positively correlated with competence; however, this does not impact on competence in RHIS-related tasks. This finding refutes a recent study by Mphatswe et al.[141] which used a data collection and feedback training intervention to improve the quality of routinely collected data. Perhaps a reassessment of the content of RHIS training should be considered. These findings have been published in a peer reviewed journal.[186]

This study has also highlighted the differences in the performance of the facilities managed by selected organisational authorities. It is evident that organisational structures influence behavioural determinants and RHIS processes. There was no difference by region (or even authority) in terms of the culture of information use. The Amajuba district and MDHS were more likely to follow the DHMIS standards. For instance, the findings show that they have RHIS SOPs and performance improvement tools, training manuals, and supervisory checklists. The CoCT has room to strengthen supervision and training. However, all the facilities scored very low on the indicator for governance and financial management. In addition, support structures for RHIS supervision, planning and training are lacking in most facilities. Only about half of the facilities visited had a supervisory support structure in place; there were no system in place for planning, and training is done haphazardly. As discussed elsewhere (*Sub-section 7.5.2*), this is related to the centralised management of district health services by provinces. This study could not conclusively determine whether organisational factors such as leadership and management support influenced the data quality, due to the small sample size. In the context of the current delegation of authority to run the public health services, it would be important to conduct further study to assess the contribution that these organisational factors make, and identify how they could be implemented in the current system to bring issues of governance and finance to the fore.

Studies such as Lorenzi el al.[114] have cited motivation as a key determinant for RHIS successes. Findings from this study show otherwise. Despite high levels of motivation reported amongst personnel involved with data collection, this did not necessarily improve data quality nor information use, implying that factors other than staff motivation play an important role in determining RHIS success.

8.2.5   Overview of RHIS performance at facility level

Figure 8.1 gives an overview of the major findings as outlined in the PRISM framework. It shows that the input (behavioural, technical, and organisational factors) have impacted on RHIS processes, which, in turn, impact on the output indicators (data quality and information use). The figure highlights challenges with the RHIS across the three components of the Logic Model, particularly behavioural and organisational factors, RHIS processes, data accuracy and information use. Drawing on the assumptions of the PRISM framework, one could argue that the poor performance of the RHIS in terms of data quality and information use shown in *Figure 8.1* is as a result of the absence of key components of the behavioural and organisational factors, impacting on RHIS processes to affect data quality and information use. To ensure a successful implementation of future RHIS, more emphasis and considerations should be placed on strengthening components such as personnel's knowledge of RHIS rationale, data quality checking skills, competence in RHIS-related tasks, support structures for training and planning, and mechanisms to communicate a common RHIS vision and organogram may be useful as well as an enabling process around financial management.

RHIS overview and major findings at the facility level (N= 57)

INPUTS	PROCESSES	OUTPUTS

Technical Factors

Easy to use data collection forms	83
Health system picture	83
RHIS integration	83
User-friendly software	83
Software integrates information	33
Manual is user-friendly	67
IT Complexity	100
IT provides access to information	50

Behavioral Factors

Knowledge of RHIS rationale	22
Data quality checking skill	36
Problem solving for RHIS tasks	24
Competence in RHIS tasks	30
Confidence levels for RHIS Tasks	69
Motivation	74

RHIS Processes

Data collection	61
Data transmission	23
Data processing	100
Data Analysis	48
Data presentation	74
Data quality checks	20
Feedback	91

RHIS Performance

Tolerence levels

	20%	10%	0%
Data Quality	86	81	71
Completness	98	96	91
Accuracy	73	65	51
Information Use		53	

Organizational Factors

Management functions

Governance	22
Planning	58
Training	45
Supervision	54
Quality assurance	62
Finance	5

Others

Promotion of culture of information	68
Availability of resources	80

0% - Actual picture

Figure 8.1: Summary of RHIS and major findings at the facility level in both study sites

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8.3   The functionality of the DHMIS that supports the PMTCT programmes

In order to address the first research question, there was a need to map the information systems used to monitor PMTCT programmes in the study sites, and to identify gaps in the systems. Generic issues relating to the DHMIS were highlighted as this system is central to the production of information to manage the PMTCT programme at the facility and district levels. The review of indicators highlighted that the DHMIS does not include any PMTCT process indicators such as the number of facilities that provide ART, and number of health personnel trained to deliver PMTCT services. Despite the importance of process indicators,[19,20,21,22] this study was unable to identify any system that captures information on PMTCT process indicators.

Challenges such as organisational, behavioural and technical issues, and RHIS processes were identified. The findings show that there are multiple information systems for monitoring PMTCT programmes at the district level in both study sites. This is mostly structural as the PMTCT interventions have to be implemented across several types of health care facilities. However, in Khayelitsha and Eastern Sub-districts (WC), there are two authorities managing the health facilities – the provincial department of health, also known as the MDHS, and CoCT. These authorities use different RHIS at the facility levels (the PHREMIS used by the CoCT; the DHIS, Cradle, Clinicom, and the PHCIS used by the MDHS-managed facilities and the DHIS used at all levels in the Amajuba district in KZN). The information from the health facilities in the WC is captured onto Sinjani at the district level, and later exported at the provincial level onto the DHIS – a system that is nationally used for reporting PMTCT indicators.

A number of challenges have been identified in this study and in literature as barriers to the successful implementation of the DHMIS.[40,44,45,46,47,48] These challenges, which are not unique to the RHIS that support the PMTCT programme, are behavioural, organisational, and technical in nature and include: inadequate and inappropriate human resources, inadequate training, staff's lack of understanding of the RHIS role in supporting health services, managers' inability to analyse, interpret and use data from the RHIS, and a commitment to ensuring data quality. A lack of resources such as registers, computers, printers, intranet and internet connectivity were also identified. The study highlights inadequacies in the resources and equipment for monitoring PMTCT programmes, which were neither available nor out of order. Facilities in the WC (CoCT and MDHS) appear to be better resourced than those in the Amajuba district. However, stock-outs of paper-based resources such as registers and tally

sheets were reported in all three organisational authorities. The latter creates opportunities for underreporting and data compromise. If the above barriers are effectively addressed, they could improve the performance of the district health management information system that supports PMTCT programmes.

This study was unable to identify international standards and minimum requirements for computers and human resources for RHIS per facility, to benchmark against observed results, and determine whether a facility is under- or over-resourced or equipped.

8.4   Improving the quality of reporting and analysis of PMTCT data

The second research question sought to assess data quality and identify ways of improving the quality of reporting and analysis of PMTCT programme performance data at the facility and district levels. Findings from this study have shown that the RHIS for managing PMTCT programmes in the study sites is suboptimal in terms of the quality of data generated by the system. *Chapters 5, 6,* and *7* have highlighted numerous challenges associated with the performance of the RHIS, such as shortages of skilled manpower, inadequate skills to check data quality, insufficient competence in RHIS tasks, lack of knowledge of RHIS rationale among personnel involved with data collection, and insufficient RHIS processes at the facility level which include: the lack of directives for timely reporting of data, and no clear RHIS mission statement or organisational chart outlining the roles and responsibilities of RHIS personnel, causing a situation of non-accountability. Drawing from the findings highlighted in this study, a number of activities to improve the quality of reporting and analysis of PMTCT programme performance data at the health facility level using the DHMIS can be instituted, such as employing the right skills, adequate training for RHIS personnel, improving RHIS processes at the facility level, having a standardised system for data collection at both the facility and district levels, and having adequate and functional equipment and resources for data collection. In addition, the issues of good leadership, and adequate culture of data demand and data use is vital. While these steps will go some way to improve the quality of the RHIS data, organisational issues should be assessed further. Mechanisms to communicate a common RHIS vision and organogram may be useful as well as an enabling process around financial management.

8.4.1 Association between education and competence

This study found a positive association between education, job category, and competence, implying that levels of education may be associated with the level at which RHIS competencies is acquired. It further revealed that three years or more of post-matriculation education is necessary to meet the required standard to perform RHIS-related tasks. This has serious implications for recruiting health information personnel such as nurses, information officers, and data capturers at the facility and district levels. At the moment, there are no published standard documentations outlining the minimum requirements for standard HIS posts. It would be appropriate if such documentation could be developed and implemented to ensure a skilled cadre of HIS personnel with appropriate competency level to perform RHIS-related tasks. Such documents will be useful in curbing the current situation in some facilities where inexperienced and unqualified personnel are hired to perform RHIS-related tasks, resulting in circumstances where data are incorrectly collected.

8.4.2 Adequate training

Challenges faced with inadequate skills for the data collection processes have been reported in *Chapter 7*. Personnel involved in the data collection processes are not sufficiently skilled, and lack basic competence to collate, analyse, interpret, and use data. One of the reasons identified in *Chapters 5* and *7* for these inadequacies is the lack of numeracy skills. A major part of the data collection processes require numeracy skills such as basic arithmetic, calculating percentages, and the ability to pay attention to detail. This study has demonstrated that most data capturers, nurses, and facility managers lack these basic skills. Addressing the issues around inadequate numeracy skills would require a systematic approach and a dedicated effort by Government, especially when addressing the challenges around the low pass rates in numeracy subjects among high school learners in South Africa.[185] The efforts made by the NDoH in 2011/2012 to train 3535 personnel for data capturing[111] are inadequate, since several studies have shown that training personnel on RHIS-related tasks has not made substantial differences in skills acquisition and behavioural change.[46,48] It is not clear why, in spite of the resources invested in training, personnel still lack the skills to effectively function in RHIS-related tasks. Even though about 40% of respondents reported having had training six months prior to the study, the training was not sufficient to improve competence in RHIS-related tasks, and impact on data quality. This raises the question why additional training is unable to aid the upskilling of staff.

Results from the in-depth interviews (*Chapter 5*) has highlighted some challenges faced with staff training and recommend other forms of pedagogy which should be based on adult learning such as experimental, structural, and participatory on-the-job training, tailored to meet the needs of RHIS personnel. This finding is consistent with the body of knowledge on the use of novel, and innovative pedagogy,[187,188,189,190] which have argued for a shift from the traditional didactic way of teaching, to a more practical way. They proposed the Active Learning Technique as the best way for skills acquisition and retention. Active learning as defined by Dewing[188 (p 22,23)] is:

> 'An approach for in-depth learning that draws on, creatively synthesises and integrates numerous learning methods… It draws on the principle of multiple intelligence; critical reflection; learning from self; from dialogue and shared experiences with others; skilled facilitation, intentional action and takes place in the workplace.'

These studies have demonstrated the effectiveness of the Active Learning Techniques among nursing, and medical students. This approach could be adopted when training current RHIS personnel.

Other factors such as the content and structure of the training, the environment in which training is given, the facilitators, and the mode of delivery may contribute to non-retention of skills. Staff attrition,[122] is another factor that may also contribute to skills shortages. This notwithstanding, interventions such as establishing a HIS career path, and developing a cadre of HIS personnel to function at both the facility and district levels, as was the case in Botswana,[191] should be encouraged to fill the current gaps and meet the demands for HIS personnel. In addition, efforts to improve RHIS skills should be encouraged through ensuring that appropriately skilled people are hired to perform such tasks; and those currently functioning in RHIS-related positions should also be trained with the techniques highlighted above.

8.4.3   Improving RHIS processes

RHIS processes refer to the structures in place for the daily collection, collation, analysis, interpretation, and use of information at all organisational levels of the health systems. The PRISM framework[59] has proposed seven processes for a functional routine health information system. These processes, which impact on RHIS performance, include: processes for data collection, data transmission, data processing, data analysis, data presentation or display,

data-quality checks and feedback. This study found that some RHIS processes such as processes for data transmission, data analysis, and data quality checks are not in place in most facilities (*Figure 8.1*). The absence of processes for data-quality checks at the facility level has been highlighted in *Chapter 5* as one of the problems associated with poor data quality. This implies that less emphasis is placed on data-quality checks at the facility level, which could be due to a lack of skills and knowledge of checking data quality among health information personnel at the facility level. These inadequacies and the absence of mechanisms for checking data quality at facility level are indications that data are generated and transmitted to the district level without proper quality checks, further encouraging the production of poor-quality data. If data-quality checking mechanisms were in place at the facility level, chances are that transcription errors would be detected and corrected before the transmission of such data to the next level.

The absence of data analysis processes at the facility level also led to the non-use of data for managing day-to-day activities in some facilities. For facility managers to effectively utilise evidence-based data for daily planning and management of primary health care delivery, data generated from the facilities must be processed into a usable format, through analysing and making meaningful sense of the data. It is evident from this study that data analysis is not encouraged at the facility level, specifically in facilities managed by the City of Cape Town (CoCT) and the Cape Metro District Health Services (MDHS).

The correlation and regression analyses found the feedback process to be associated with, and a predictor of data accuracy, as was clearly reflected in the MDHS managed facilities. All the facilities reported having a feedback process in place, and were shown to have better data quality. This finding is consistent with Muschel[28] and English et al.[48] who attributed poor data quality, and insufficient skills to analyse, interpret and use data, to a feedback mechanism that is lacking between different levels of the health system. A data collection and feedback training intervention has been used to improve the quality of routinely collected data in South Africa.[141] Timely feedback is also a crucial part of the supervisory process and is important for enhancing data quality, especially when audits are done.[48,48,53] This study found the MDHS managed facilities to have a better supervisory system in place, hence better data quality.

It is expected from the PRISM framework[59] that data display will impact positively on data quality; but the regression analysis show a negative association. Over 90% of the facilities

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managed by the Amajuba district authorities reported having a data display mechanism, but this did not improve data quality. Instead, facilities that reported low data display, as is the case in MDHS, reported better data quality.

The NDoH should ensure that the necessary processes for data collection, collation, and analysis are in place at all facilities. Great strides have been made by the introduction of DHMIS standard operating procedures[110] at all levels of the Department of Health, which outline the roles and responsibilities of each cadre of information personnel. However, stringent measures should be introduced to ensure that the DHMIS standard operating procedures are successfully implemented.

8.4.4 Adequate and functional equipment and resources

Several studies have shown that key resources needed for the operation of the HIS in low- and middle-income countries, such as personnel, stationery, and management support were inadequate; basic equipment for data collection and processing were also not available.[39,40,44,53] Despite the importance of resources and information tools for monitoring PMTCT programmes, this study has identified some challenges with the availability of personnel, equipment, and paper-based resources such as stationery and registers. Results from the study highlighted differences in the availability of skilled personnel, functional computers and printers. Also highlighted are issues with stock outs of data collection tools in some facilities, leading to situations where nurses are forced to photocopy unused pages of old registers in order to carry on with the data-recording processes. Sometimes the photocopied pages are of poor quality because of a lack of ink cartridges, making it difficult to read the instructions on the page, as was cited by participants in the in-depth interviews (*Chapter 5*). The above issues can be avoided if planning and resource allocations are based on accurate and reliable information.

8.4.5 Standardised systems for data collection

This study identified several data collection systems in the study sites, with no standardised systems for managing and reporting PMTCT programmes in each of the organisational authorities. Some of the health facilities in the WC are managed by dual authorities (MDHS and CoCT), with different routine health information systems. Hence the data collected at these facilities are merged at the provincial level into the DHIS which is required for national

comparison (*Chapter 4*). The absence of uniform structural data collection processes for PMTCT data create opportunities for transcription errors, as has been identified in *Chapter 6*. The NDoH should encourage the use of standardised data collection tools for the monitoring of PMTCT programmes.

8.4.6   Effective leadership and support structure

Organisational factors such as leadership, planning, management support, and culture have been highlighted as factors influencing the successful implementation of a functional health information system.[52,56,113,114,115,116,117] This study has shown that some management criteria such as RHIS governance and finance functions are missing at the facility level. This could be because health budgets and allocations are centrally managed at the provincial and national levels. Studies[52,113] have shown the impact organisational factors such as leadership and management support have on RHIS implementation. Kamadjeu et al.[56] highlighted leadership issues as one of the challenges faced with the adoption and sustainability of an electronic health care record in Cameroon (Central Africa). However, this study was unable to determine whether organisational factors influence data accuracy due to sample size, hence further studies should be developed with a larger sample to determine the extent to which such organisational factors impact on data quality. This notwithstanding, RHIS governance functions like the display of the RHIS mission statement and organisational chart showing functions related to RHIS or health information should be encouraged at the facility level. These will not only enable RHIS personnel to know the reasons for and the importance of data collection, but will also help with accountability – knowing each staff member's responsibilities regarding particular tasks or assignments. RHIS roles should be clearly defined, and personnel should be encouraged to take ownership and responsibility of the data collection processes. A culture of data demand, and information use should also be encouraged.

8.5   Barriers to information use

The third research question was to assess the barriers to the use of information by facility and programme managers for planning and monitoring PMTCT programmes. Results from objective 3, reported in *Chapter 5*, highlight the challenges faced with information use at the facility and district levels. The study shows that information is not adequately used by managers to inform decisions and for planning purposes, but is selectively used for reporting

and monitoring programme outputs at the provincial level. The inadequate use of information has been attributed to several barriers, which include: a lack of trust in the data; the inability of some managers to analyse, interpret, and use information, owing to insufficient skills; and the lack of or inadequate culture of information use at both the district and facility levels. The lack of information use among facility managers negates the expectations of the NDoH that facility managers and professional nurses are expected to have skills to analyse, interpret and use data.

Results from this study have shown that the major causes of a lack of information for management stem from organisational issues such as the lack of a culture of information use at both facility and district levels. It refers to 'the capacity and control to promote values and beliefs among members of an organisation by collecting, analysing and using information to accomplish the organisation's goals and mission'.[59 (p 222),120] The in-depth interviews from key informants have identified a lack of trust in the data as one of the reasons cited by managers for the non-use of information for management purposes. This hinges on inaccurate and incomplete reporting at the facility level, which is influenced by human-related factors such as a lack of core competencies for data collection, skills shortages, staff attitudes, staff shortages, and demanding workloads. These findings have policy implications – studies have shown that accurate and reliable data is needed to inform policy development, management, planning and the delivery of essential patient care. The fact that the DHIS, which is the official information system to collect monthly facility-based data from the public sector primary health services and district hospitals,[28] cannot be relied upon means that decisions are made with misleading information or that there are other reliable sources of information used for planning and management purposes. If the former is true, it means that the decisions made in terms of service delivery, resource allocation may be misleading. If the latter is true, which is unlikely, we are wasting scarce resources through the time spent by nurses collecting routine data that may never be used. Regardless of the poor quality of the PMTCT data, studies[9,12,98] have shown that PMTCT interventions seems to be having an impact. It will be interesting to know how decisions for planning and evaluating key programmes are made, and what informs such decisions if not the data.

8.6   Contribution to knowledge

This research project has provided insights to guide policy makers, both locally and internationally, especially the national and provincial Departments of Health to improve the

RHIS which has been acknowledged to be problematic. The study used a comprehensive framework for the evaluation of the RHIS. The PRISM framework proposes that organisational and technical factors affect behavioural factors, which in turn impact on RHIS processes that affect RHIS performance: data quality and information use. This is the first time that the framework and tools have been applied extensively in the South African setting, and in the context of the PMTCT programme.

The contribution of this study to the body of knowledge on the evaluation of the PMTCWT routine health information systems can be classified into two categories: Analytical and audit contributions, respectively, as discussed below.

Analytical contribution

The most significant contribution of this study is the demonstration of the impact that human factors such as knowledge of RHIS rationale, data-quality checking skills, problem-solving skills, and competence in RHIS-related tasks, have on RHIS processes and RHIS performance (data quality and information use). Despite wide documentation of challenges observed with poor data quality in the literature, very few studies have investigated the determinants of data quality. More so, most evaluations of the RHIS performance have focused on the technical and organisational aspects, and have failed to explain the determinants of RHIS successes or failures in different settings. The few studies[45,160,163,165] that evaluated the people aspects of the RHIS have only focused on the availability of human resources. Results from this study have highlighted the factors responsible for poor quality data, most of which are human-related such as inadequate skills to check data quality, insufficient competence in RHIS tasks, lack of knowledge of RHIS rationale among personnel involved with data collection; and the need for improved RHIS knowledge and core RHIS competences amongst RHIS personnel such as facility and programme managers, health information officers, and data capturers. Findings from the study have shown that the average competence for RHIS tasks among personnel involved in the data-collection processes is low; and that education is a predictor of RHIS competence, and RHIS rationale. The study found that in this context, three years of post-matriculation education is necessary to meet the required standard to perform RHIS-related tasks.

The study also found that understanding the rationale for establishing the RHIS, knowledge of checking data quality, and problem solving skills, are determinants of RHIS competence. There were differences by job category and gender in terms of RHIS competence and

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knowledge of checking data quality. Men were found to be more confident in performing RHIS tasks, when in actual fact, they lack the skills to perform such tasks. One of the reasons given for the inadequate competence in RHIS-related tasks stems from the fact that the majority of the personnel are not numerically inclined. Other reasons include lack of training in RHIS-related tasks. Motivation, on the other hand was not associated with competence.

Hotchkiss et al.[128 (p 16)] reiterated that: 'the predictive value of the PRISM framework needs to be demonstrated with further applied research in a different setting'. Unlike the PRISM's assumption that motivation improves performance, this study found that in this setting, despite personnel being highly motivated, this had no impact on performance. Furthermore, the PRISM framework[59] assumes that data display and feedback processes will impact positively on data quality; the regression analysis found only the feedback process to be a predictor of data accuracy. Data display processes showed a negative association with data accuracy. About three-quarters of the facilities surveyed reported having a data display mechanism in place, but this did not improve data quality. This study has validated some of the behavioural determinants of the PRISM framework, and has found these to have a positive impact on data quality. In-depth interviews were used to explore in detail, the behavioural determinants, and support some assumptions in the PRISM framework such as issues around training, numeracy skills, data analysis, data-quality checking skills, and the feedback processes. The framework has also been enriched with qualitative methods which suggest that the framework may need some refinement.

Audit contribution

A primary objective of this study was to identify reasons why routine health information is not adequately used by programme and facility managers for planning, and monitoring of progress on maternal and child health PMTCT programmes. Despite the RHIS containing valuable information that can be used for programme monitoring, this study found that only about half of the facilities surveyed use this information for the daily management of services delivery, confirming findings from other studies on the non-use of information by programme and facility managers for decision making.[144,147,148,149,150] The body of knowledge has shown that routine information is not often used for managing programmes, however, no study has been conducted in South Africa, and in the context of maternal and child health programmes, that investigates the barriers to using information for management purposes. This is the first study that has identified barriers to using information, hence making a new contribution in terms of the determinants of the non-use of information in South Africa. The study suggests

that a lack of trust in the data, as a result of poor quality data, plays a key role. In addition, this study has shown that programme and facility managers lack the skills to analyse, interpret and use data. Further barriers identified for the non-use of information are issues around the absence of a culture of information use at the facility, district and provincial levels. Findings further suggest that the inadequate demand for information from senior management has resulted in the non-use of information for management purposes. The study found that the breakdown of information flow is at the facility level, therefore training should be focused on the nurses and data capturers who collect data rather than health information officers at the district and provincial levels.

Another important contribution to knowledge is the development of maps of the routine health information systems that support the PMTCT programmes. The data flow from the facility level to national level was mapped, which has highlighted the different stages in the data-collection processes in both study sites. Also, this research has contributed to the body of knowledge that has identified gaps in the quality of the PMTCT data at the facility, district, and national levels. The study not only identified challenges with the quality of the data, but also highlighted factors that influence data quality. The study has shown that organisational structures and authorities influence the performance of the RHIS. It shows that facilities managed by the MDHS performed better on data quality than other authorities, that Amajuba follows the DHMIS SOPs more closely but is less resourced than the other two authorities, and that there is room for strengthening the supervision and training in CoCT facilities. This notwithstanding, further research is required to investigate the factors in the organisational structures and authorities that are likely to impact on RHIS performance.

Process indicators have been identified in the literature as important indicators that influence both output and outcome indicators.[19,20,23] This study evaluated the process and output indicators in the context of the DHMIS that support the PMTCT programmes. Due to the absence of data, we were unable to evaluate the process indicators for PMTCT such as the number of personnel trained to deliver PMTCT services, and the number of facilities offering PMTCT treatment services. However, unpublished results by the National Department of Health (NDoH) suggest that about 15% of public health facilities in South Africa are not equipped to administer PMTCT services.[12] Nonetheless, results from this study not only confirm findings from other studies,[19,20,21,22,23] but have also shown that output indicators are crucial to improve outcomes. The NDoH should consider whether to extend emphasis on the process and output indicators for monitoring PMTCT programmes.

8.7   Significance of the study

This cross-sectional study gives a snapshot of the RHIS that support the PMTCT programmes in the selected districts at any given time. The study design also allows for the establishment of associations between dependent and independent variables, but could not establish causality. The findings of this research, which focus on strengthening the performance of the PMTCT routine health information systems in terms of data quality and use of information, will provide insights to guide the local and international health informatics community and decision makers, especially the NDoH to improve the routine health information system which has been acknowledged to be problematic. The study is of great relevance within the context of the South African health priorities, and the findings will help improve the quality of reporting and provision of accurate and reliable statistics. Although the study focused on PMTCT information system, most of the issues raised can be applicable to other generic information systems and in other low- and middle- income countries.

The study which made use of the PRISM framework and tools for evaluating RHIS, provides unique insights into the behavioural determinants of RHIS performance, an aspect that is usually neglected in RHIS evaluation. These should inform future planning for human capacity development for all staff at all levels of the health system. It will also ensure that the necessary information, and processes to measure performance of PMTCT intervention indicators are being implemented at the facility, district and provincial levels. This was done through the use of an audit to identify the barriers in PMTCT programmes in terms of data availability, and data quality. In-depth interviews with key informants were used to investigate barriers to the use of information. In addition, analytical approaches were used to investigate the associations between personnel's background characteristics and human factors, institutional factors and RHIS performance. The study also predicted factors affecting data accuracy, as well as factors associated with behavioural determinants. These findings would be very useful to inform policy makers on focus areas to strengthen the performance of the RHIS. In terms of information use, this study provides useful insights as to why information is not adequately used by programme and facility managers to plan, manage and deliver quality services.

8.8   Limitations

A major limitation of this study is the sample size. The study is based on a purposive sample of the health facilities in two health districts, which may not have the same characteristics as other districts. Hence the results of this study may not necessarily reflect RHIS performance in other districts. The study focused on priority districts with a high HIV prevalence, where important lessons could be learned for the monitoring and evaluation of PMTCT programmes, and where improved information could potentially make an impact on health care delivery and health outcomes. However, as only two districts, which may not be representative of other districts, were included in this study, the study cannot be generalised.

Nonetheless, this study gives a snapshot of the RHIS situation in the two districts, purposely selected from the eighteen priority sub-districts identified by the NDoH as the most deprived, having the highest burden of HIV, with the poorest health status, and limited access to health care and health service delivery. Findings may therefore provide insights into the situation in other districts with similar socio-economic characteristics. Furthermore, since the DHMIS is applied throughout all the nine provinces, it may not be necessary to have sampled all the provinces, since there is evidence[15,16,47] that shows the poor quality of data extracted from the DHMIS dataset at the provincial level, and the issues surrounding human resources and equipment for the DHMIS in each of the nine provinces. In addition, the quarterly report-backs by provincial information officers during the National Health Information System of South Africa (NHISSA)[a] meetings, have constantly highlighted the challenges faced with the poor quality of data generated at the facility level. Therefore, it can be safely assumed that similar problems and challenges identified in this study may also apply in other provinces.

The cross-sectional design used in this study allowed for the establishment of associations between dependent and independent variables, but could not establish causality. Furthermore, although the study attempted to predict the determinants of data accuracy using a multiple regression analysis approach, the number of observations of facilities included in the study (N=57) limited the scope to perform a high-level analysis. Multicollinearity could not be fully investigated and there was insufficient power to investigate the statistical significance of factors included in the model (*Model 10, Table 6.3*).

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[a] Recommendations of the NHISSA meeting held on the 27 – 28 October 2014. National DOH Audit findings, and provincial responses presentations.

Despite their strengths, qualitative interviews have their own weaknesses, which include the fact that they are prone to bias. Kaplan and Maxwell[192] argue that since the researcher is a major part of a research instrument, he/she is likely to incorporate personal opinions and perceptions that may influence the study. Furthermore, participants may anticipate an interviewer's expectations and respond accordingly. The probing is likely to focus the attention of the respondent on the issue of interest, which may change the way the respondent thinks about the topic and therefore confounds future attempts. With this method, it was difficult to obtain accurate information on highly sensitive issues. However, the in-depth interview shows that information is used for target-setting but not for decision-making.

While the validity of the PRISM tool has been evaluated to some extent,[128] another limitation of this study is the appropriateness of the organisational and behavioural assessment tool (OBAT) for different health information personnel, and the tool's ability to measure specific core skills of certain health information personnel. The OBAT was used to assess health information personnel's competence in RHIS tasks, which were classified by job category and educational levels. The same tool was administered to health information officers, facility managers, data capturers and clerks. It is not clear whether the evaluation tool is appropriate for the lower-level clerks. For instance, clerks and data capturers are not expected to interpret and use data. These functions are applicable to Health information officers and Clinic/facility managers. The key skills needed by clerks are good attention to detail, good organisational and administrative skills, and accuracy. However, the tool did not measure these skills, raising concern about the appropriateness of the OBAT for all levels of personnel.

Language barriers could pose a major limitation to the study, especially during the in-depth interviews; efforts were made to recruit research assistants and fieldworkers who spoke the indigenous languages (isiZulu, Afrikaans, and English) in the study areas.

8.9   Conclusion and policy implications

In conclusion, this study has demonstrated how the Health Management Information System at the district level functions, and has suggested ways of strengthening the system to support PMTCT programmes. It has also identified the data quality issues with the RHIS, and has highlighted the skill shortages in performing RHIS-related tasks at both the facility and district levels, especially at the facility level, where they are mostly needed. This is clearly

illustrated by the inability of staff, including facility managers, to collect good-quality data, and managers' inability to use data for planning and the day-to- day management of service delivery.

The results from this study not only show that the RHIS used for managing PMTCT programmes in the study sites differ according to organisational authorities, but also that these authorities, responsible for managing the health facilities of interest, have a positive influence on the performance of the RHIS. For instance, facilities managed by the MDHS have consistently been shown to perform better than facilities managed by other authorities in almost all aspects of the study.

Also identified in this study are some determinants influencing the use of information for management and planning purposes at all levels of the Department of Health. These determinants are behavioural and organisational in nature. However, this does not undermine the importance of other factors, such as data quality, especially at the facility level. The above findings therefore can be used as the basis for a number of policy recommendations.

Firstly, the fact that behavioural factors such as data-quality checking skills, knowledge of reasons for data collection, and competences in RHIS-related tasks, were found to have an significant impact on data accuracy, suggests that improving institutional capacity for competence assessment and recruitment of qualified personnel with basic knowledge of the data collection processes, and core competencies for RHIS-related tasks, particularly in the light of plans to introduce a National Health Insurance scheme, may have a huge impact on improving data quality at all levels of the Department of Health. This study highlighted that the deficiencies in numeracy skills among personnel involved with data collection at both the facility and district levels, could be attributed partly to inadequate numeracy skills training in high school, as indicated by the annual low pass rate of learners in numeracy-related subjects, and in nursing training. Hence, numeracy training should be made mandatory for all nurses; skills in basic mathematics should be considered a prerequisite for all prospective nursing students. This is, however, a long-term investment. Alternatively, in the interim, RHIS personnel should be provided with in-service mentoring, tailored to meet the needs of information personnel, and adequate supervision for RHIS-related tasks should also be encouraged, since this study has shown that training alone is not sufficient to change behaviour.

Secondly, a lot of emphasis has been placed on improving RHIS technology, or replacing existing system, and less emphasis on the people who collect the information, which this study has shown to lack the necessary skills and competence to perform RHIS-related tasks. The implication of this finding is that since people are important assets in the successful implementation of the RHIS, if adequate resources are not channelled into developing a cadre of qualified and skilled health information personnel, we will continue to have skill shortages, and issues around poor data quality would be a constant and recurring topic in the health informatics literature. The DHIS is now used internationally in almost 23 countries, some of which are already transitioning towards the DHIS2 (web-based version). The same issues identified in this study are applicable to other countries using the DHIS.[123] It is imperative to mention that if the issues of competence and inadequate skills identified in this study are not speedily addressed, not only will we deal with inaccurate and unreliable data, the same issues will be transferred to the new system (DHIS2). As long as the system involves capturing of data, the issues of competence will still come to play, since people would still be required to do the capturing.

Thirdly, the study has shown that some RHIS processes are not in place, particularly processes for data-quality checks, data transmission and data analysis. Furthermore, management functions such as RHIS governance, finance, and training are not adequate at the facility level. This may undermine RHIS performance in terms of data quality and utility of the information from the system. Hence provincial authorities should ensure that adequate and functional RHIS processes are in place at the facility level.

Finally, the inability of facility and programme managers to use information for planning and management purposes implies that decisions for programme implementation and improving service delivery are not always based on information. This could have a negative impact on the way health care services are delivered. In line with this, the NDoH should promote a culture of information use at all levels, especially at the facility level. Facility and programme managers should be trained and encouraged to use information for planning, management, and decision making.

8.10 Recommendations

Based on the findings of this evaluation and the importance of having good quality data, and using information for planning, management, and for decision making, the author therefore propose the following recommendations:

- Efforts to improve RHIS performance, in terms of data quality and information use, must continue, as these are essential to monitor programme progress and for effective service delivery.

- Facility and programme managers should be trained and encouraged to use information, by improving the quality of, access to, and presentation and packaging of information. However, such training should be based on the Active Learning Technique[188] such as experimental, structural, and participatory in-service training tailored to meet the needs of RHIS personnel. In addition, a culture of information use should also be encouraged at different organisational levels. This must also include a feedback mechanism, which has been identified as a crucial part of the supervisory process, and is essential for the generation of quality data.[28, 48]

- Institutional capacity to recruit qualified personnel with basic knowledge of the data collection processes, and core competencies for RHIS-related tasks, including data-quality checking skills, and data validation, should be encouraged, particularly in light of plans to introduce the National Health Insurance plan. This capacity building could be in the form of regular in-service RHIS mentoring, tailored to meet the needs of RHIS personnel.

- South Africa has made considerable strides in the provision of universal basic education since the 1990s following the abolition of the apartheid regime. However, there are some problems confronting the education sector, efforts are needed to strengthen and improve the country's education system in terms of limited numeracy skills, in both basic education, and training of health professions. This may involve the re-orientation of teachers involved in basic education to meet these demands, and may also involve a review of the current high school mathematics curriculum.

- This study has identified the lack of numeracy skills among HIS personnel as a major barrier influencing the quality of PMTCT data, thus numeracy training should be made mandatory for all nursing degrees. Skills in basic arithmetic should be considered a prerequisite for all prospective nursing, and health information students. In addition, basic numeracy skills should be considered a compulsory requirement when recruiting health information personnel.

- The NDoH and other low- and middle- income countries should implement and monitor standards for HIS staffing and IT equipment outlined in the DHMIS policy guidelines and standard operating procedures. Adequate allocation of resources needed to address the information technology infrastructure should also be strengthened, including the standardisation of the data generation processes nationwide, to allow for easy interoperability. Resource allocation should be based on informed decisions, so that adequate resources are channelled to where they are needed, to avoid situations where facilities are either over- or under-resourced.

8.11 Future research

- Human factors, such as the lack of core RHIS competences among personnel tasked with the routine collection of data, have been identified as barriers that influence the quality of PMTCT data. Interventions to address the issues of health information system (HIS) skill shortages are needed to minimise the workload of nurses and other frontline staff. The NDoH has made some strides in training data capturers; however strategies are needed to ensure the sustainable development of a cadre of HIS personnel, and the establishment of an HIS career path, and more accredited training programmes at the undergraduate level. The NDoH could adopt the model used in Botswana[191] to create a cadre of health information officers.

- The focus areas of this study was to assess the quality of the PMTCT data, which is one of many programmes captured in the DHMIS. The findings suggest that the quality of the PMTCT data needs urgent attention. However, it is not clear whether the findings from this study reflect the situation of the entire DHMIS database in terms of all other programmes captured into the system. Since this is beyond the scope of this current study, further research is needed to explore the data quality of other programmes

captured in the DHMIS to determine the overall quality of information made available for management and planning purposes.

- Attempts made to predict the factors associated with data accuracy at the facility level identified the feedback process as a predictor of data accuracy; however, owing to the sample size, the study could not conclusively predict the causes of poor data accuracy. An extended study with a larger sample size should be conducted to explore other possible factors that may influence data accuracy at the facility level, such as supervision, training, resources, technology, use of information and skills in core RHIS competences.

- While a majority of the reasons given for poor PMTCT data quality and suboptimal use of information for planning and decision making is human- and institutional-related, further research is needed to examine and theorise on the relationships between human and institutional agency-related aspects, and how individual actions can bring about changes in institutional routines.

- Regardless of the poor quality of the PMTCT data, studies have shown that the PMTCT interventions seems to be having an effect, as has been shown by the decline in the transmission rates. An investigation is needed to determine how decisions for planning and evaluating key programmes such as PMTCT are made, and what informs such decisions if not the data.

- Despite the importance of human resources and equipment for the implementation of the RHIS, no study has been conducted to determine the standard minimum requirements or number of computers and human resources for health information systems needed per facility, to determine whether a facility is under- or over- resourced or equipped. Action research is needed to determine standard minimum requirements per facility headcount to establish a set of norms for RHIS resources such as staff and equipment per health facility.

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APPENDICES

Appendix A: South African National DoH PMTCT treatment regimens

Maternal regimens		
Woman	**Regimen**	**Comment**
1st antenatal visit		
All women at first antenatal visit (any gestational age)	FDC initiated immediately	If there is a contraindication to the FDC: Start AZT immediately and review within a week. (see figure 2- algorithm)
Currently on lifelong ART	Continue the ART regimen If the woman is on a compatible regimen (EFV, 3TC TDF) change to FDC	Check a VL when pregnancy diagnosed
2nd antenatal visit (1 week later)		
Creatinine ≤85µmol/l Any CD4 cell count	Continue FDC	
Creatinine > 85 µmol/l TDF contraindicated (renal disease)	AZT + 3TC + EFV	If haemoglobin <7g/dl AZT is contraindicated. Use D4T instead of AZT. Refer for investigation for cause of renal disease
Contraindication to EFV (active psychiatric illness) CD4 ≤ 350cells/mm^3	TDF + FTC + NVP	Substitute LPV/RTV for NVP in women with CD4 counts > 250cells/mm^3
Contraindication to EFV (active psychiatric illness) CD4 > 350cells/mm^3	AZT in pregnancy	
	sdNVP + sd TDF + FTC and AZT 3hrly in labour	
Labour		
Unbooked and presents in labour and tests HIV positive	sdNVP + sd TDF + FTC and AZT 3hrly in labour	Assess maternal ART eligibility before discharge
	start FDC after delivery if woman will breast feed	
Infant regimens		
Infant	**Regimen**	**Comment**
Mother on lifelong ART or antenatal prophylaxis received (including TDF + 3TC/FTC + EFV or AZT)	NVP at birth and then daily for 6 weeks	If mother is breast feeding and not virally suppressed e.g. late booking or AZT mono-therapy continue NVP for infant throughout breast feeding until one week post cessation of breastfeeding,
Mother did not get any ART before or during delivery and tests HIV positive post delivery	NVP as soon as possible and daily for 6 weeks	Assess ART eligibility as soon as possible
Unknown maternal status because orphaned or abandoned	Give NVP immediately* Test infant with rapid HIV test. If positive continue NVP for 6 weeks. If negative discontinue NVP	Follow up 6 week HIV DNA PCR
Mother on AZT regimen (due to any contraindication to the FDC regimen)	NVP at birth and then daily for 6 weeks.	Test infant with 6 week DNA PCR test. If negative and breastfeeding continue NVP till one week after complete cessation of breastfeeding
* If rapid HIV test can be done within 2 hours, then wait for HIV result before commencing NVP		
Source: PMTCT guidelines (2013)[66]		

Appendix B: UNGASS Indicators and additional recommended indicators, and PEPFAR PMTCT indicators

	NATIONAL INDICATORS	
	I. NATIONAL COMMITMENT AND ACTION	
	NATIONAL COMMITMENT	
1	**Domestic and international AIDS spending by categories and financing sources**	**UNGASS #1**
2	**National Composite Policy Index (NCPI)** [Progress in the development and implementation of national level HIV and AIDS policies and strategies. Areas covered: strategic plan; political support; prevention; treatment, care and support; human rights; stigma and discrimination, civil society involvement; gender, most-at-risk populations, monitoring & evaluation]	**UNGASS #2**
	NATIONAL ACTION	
3	**Percentage of donated blood units screened for HIV in a quality-assured manner**	**UNGASS #3**
4	Percentage of health facilities with post-exposure prophylaxis available [disaggregated by exposure (occupational, non-occupational) and sector (public, private)]	Additional #1
5	Percentage of health facilities that offer ART (i.e., prescribe and/or provide clinical follow-up) [disaggregated by sector (public, private)]	Additional #2 **(PMTCT #1)**
6	Percentage of health facilities dispensing ARV that experienced a stock-out of at least one required ARV in the last 12 months [disaggregated by sector (public, private)]	Additional #3 **(PMTCT #2)**
7	Percentage of facilities providing ART using CD4 monitoring in line with national guidelines or policies, either on site or through referral [disaggregated by sector (public, private)]	Additional #4 **(PMTCT #3)**
8	**Percentage of adults and children with advanced HIV infection receiving antiretroviral therapy [disaggregated by sex (female, male) and age (<15, 15+)]**	**UNGASS #4**
9	**Percentage of HIV-infected pregnant women who received antiretroviral to reduce the risk of mother-to-child transmission**	**UNGASS #5 (PMTCT #4)**
10	**Percentage of estimated HIV-positive incident TB cases that received treatment for TB and HIV [disaggregated by sex (female, male)]**	**UNGASS #6**
11	**Percentage of women and men aged 15-49 who received an HIV test in the last 12 months and who know their results [disaggregated by sex (female, male) and age (15-19, 20-24, 25-49)]**	**UNGASS #7**
12	Percentage of sexually active young women and men aged 15-24 who received an HIV test in the last 12 months and who know their results [disaggregated by sex (female, male) and age (15-19, 20-24)]	Additional #5
13	**Percentage of most-at-risk populations (IDU, MSM, SW) who received an HIV test in the last 12 months and who know their results [disaggregated by sex (female, male), and age (<25, 25+)]**	**UNGASS #8**
14	Percentage of TB patients who had an HIV test result recorded in the TB register [disaggregated by sex (female, male), age (0-4, 5-14, 15 and above), and HIV status (positive, negative)]	Additional #6
15	Percentage of pregnant women who were tested for HIV and who know their results [disaggregated by service type (Antenatal Care, Labour & Delivery, Post-Partum)]	Additional #7 **(PMTCT #5)**

16	Percentage of infants born to HIV-infected women who received an HIV test within 12 months [disaggregated by type/timing of testing (virological testing within 2 months, virological testing between 2 and 12 months or antibody testing between 9 and 12 months)]	Additional #8 **(PMTCT #6)**
17	Percentage of infants born to HIV-infected women who are started on cotrimoxazole prophylaxis within two months of birth	Additional #9 **(PMTCT #7)**
18	**Percentage of most-at-risk populations (IDU, MSM, SW) reached with HIV-prevention programmes [disaggregated by most-at-risk population (IDU, MSM, SW), sex (female, male), and age (<25, 25+)]**	**UNGASS #9**
19	**Percentage of schools that provided life skills-based HIV education in the last academic year [disaggregated by level of education (primary education, secondary education)]**	**UNGASS #10**
20	**Current school attendance among orphans and non-orphans aged 10-14 [disaggregated by sex (female, male)]**	**UNGASS #11**
21	**Percentage of orphaned and vulnerable children aged 0-17 whose households received free basic external support in caring for the child**	**UNGASS #12**
22	Total number of male and female condoms available for distribution nation-wide during the last 12 months per person aged 15-19 [disaggregated by condom type (male, female)]	Additional#10
II. NATIONAL KNOWLEDGE AND BEHAVIOUR		
23	**Percentage of young women and men aged 15–24 who both correctly identify ways of preventing the sexual transmission of HIV and who reject major misconceptions about HIV transmission [disaggregated by sex (female, male) and age (15-19, 20-24)]**	**UNGASS #13**
24	**Percentage of most-at-risk populations (IDU, MSM, SW) who both correctly identify ways of preventing the sexual transmission of HIV and who reject major misconceptions about HIV transmission [disaggregated by sex (female, male) and age (<25, 25+)]**	**UNGASS #14**
25	Percentage of young women and men aged 15-24 who report they could get condoms on their own [disaggregated by sex (female, male) and age (15-19, 20-24)]	Additional #11
26	Percentage of never married young women and men aged 15-24 who have never had sex [disaggregated by sex (female, male) and age (15-19, 20-24)]	Additional #12
27	**Percentage of young women and men aged 15-24 who have had sexual intercourse before the age of 15 [disaggregated by sex (female, male) and age (15-19, 20-24)]**	**UNGASS #15**
28	**Percentage of women and men aged 15-49 who have had sexual intercourse with more than one partner in the last 12 months [disaggregated by sex (female, male) and age (15-19, 20-24, 25-49)]**	**UNGASS #16**
29	**Percentage of women and men aged 15-49 who have had more than one sexual partner in the last 12 months reporting the use of a condom during their last sexual intercourse [disaggregated by sex (female, male) and age (15-19, 20-24, 25-49)]**	**UNGASS #17**
30	**Percentage of female and male sex workers reporting the use of a condom with their most recent client [disaggregated by sex (female, male) and age (<25, 25+)]**	**UNGASS #18**
31	Percentage of men aged 15-49 reporting sex with a sex worker in the last 12 months who used a condom during last paid sexual intercourse [disaggregated by age (15-19, 20-24, 25-49) and population group (migrant worker, military, truck drivers, other)]	Additional #13

32	**Percentage of men reporting the use of a condom the last time they had anal sex with a male partner [disaggregated by age (<25, 25+)]**	**UNGASS #19**
33	**Percentage of injecting drug users reporting the use of a condom the last time they had sexual intercourse [disaggregated by sex (female, male) and age (<25, 25+)]**	**UNGASS #20**
34	**Percentage of injecting drug users reporting the use of sterile injecting equipment the last time they injected [disaggregated by sex (female, male) and age (<25, 25+)]**	**UNGASS #21**
35	Percentage of women and men aged 15-49 expressing accepting attitudes towards people living with HIV [disaggregated by sex (female, male), age (15-19, 20-24, 25-49), and education level (none, primary, secondary or higher)]	Additional #14
36	Percentage of children under the age of 18 who are orphans [disaggregated by sex (female, male), age (<5, 5-9, 10-14, 15-17), and type of orphan (maternal, paternal, double)]	Additional #15
37	**Percentage of young people aged 15-24 who are HIV-infected [disaggregated by age (15-19, 20-24)]**	**UNGASS #22**
38	**Percentage of most-at-risk populations (IDU, MSM, SW) who are HIV-infected [disaggregated by sex (female, male) and age (<25, 25+)]**	**UNGASS #23**
39	**Percentage of infants born to HIV-infected mothers who are infected**	**UNGASS #24 (PMTCT #8)**
40	**Percentage of adults and children with HIV still alive and known to be on treatment 12 months after initiation of antiretroviral therapy [disaggregated by sex (female, male) and age (<15, 15+)]**	**UNGASS #25**
Source: UNGASS[85] and PEPFAR[87]		

Appendix C: UNGASS PMTCT indicators

Process	Outputs
Percentage of health facilities that offer ART	*Percentage of pregnant women who were tested for HIV and who know their results*
Percentage of health facilities dispensing ARV that experienced a stock-out of at least one required ARV in the last 12 months	*Percentage of infants born to HIV-infected women who received an HIV test within 12 months*
	Percentage of infants born to HIV-infected women who are started on Cotrimoxazole prophylaxis within two months of birth
	Percentage of infants born to HIV-infected mothers who are infected
	Percentage of HIV-infected pregnant women who received antiretroviral to reduce the risk of mother-to-child transmission

Appendix D: Family Health International[*]

Output indicators
Number of HIV-positive women counselled on or referred to family planning
Percentage of HIV-positive women counselled on or referred to family planning
Number of women enrolled or referred to a comprehensive care programme
Percentage of all HIV-positive women enrolled or referred to a comprehensive care programme
Number of women who attend antenatal clinic (ANC) with PMTCT services for a new pregnancy
Number of women with known HIV infection among those seen at antenatal clinics that offer PMTCT services
Number of pregnant women attending at least one ANC visit at a PMTCT site who accept HIV testing
Percentage of women attending at least one ANC visit at a PMTCT site who accept HIV testing
Number of women testing positive for HIV
Percentage of women testing positive for HIV
Number of women testing positive who received HIV test result and post-test counselling
Percentage of women testing positive who received HIV test result and post-test counselling (stratified by serostatus)
Total number of HIV-positive women seen in the last quarter (previously known status and tested)
Number of all pregnant women counselled about PMTCT
Percentage of all women counselled about PMTCT
Number of HIV-positive women counselled about breastfeeding
Percentage of HIV-positive women counselled about breastfeeding

Appendix E: NDoH HIV/AIDS & STI NSP, 2007-2011, and Strategic Plan 2009-2014

Output indicators[66]
Proportion ANC clients tested for HIV
Nevirapine uptake rate among new-born babies of HIV+ women
Nevirapine uptake rate among pregnant HIV+ women
HIV prevalence (amongst 15-24 year old pregnant women)
Mother to child transmission rate of HIV
Percentage of eligible HIV positive women initiated on ART

Appendix F: PEPFAR PMTCT indicators

Outputs
Number of pregnant women with known HIV (includes women who were tested for HIV and received their results)
Number of HIV+ pregnant women who received antiretroviral to reduce risk of mother-to-child transmission during pregnancy and delivery
Number of health facilities providing ANC services that provide both HIV testing and ARVs for PMTCT on site
Number of HIV+ pregnant women assessed for ART eligibility through either clinical staging (using WHO clinical staging criteria) or CD4 testing
Number of HIV+ pregnant women newly enrolled into HIV care and support services
Percentage of infants born to HIV+ women who received an HIV test within 12 months of birth
Infants who received virological testing in the first 2 months
Infants that were tested either virologically between 2 and 12 months, or by serology between 9 and 12 months
Source: PEPFAR[87]

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[*] Family Health International. Monitoring HIV/AIDS Programs: A Facilitator's Training Guide. Core Module 1: Introduction to Monitoring and Evaluation. Arlington, (VA). 22201. Family Health International [Internet]. 2004. [cited 2014 April 23]. Available from: Available from http://www.fhi360.org/resource/monitoring-hivaids-programs

Appendix G: PRISM tools

1

(Objective 1F)

Burden of Disease
Research Unit

Evaluating the Process and Output Indicators for Maternal, Newborn and Child Survival in South Africa: a comparative study of PMTCT information systems in KwaZulu Natal and the Western Cape

Thank you for agreeing to answer these questions. This survey is part of a study to improve the Health Management Information systems supporting maternal and child health HIV/AIDS programmes. The objective of the survey is to help develop interventions for improving the routine health information systems (RHIS) and the use of information. Please express your opinion honestly. Your responses will remain confidential and will not be shared with anyone, except for presented table forms. We appreciate your assistance and co-operation in completing this study.

Routine Health Information System (RHIS)

Facility/Office Checklist
(Interview Facility Manager or person in charge of RHIS at the office)
Name of district:
Sub-district:
Function/Title:
Facility:
Type: (Hospital/Clinic/District office/Region office/Ministry RHIS unit, etc.)
Ownership (Public/Private/Mixed)
Name of the Assessor:
Date of Assessment:
Facility check list

(Interviewer: Please verify if the following equipment is available in the facility)

1. Equipment		
Hardware Equipment	**Total Quantity**	**How many are in working condition?**
a. Computers		
b. Data Back-up Unit (e.g. external Hard drive, CD, Flash drive)	0. No	1. Yes
c. Printers		
d. Modems		
e. Uninterrupted Power Supply (UPS)		
f. Generators		
g. Regular telephone		
h. Radio telephone		
i. Access to the internet		
j. Calculator		
k. Access to intranet		

2. Utilities		
a. Is there a continuous electricity supply?	0.No	1. Yes
b. How often is the electricity supply interrupted? 0. Never/occasionally 1. Once a month 2. Twice a month 3. Weekly 4. Daily		
c. Is the room, where the computer hardware is kept, air-conditioned? *(Observe)*	0.No	1. Yes
d. Is running water available in the facility? *(Observe)*	0.No	1. Yes

3. Availability of registers, forms		
List all types of record, report or register	**Have you run out of this form in the past 12 months? If 'yes', why?**	
a.	0.No	1. Yes *(why?)*
b.	0.No	1. Yes *(why?)*
c.	0.No	1. Yes *(why?)*
d.	0.No	1. Yes *(why?)*
e.	0.No	1. Yes *(why?)*

A-8

B. Organization of the health facility

B.1. Please list the total number of persons under each category below:

B.2. **Title/ post**	**Number**		**Number**
1. Medical officer		10. Health educator	
2. Comprehensive registered nurse		11. Health inspector	
3. Comprehensive nurse enrolled		12. Laboratory technician	
4. Nursing Assistance		13. Public health dental assistant	
5. Clinical officer		14. Anesthetic officer	
6. Laboratory Assistant		15. Midwife	
7. Health Assistant		16. Support staff	
8. Dispenser		17. Other (specify)	
9. Health information clerks			

B.3. Who fills in the Health Management Information System monthly reports? *Specify the codes from Q B.2.*

B.4. List those staff members who, within the past 3 years, received any training in the recording, processing, or reporting of health information, the number of trainings received, and the year of the latest training.

B.4.a. Title or Post (Coding from QB.2)	B.4.b. How many trainings courses/sessions did this person received in the last three years?	B.4.c. Year of last training?	B.4.d. Subjects of last training: 1. data collection 2. data analysis 3. Data display/report 4. 1&2 5. 1&3 6. 2&3 7. 1,2 & 3 8. other (specify)
1.			
2.			
3.			
4.			

BB1. Only for Staff at sub-District or Higher level

Staffing	
BB.1 Total number of persons working in district HMIS office, including sub-districts?	
BB.2 Total number of persons working in district HMIS office excluding sub-districts staff?	
BB.3 Total number of district and sub-district staff in district HMIS office trained to collect, verify and analyze information?	

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Burden of Disease
Research Unit

2
(Objective 1D)

Evaluating the Process and Output Indicators for Maternal, Newborn and Child Survival in South Africa: a comparative study of PMTCT information systems in KwaZulu Natal and the Western Cape

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Routine Health Information System Overview   **Overview of Information Systems in Health Sector**   (Interview HIS Manager at sub-district/district and sub-national level)
Level: ☐ Sub-national (district, province, etc)   Name (of district, province, etc) _____
Sub-district:
Function/Title:
Type: (Hospital/Clinic/District office/Region office/Ministry RHIS unit, etc.)
Name of the Assessor: Date of Assessment:
Mapping existing routine information systems in health sector (OPTIONAL)
Using sheet 1: "Information system mapping", list all routine information systems existing in the country/region/district.   This exercise will help you to understand types of health sector information that are included (or not included) by information systems. It will also help to identify duplication of information systems.   1) Write down specific names of the information systems.   2) Identify types of information covered by each system and check relevant boxes. You may also write comments in the box. For example, an information system for EPI may handle information on drug supplies but it might be limited to vaccines. You can indicate "vaccine only" in the box. Similarly, MCH specific information systems may collect information on service utilization of MCH services only.   3) Please describe how information from different information systems is shared. For example, between TB programs and HIV/AIDS programs   1

"Information system mapping"

2: Types of information handled by each system

Type of information system	Specific name if any	Service Utilization	Occurrence of selected disease(s)	Disease Outbreak (Immediate report)	Drug, contraceptive vaccine, stock	Human resources	Equipment/ Building	Vital Events	Others
Routine service based reporting system									
Epidemiological surveillance for notifiable infectious diseases									
Special program reporting systems (EPI)									
Special program reporting systems (TB)									
Special program reporting systems (Malaria)									
Special program reporting systems (HIV/AIDS)									
Special program reporting systems (MCH)									
Special program reporting systems (specify)									
Special program reporting systems (specify)	06								
Special program reporting systems (specify)									
Community Base information system									
Administrative system (Training)									
Administrative system (drugs, contraceptive, vaccine, logistics)									
Administrative system (Infrastructure, equipment, transport)									
Vital Registration									
Other system									

A-11

2. Data collection and transmission

Please list all data collection tools/forms that are used at the community/health facility level. If space is not enough, please add an additional sheet of paper.

Facility-based data collection tools: (such as patient registers)	Comments on tools. Is the form easy to use? Enough space to record data? Takes too much time?
• Outpatient register	
• Inpatient register	
• Baby register	
• ANC/HCT register	
• Maternity/Labour register	
• Facility staff meeting register	
•	
•	
•	
Data transmission/reporting forms	Comments on forms. Is the form easy to use? Enough space to record data? Takes too much time?
• Monthly reporting form	
• Quarterly reporting form	
• Disease outbreak form	
•	
•	

3. Information flowchart

Using the chart provided on the next page, illustrate the flow of information from community to health facility, health facility to sub-district level, sub-district level to district level, district level to provincial level, provincial level to national level. For each level, please indicate specific departments/job titles which should receive and process information received from a lower level.

This exercise will help you to clarify information flows in existing information systems and identify potential problems, which affect the performance of the information systems.

1) If some levels, e.g. community level and regional level are not relevant to systems that you are examining, please omit them from the exercise.

2) Please be as specific in identifying information sources and data transmission points as possible. For example, if different types of facilities have different reporting units at district level, you will want to indicate these different paths of information.

3) Add more than one information system to see interactions between information systems and how complicated or simple information flows are in your health system. You can see how basic routine health information system's information flow interacts with special program information systems such as EPI, HIV/AIDS, and Malaria.

4) You can be creative in indicating different information flows in different colors. For example, you can indicate the data aggregation process in red and the information feedback process in blue color. Or General RHIS in green and EPI in pink, etc.

Information flowchart

Levels	Information Flow Sheet							
	Types of Information Systems							
	HMIS	PMTCT	HIV/AIDS	TB	EPI	MCH	Administrative system (finance)	OTHERS
National Level								
Provincial Level								
District Level								
Sub-district Level								
Facility Level								
Community Level								

A-13

3

(Objective 2F)

Evaluating the Process and Output Indicators for Maternal, Newborn and Child Survival in South Africa: a comparative study of PMTCT information systems in KwaZulu Natal and the Western Cape

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Routine Health Information System (RHIS)
Performance Diagnostic Tool

Use of Information: Facility Assessment Form
Name of district:
Sub-district:
Function/Title:
Facility:
Type:
Name of the Assessor:
Date of Assessment:
Checking information use at the facility level

A-14

	RHIS report production			
FU1	Does this facility compile routine health information Data?	1.Yes	0.No	
FU2	Does the facility compile any report containing routine health information?	1.Yes	0.No	If 'No', go to FU4
	Frequency and type of RHIS report produced			
FU3	If yes, please list reports that contain data/information generated through the routine health information system (RHIS). Please indicate the frequency of these reports and the number of times the reports were actually issued during the last 12 months. Please confirm the issuance of the report by visually observing, counting and putting the number in column 3.			
	1. Title of the report	2. No. of times this report is supposed to be issued per year	3. No. of times this report actually has been issued during the last 12 months	
FU3a	Monthly			
FU3b	Quarterly			
FU3c	Annually			
FU3d				
FU4	During the last three month, did the facility receive any feedback report from district office on their performance using RHIS information?	1.Yes	0. No	
	Display of information in the facility			
FU5	Does the facility display the following data? Please indicate types of data displayed and whether the data have been updated for the last reporting period.			If 'No' go to FU6
	1. Indicator	2. Type of display *(Please tick)*	3. Updated	
FU5a	Related to maternal health	Table	1.Yes 0.No	
		Graph/Chart		
		Map/other		
FU5b	Related to child health	Table	1.Yes 0.No	
		Graph/Chart		
		Map/other		
FU5c	Facility Utilization	Table	1.Yes 0.No	
		Graph/Chart		
		Map/other		
FU5d	Disease surveillance	Table	1.Yes 0.No	
		Graph/Chart		
		Map/other		
FU6	Does the facility have a map of the catchment area?	1.Yes	0.No	

A-15

FU7	Does the office display a summary of demographic information such as population by target group(s)? *(Observe)*	1.Yes	0.No	
	Use of Information in available report at facility			
FU8	Is feedback, quarterly, yearly or any other report on routine health information system (RHIS) data available, which provides guidelines/ recommendations for actions? *(Observe)*	1.Yes	0.No	If 'No' go to FU10
FU9	If you answered yes to question FU8, what kinds of action-oriented decisions have been made in the reports (based on RHIS data)? Please check the boxes accordingly.			
	Types of decisions based on types of analyses			
FU9a	Review strategy by examining service performance target and actual performance from month to month	1.Yes	0.No	
FU9b	Review facility personnel responsibilities by comparing service targets and actual performance from month to month	1.Yes	0.No	
FU9c	Mobilization/shifting of resources based on comparison by services	1.Yes	0.No	
FU9d	Advocacy for more resources by showing gaps in ability to meet targets	1.Yes	0.No	
	Discussion and Decision based on RHIS information			
FU10	Does the facility have routine meetings for reviewing managerial or administrative matters?	1.Yes	0.No	If 'No', go to FU15
FU11	How frequently is the meeting supposed to take place? 4. Weekly 3. After every two weeks 2. Monthly 1. Quarterly 0. No schedule			
FU12	How many times did the meeting actually take place during the last three months? 12. 12 Times 11. Between 7 and 11 6. 6 Times 5. Either 4 or 5 3. 3 times 2. 2 Times 1. 1 Time 0. None			
FU13	Is an official record of management meetings maintained?	1.Yes	0.No	If 'No', go to FU15
FU14	If yes, please check the meeting records for the **last three months** to see if the following topics were discussed:			
FU14a	Management of RHIS, such as data quality, reporting, or timeliness of reporting	1.Yes, observed	0. No	
FU14b	Discussion on RHIS findings such as patient utilization, disease data, or service coverage, medicine stock out	1.Yes, observed	0. No	
FU14c	Have they made any decisions based on the above discussions?	1.Yes, observed	0. No	
FU14d	Has any follow-up action taken place regarding the decisions made during the previous meetings?	1.Yes, observed	0. No	
FU14e	Are there any RHIS related issues or problems that were referred	1.Yes,	0. No	

A-16

	to the district or regional level for actions?	observed		
Promotion and Use of RHIS information by the district/higher level				
FU15	Did the observed facility receive annual/monthly planned targets based on RHIS information	1.Yes	0.No	
FU16	Do facility records for the last three months show that district/senior management issued directives concerning the use of information	1.Yes	0.No	
FU17	Did the facility receive a district or national RHIS office newsletter or report in the last three month? If yes, did the report give examples of how information has been used successfully in last three months?	1.Yes	0.No	
FU18	Does documentation exist showing the use of information for advocacy purposes?	1.Yes	0.No	
FU19	Did the person in charge of the facility participate in meetings at district level to discuss RHIS performance over the last three months?	1.Yes	0.No	

FU20: Please give examples of how the facility uses RHIS information for health system management

0.   No examples   1. Yes *(details follows)*

………

………

………

Supervision by the district health office				
FU21	How many times did the sub-district/district supervisor visit your facility during the last three months? *(tick the answer)*	0. 1. 2 3. 4. >4.		If zero, go to FU26
FU22	Did you observe a supervisor having a checklist to assess data quality?	1.Yes	0.No	
FU23	Did the supervisor check the data quality?	1.Yes	0.No	
FU24	Did the district supervisor discuss your facility's performance based on the use of RHIS information when he/she visited your facility?	1.Yes	0.No	
FU25	Did the supervisor help you make a decision based on using information from the RHIS?	1.Yes	0.No	
FU26	Did the supervisor send a report/feedback/note on the last two supervisory visits?	1.Yes	0.No	

A-17

4

(Objective 2D)

Evaluating the Process and Output Indicators for Maternal, Newborn and Child Survival in South Africa: a comparative study of PMTCT information systems in KwaZulu Natal and the Western Cape

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**Routine Health Information System (RHIS)
Performance Diagnostic Tool**

Use of Information Sub-district/District Assessment Form
Name of district:
Name of Sub-district:
Function/Title:
Name of the Assessor:
Date of Assessment:
Assessing the use of information at the sub-district/district level

A-18

	RHIS report production			
DU1	Does this district office compile routine health information data submitted by facilities/sub-districts?	1.Yes		0.No
DU2	Does the sub-district/district issue any report containing routine health information?	1.Yes	0.No	If "No", go to DU4

	Types of RHIS Reports produced and their frequency			
DU3	If "Yes", please list reports that contain data/information generated through the routine health information system (RHIS). Please indicate the frequency of these reports and the number of times the reports actually were issued during the last 12 months. Please confirm the issuance of the report by counting them and putting the number in column 3.			
	1. Title of the report	2.No. of times this report is supposed to be issued per year	3. No. of times this report is actually issued for the last 12 months	
DU3a	Monthly			
DU3b	Quarterly			
DU3c	Annually			
DU3d				
DU3e				
DU4	Did the sub-district/district office send a feedback report using RHIS information to facilities/sub-district during the last three months?	1.Yes	0.No	

	Display of information			
DU5	Does the sub-district/district office display the following data? Please indicate the types of data displayed and whether the data are updated for the last reporting period. *(Observe)*			If no go to DU6
	1.Indicator	2.Type of display *(Please tick)*		3. Updated
DU5a	Related to mother's health	Table		1.Yes	0.No
		Graph/Chart			
		Map			
DU5b	Related to child health	Table		1.Yes	0.No
		Graph/Chart			
		Map			
DU5c	Facility Utilization	Table		1.Yes	0.No
		Graph/Chart			
		Map			
DU5d	Disease surveillance	Table		1.Yes	0.No
		Graph/Chart			
		Map			

A-19

DU6	Does the office have a map of the catchment area? *(Observe)*	1.Yes		0.No
DU7	Does the office display a summary of demographic information such as population by target group(s)? *(Observe)*	1.Yes		0.No
Use of Information in available Reports at the sub-district or Higher level				
DU8	Is feedback, quarterly, yearly or any other report on RHIS data available, which provides guidelines/ recommendations for actions? *(Observe)*	1.Yes	0.No	If no go to DU10
DU9	If yes to DU8, what kinds of decisions are made in reports of RHIS data/information for actions? Please check types of decision based on types of analysis present in reports. *(Observe)*			
Types of decisions based on types of analysis				
DU9a	Appreciation and acknowledgement based on number/percentage of facilities showing performance within control limits over time (month to month comparisons) *(Observe that the report(s) provides appreciation for those facilities that are performing well)*	1.Yes		0.No
DU9b	Mobilization/shifting of resources based on comparison by facilities *(Observe the report contains analysis that compares the performance of the facilities over time.)*	1.Yes		0.No
DU9c	Advocacy for more resources by comparing performance by areas (sub-districts, cities, villages), human resources and logistics. *(Observe whether the report shows any kind of advocacy to ask for more resources from higher levels, the community, or other external sources)*	1.Yes		0.No
DU9d	Development and revision of policies by comparing types of services. *(Observe whether the report shows that a decision was made to revise a policy or to develop a new policy.)*	1.Yes		0.No
Discussion and decisions about use of information				
DU10	Does the district office have routine meetings for reviewing managerial or administrative matters?	1.Yes		0.No
DU11	How frequently is the meeting supposed to take place? Circle appropriate answer 4. Weekly 3. After every two weeks 2. Monthly 1. Quarterly 0. No schedule			
DU12	How many times did the meeting take place during the last three months? Circle appropriate answer. 12. 12 Times 11. Between 7 and 11 6. 6 Times 5. Either 4 or 5 3. 3 Times 2. 2 Times 1. 1 Time 0. None			

A-20

DU13	Is an official record of management meetings maintained?	1.Yes	0.No	If no, go to DU15
DU14	If yes, please check the meeting records for the last three months to see if the following topics were discussed:			
DU14a	Management of RHIS, such as data quality, reporting, or timeliness of reporting.	1.Yes, *observed*	0. No	
DU14b	Discussion about RHIS findings such as patient utilization, disease data, or service coverage, or medicine stock out.	1.Yes, *observed*	0. No	
DU14c	Have they made any decisions based on the above discussions?	1.Yes, *observed*	0. No	
DU14d	Has any follow-up action taken place on the decisions made during the previous meetings?	1.Yes, *observed*	0. No	
DU14e	Are there any RHIS related issues/problems referred to regional/national level for actions?	1.Yes, *observed*	0. No	
	Promotion and Use of RHIS information at sub-district/higher level			
DU15	Did the district annual action plan show that decisions were made based on HIS information? *(Verify from the report that RHIS information is used during annual planning.)*	1.Yes	0.No	
DU16	Did District office records from the previous three months show that district/senior management issued directives based on the use of information? *(Verify)*	1.Yes	0.No	
DU17	Did the district or national RHIS office publish a newsletter/report in last three months that include use of information success stories? *(Verify if a report exists then validate that news of RHIS information success stories were published.)*	1.Yes	0.No	
DU18	Does the office have documentation showing that RHIS information is used for advocacy? *(Verify from report.)*	1.Yes	0.No	
DU19	Do district staff meeting records show that those in charge of health facilities attended meetings that focus on RHIS performance at their facilities? *(Verify from report.)*	1.Yes	0.No	

DU20: Please give examples of how the sub-district/district office uses RHIS information for health system management.

                0. No examples   1. Yes *(record details below)*

……

……

……

……

6

(Objective 3D)

**Burden of Disease
Research Unit**

Evaluating the Process and Output Indicators for Maternal, Newborn and Child Survival in South Africa: a comparative study of PMTCT information systems in KwaZulu Natal and the Western Cape

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Routine Health Information system (RHIS)
Performance Diagnostic Tool

Quality of Data Assessment: Sub-District/District Office Form
Name of district:
Sub-district:
Function/Title:
Name of the Assessor:
Date of Assessment:
Checking data quality at the sub-district/district levels

	Data Transmission			
DQ 1	Does the sub-district/district office keep copy of RHIS monthly reports sent by health facilities?	1.Yes		0.No
DQ 2	What is the number of facilities in the sub-district/district that are supposed to be reporting to/enrolled in RHIS?			
DQ 3	What is the number of facilities in the sub-district/district that are actually reporting to/enrolled in RHIS?			
DQ 4	Count number of monthly reports for the selected two months available at the sub-district/district office	a. month		b. month
DQ 5	What is the deadline for the submission of the RHIS monthly report by facility/sub-district?			If no deadline is set, write no and go to Q8
DQ 6	Does the sub-district/district office record receipt dates of RHIS monthly report?	1.Yes	0.No	If receipt dates are not recorded, go to Q8

	If DQ6 yes, check the dates of receipts for the selected months (same as in Q4).				
DQ 7		a. Month (specify)		b. Month (specify)	
	Item	1. Before deadline	2. After deadline	3. Before deadline	4. After deadline
	Number of facilities/Sub-districts				

DQ 8	Does sub-district/district have a record of people who receive monthly report data by a certain deadline after receiving monthly report from the facilities?	1.Yes		0.No
DQ 9	Does sub-district/district have a record of submitting data on time to district/provincial levels?	1.Yes		0.No

	Data Accuracy Check						
	Manually count the number of the following data items/elements from the RHIS monthly reports for the two months under review. Compare the figures with the reports from the computer.						
DQ 10		Month A (specify)			Month B (specify)		
	Item	Manual count	Computer	Match	Manual count	Computer	Match
DQ A							
DQ B							
DQ C							
DQ D							
DQ E							
DQ F							

A-23

	Data Processing/Analysis			
DQ 11	Does a database exist to enter and process data?	0. No	1. Yes, by manual	2. Yes, by computer
DQ 12	Does the database produce the following:			
DQ 12A	Calculate indicators for each facility catchment area?	1.Yes	0.No	
DQ 12B	Data summary report for the district?	1.Yes	0.No	
DQ 12C	Comparisons among facilities?	1.Yes	0.No	
DQ 12D	Comparisons with district/national targets?	1.Yes	0.No	
DQ 12E	Comparisons among types of services coverage?	1.Yes	0.No	
DQ 12F	Comparisons of data over time (monitoring over time)	1.Yes	0.No	

RHIS Registers, Data Collection Forms, Information Technology

DQ13	Do you think that RHIS procedure manual is user-friendly?	1.Yes	0.No	
DQ 14	Do you think that monthly report form is complex and difficult to follow?	0.yes	1.No	
DQ 15	Do you find the data software user-friendly?	1.Yes	0.No	
DQ 16	Do you find that information technology is easy to manage?	1.Yes	0.No	
DQ 17	Do you think that the information system design provide comprehensive picture of health system performance?	1.Yes	0.No	
DQ 18	Do you think existing RHIS gather information that is also included in other information systems?	1.Yes	0.No	
DQ 19	Does a software or data warehouse exist that integrates data from different information systems?	1.Yes	0.No	
DQ 20	Does the information technology (Local Area Network [LAN] or wireless network) exist to provide access to information to all district managers and senior management?	1.Yes partially	2.Yes completely	0.No

A-24

5

(Objective 3F)

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Research Unit

Evaluating the Process and Output Indicators for Maternal, Newborn and Child Survival in South Africa: a comparative study of PMTCT information systems in KwaZulu Natal and the Western Cape

Thank you for agreeing to answer these questions. This survey is part of a study to improve the Health Management Information systems supporting maternal and child health HIV/AIDS programmes. The objective of the survey is to help develop interventions for improving the routine health information systems and the use of information. Please express your opinion honestly. Your responses will remain confidential and will not be shared with anyone, except for presented table forms. We appreciate your assistance and co-operation in completing this study.

RHIS Performance Diagnostic Tool

Quality of Data Assessment: Health Facility Form
Name of district
Sub-district:
Function/Title:
Facility:
Type:
Name of the Assessor:
Date of Assessment:
Checking data quality at the facility level

Data Recording				
Data Recording				
FQ1	Does this facility keep copies of Routine Health Information System (RHIS) monthly/quarterly reports, which are sent to the sub-district/district office?	1.Yes	0.No	If 'No', go to FQ3
FQ2	Count the number of RHIS monthly/quarterly reports that have been kept at the facility for the last 12 months	#:		
FQ3	Does this facility keep outpatient register?	1.Yes	0.No	If 'No', go to FQ5

<table>
<tr><td colspan="5" align="center">Data Accuracy Check</td></tr>
<tr><td>FQ4</td><td colspan="4">Using the outpatient register, fill in the following information for any two months (Month A and Month B). If the facility does not keep copies of the monthly report, obtain copies at the sub-district/district office. Compare the figures with the computer-generated reports.</td></tr>
</table>

Item	January 2012		April 2012	
	# from register	# from report	# from register	# from report
FQ4a	*Baby given Nevirapine within 72 hours after birth*			
FQ4b	*Antenatal client HIV re-test at 32 weeks*			
FQ4c	*Baby PCR test around 6 weeks*			
FQ4d	*HIV exposed babies initiated on Cotrimoxazole prophylaxis around 6 weeks*			
FQ4e	*Antenatal client HIV 1st test*			
FQ4f	*Antenatal client initiated on HAART*			

Routine Health Information System (RHIS) Processes			
Routine Health Information System (RHIS) Processes			
FQ 5	Did you receive a directive in the last three months from the Senior Management in the district office to:		
FQ5a	Check the accuracy of data at least once in three months?	1.Yes, *Observed*	0. No
FQ5b	Fill the monthly/quarterly report form completely?	1.Yes, *Observed*	0. No
FQ5c	Submit the report by a declared deadline?	1.Yes, *Observed*	0. No
FQ 6	During the last three months, did you receive notification from the Senior Management in the sub-district/district office that there will be consequences for not adhering to the following directives:		
FQ6a	If you do not check the accuracy of data?	1.Yes, *Observed*	0. No
FQ6b	If you do not fill the monthly reporting forms completely?	1.Yes, *Observed*	0. No
FQ6c	If you do not submit the monthly report by the specific deadline?	1.Yes, *Observed*	0. No

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		Data Completeness		
FQ 7	How many data elements does the facility need to report on in the RHIS monthly report? Excludes data elements for services not provided by this health facility.		#:	
FQ 8	Count the number of data elements that are supposed to be filled in by this facility but left blank without indicating "0" in the selected month's report.		#:	

		Data Transmission, Processing and Analysis		
FQ 9	Do data processing procedures or a tally sheet exist?		1. Yes, *Observed*	0. No
FQ 10	Does the facility produce the following:			
FQ10a	Calculate indicators for the facility catchment area		1. Yes, *Observed*	0. No
FQ10b	Comparisons with district/national targets		1. Yes, *Observed*	0. No
FQ10c	Comparisons among types of services coverage		1. Yes, *Observed*	0. No
FQ10d	Comparisons of data over time (monitoring over time)		1. Yes, *Observed*	0. No
FQ 11	Does a procedure manual for data collection (with definitions) exist?		1. Yes, *Observed*	0. No

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Burden of Disease
Research Unit

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(Objective 4D)

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RHIS Management Assessment Tool
(Observation at sub-district and higher levels)
MAT3. Name of district:
Sub-district:
Function/Title:
MAT1. Name of Facility:
Type: (Hospital/Clinic/District office/Region office/Ministry RHIS unit, etc.)
Ownership (Public/Private/Mixed)
MAT2. Name of the Assessor:
MAT4: Date of Assessment:
MAT – Sub-District/District

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	Governance			
MATG1	Is Routine Health Information System (RHIS) Mission statement displayed at prominent position(s)? *(Observe)*		0 No	1 Yes
MATG2	Presence of management structure for dealing with RHIS-related strategic and policy decisions at district and higher levels. *(Observe)*		0 No	1 Yes
MATG3	Presence of an updated (within the last year) district health management organizational chart, showing functions related to RHIS/health information. *(Observe)*		0 No	1 Yes
MATG4	Is there a documentation (e.g. a distribution list), which shows that the most recent RHIS monthly/quarterly report has been disseminated? *(Observe)*		0 No	1 Yes
	Planning			
MATP1	Presence of recent (written within the last 3nyears) RHIS situation analysis. *(Observe)*		0 No	1 Yes
MATP2	Presence of RHIS 5-year plan at sub-district or higher level. *(Observe)*		0 No	1 Yes
MATP3	Presence of RHIS targets at sub-district and higher level *(Observe)*		0 No	1 Yes
	Quality Standards			
MATQ1	Presence of a copy of RHIS standards (SOP) at sub-district or higher levels *(Observe)*		0 No	1 Yes
MATQ2	Presence of performance improvement tools (flow chart, control chart etc.) at the facility*(Observe)*		0 No	1 Yes
	Training			
MATT1	Does sub-district/district have a RHIS training manual?*(Observe)*		0 No	1 Yes
MATT2	Presence of mechanisms for on-job RHIS training at sub-district/district level. *(observe)*		0 No	1 Yes
MATT3	Presence of schedule for planned training *(Observe)*	0 No	1. Yes, for one year	2. Yes, for 2 years or more
	Supervision			
MATS1	Presence of RHIS supervisory checklist *(Observe)*		0 No	1 Yes
MATS2	Presence of schedule for RHIS supervisory visit *(Observe)*		0 No	1 Yes
MATS3	Presence of supervisory reports *(Observe)*		0 No	1 Yes

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		Finance		
MATF1	Presence of RHIS-related expense register *(Observe)*		0 No	1 Yes
MATF2	Presence of mechanisms for RHIS-generating funds *(Observe)*		0 No	1 Yes
MATF3	Presence of RHIS monthly/quarterly financial report *(Observe)*		0 No	1 Yes
MATF4	Presence of long-term financial plan for supporting RHIS activities *(Observe)*		0 No	1 Yes

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(Objective 4F)

Burden of Disease Research Unit

Evaluating the Process and Output Indicators for Maternal, Newborn and Child Survival in South Africa: a comparative study of PMTCT information systems in KwaZulu Natal and the Western Cape

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Management Assessment Tool
(Observation at facility)
MAT3. Name of district:
Sub-district:
Function/Title:
MAT1. Name of Facility:
Type: (Hospital/Clinic/District office/Region office/Ministry RHIS unit, etc.)
Ownership (Public/Private/Mixed)
MAT2. Name of Assessor:
MAT4. Date of Assessment:
MAT - facility

	Governance			
MATG1	Is the district's Routine Health Information System's (RHIS) Mission statement displayed at prominent position(s) *(Observe)*		0 No	1 Yes
MATG2	Presence of management structure for dealing with RHIS-related strategic and policy decisions at district and higher levels.*(Observe)*		0 No	1 Yes
MATG3	Presence of an updated (within the last year) district health management organizational chart, showing functions related to RHIS/health information.*(Observe)*		0 No	1 Yes
	Planning			
MATP1	Presence of recent (written within the last 3 years) RHIS situation analysis. *(Observe)*		0 No	1 Yes
MATP2	Presence of Routine Health Information System (RHIS) targets at facility level *(Observe)*		0 No	1 Yes
	Quality Standards			
MATQ1	Presence of a copy of RHIS standards (SOP) at facility *(Observe)*		0 No	1 Yes
MATQ2	Presence of performance improvement tools (flow chart, control chart etc.) at the facility*(Observe)*		0 No	1 Yes
	Training			
MATT1	Does facility have a RHIS training manual?*(Observe)*		0 No	1 Yes
MATT2	Presence of schedule for planned training *(Observe)*	0 No	1. Yes, for one year	2. Yes, for 2 years or more
	Supervision			
MATS1	Presence of RHIS supervisory checklist *(Observe)*		0 No	1 Yes
MATS2	Presence of schedule for RHIS supervisory visit *(Observe)*		0 No	1 Yes
MATS3	Presence of supervisory reports *(Observe)*		0 No	1 Yes
	Finance			
MATF1	Presence of RHIS-related expense register *(Observe)*		0 No	1 Yes
MATF3	Presence of RHIS monthly/quarterly financial report *(Observe)*		0 No	1 Yes

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Appendix H: Survey operational manual

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OPERATIONAL MANUAL

A comparative study of the Prevention of Mother to Child Transmission (PMTCT) of HIV information systems in KwaZulu Natal and the Western Cape

Burden of Disease Research Unit
Medical Research Council

July

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<u>Investigators and Project Support</u>

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I.	Detailed fieldwork plan for Phase I & II
II.	Fieldwork teams and contact details
III.	Letters of Approvals
IV.	Survey instrument
V.	PMTCT priority data elements and definition
VI.	Immunization priority data elements and definition
VII.	PRISM User Guide

1. RESEARCH PROTOCOL (SUMMARY)

Introduction

Systems have been put in place to scale up coverage of interventions that have been proven to be effective in reducing maternal, new-born and child survival in South Africa. Unfortunately, these interventions are not reaching those that need them. Yet, tracking coverage of these interventions is challenging, due to a lack of accurate and reliable data at the district and provincial levels

The U.S. President's Emergency Plan for AIDS Relief (PEPFAR) has made substantial investment in information systems to support various components of HIV prevention and care. Yet such investments have not necessarily impacted on routine health information systems. An attempt to assess trends in coverage of key high impact maternal, new-born and child survival interventions identified in *Countdown to 2015* initiative, has identified several data gaps as well as data quality issues. A study conducted in 2007 also found that the routine statistics from three large, high HIV-prevalence districts were neither complete nor accurate. The authors of this study concluded that the routine data were not a viable means to track process performance or outcomes for PMTCT.

The South African National Department of Health has developed a District Health Information System (DHIS) to collect monthly facility based data. Audits of the human resources and equipment have been undertaken but there has not been a comprehensive evaluation.

Objective

This study seeks to address the following research questions:

- How does the Health Management Information System function and how can it be strengthened to make it more supportive of the PMTCT programmes in maternal, new-born and child health?
- What can be done to improve the quality of reporting and analysis of HIV programme performance at the health facility level using the District Health Information System?
- What are the main causes of lack of information for management, and why are the gaps occurring? Are these gaps structural, or a result of breakdown in data flow from the health facilities to the districts, or a result of inaccurate and incomplete reporting, or lack of analysis of data, or limited usage by health care providers and managers?

Overall Goal

The main goal of this study is to evaluate the availability, quality and use of process and output indicators for monitoring and evaluating HIV interventions in maternal, new-born and child health, and to identify the information challenges in monitoring PMTCT programme in KwaZulu Natal and the Western Cape.

Specific objectives

I. To map the routine health information system in two districts (Amajuba and the Eastern region of the Cape Metro/City of Cape Town), investigate what is currently being used in monitoring progress on HIV programmes in maternal, new-born and child health and identify information gaps at different levels

II. To investigate use and barriers to the use of health information for monitoring progress on maternal and child health HIV indicators.

III. To measure the performance of the district health information system for process and output indicators in relation to data quality measured in terms of data accuracy, completeness, and timeliness at both the facility and district levels

IV. To assess the behavioural and organisational determinants affecting the District Health Management Information System's performance

Study Design

The study design is a comparative retrospective and an analytical observational study relying on both quantitative and qualitative methods of data collection, which will include facility level information, Health worker survey of use of information, knowledge, attitudes, and behaviours, and to determine the levels of the routine health information systems management support service, and how these affect the behavioural factors.

The quantitative methods will be used to assess data quality in relation to completeness, timeliness, vertical and horizontal transmission, data processing, analysis, accuracy and the reporting formats, while qualitative methods will include In-depth interviews with key informants, and observational study in selected health facilities.

Outcomes

The results of this study are expected to contribute to knowledge that seeks to strengthen the routine health information system to address MDG's 4 and 5 in South Africa. It will also improve the quality of reporting and provide accurate and reliable statistics, and ensure that the necessary information to measure maternal, new-born and child survival programme performance indicators are being collected at the facility, district and provincial levels. This will be achieved by identifying the barriers in PMTCT programmes in terms of data availability,

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data quality and use of information and the development of tools for assessing Maternal and Child Health HIV data quality, completeness, accuracy, data flow and information use. The findings of this study will be very useful to inform policy makers, and consequently lead to a reduction in the high levels of maternal, new-born and child morbidity and mortality currently experienced in the country.

Intended Feedback

Findings will be compiled in a report and thesis and presented to the National Department of Health, and the faculty of Health Sciences, Stellenbosch University. Thereafter the results will be published in a peer reviewed journal and presented at conferences and will form the basis for recommendations on strengthening the information system by targeting service providers and decision makers.

2. SURVEY ORGANOGRAM

This study will pool the expertise of several organisations namely; the MRC Burden of Disease Research Unit and Community Health division, Stellenbosch University (Figure 1).

Figure 1. Project Team Organogram
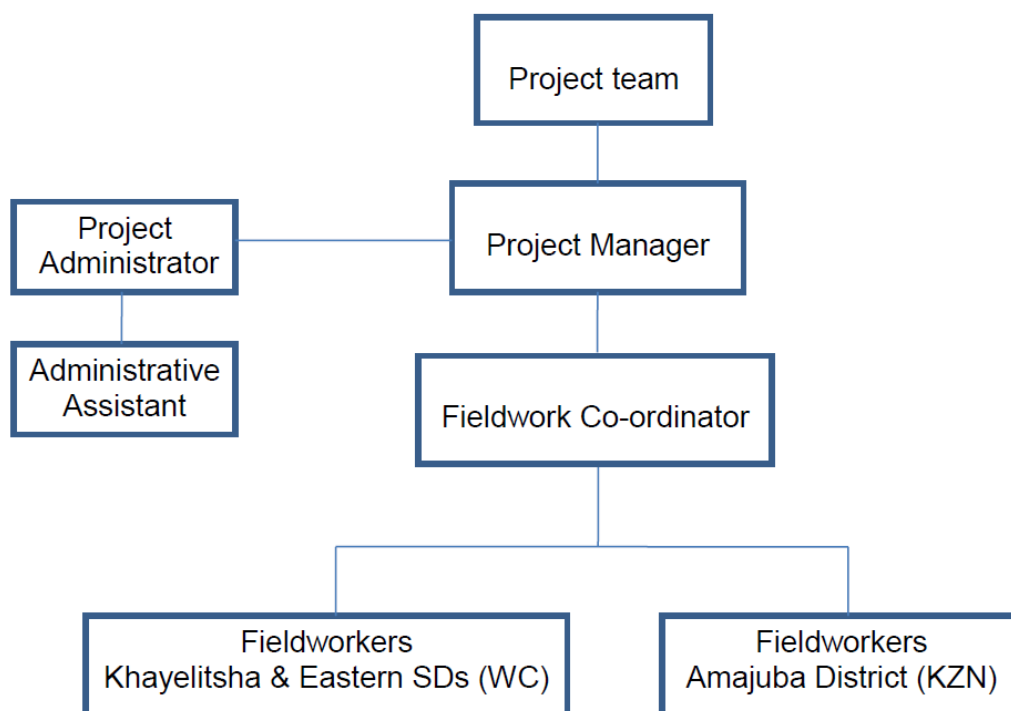
3. STUDY POPULATION

The study population will include health information officers, health facility managers, staff involved in data collection at facility and district levels, PMTCT programme managers, monitoring and evaluation officers and district managers responsible for the sub-districts included in the study.

4. SAMPLE SIZE ESTIMATION

A convenience sampling method was used to select two health districts, each incorporating one of the eighteen priority sub-districts identified by the National Department of Health (NDOH), i.e. Khayelitsha in the Cape Metro/City of Cape Town district, Western Cape Province and Dannhauser in Amajuba district, KwaZulu Natal province.

All the 28 health facilities in Amajuba district and the 32 health facilities in the Eastern region of the Cape Metro comprising of Khayelitsha and the Eastern sub-districts will be included in the study. A total of 60 health facilities will be surveyed and the PMTCT, Monitoring & Evaluation, the facility and Health information managers in the two districts will be interviewed. The expected numbers of facilities to be surveyed is reported in Table I.

Table 1: Number of facilities selected per province and expected number of personnel to be interviewed

Province	Provincial Info Officer	District Manager	SD Managers	DIO	Facility Managers	Data Capturers	Total # of interviews
KZN	1	-	-	-	28	56	85
WC	-	1	1	1	32	64	96
Total	-	1	1	1	60	120	181

5. FIELDWORK TEAMS

A total of 4 fieldworkers will be recruited across 2 provinces (Table 2). Fieldworkers will work in pairs of two per team, and each team will have a supervisor who will manage the fieldwork.

Table 2: Fieldwork teams

Phase	Region	Language required	Number of Fieldworkers	ESTIMATED days of work
PHASE 1	Cape Town (RA)	Eng, Xhosa & Afr	1	180
	Cape Town (FW)	Eng, Xhosa & Afr	1	40
PHASE 2	Newcastle (FW)	Eng, Zulu & Afr	2	40
Total			4	260

Eng= English; Afr=Afrikaans; RA=Research Assistant; FW=Fieldworker

Appendix I contains the detailed Fieldwork plans for Phase I and Phase II of the study.

See **Appendix II** for contact details of the fieldworkers.

6. FIELDWORK PROTOCOLS

Principles of fieldwork

There are generic good fieldwork practices and principles that should be followed during all fieldwork to enable you to acquire high quality field data and observations.

- **Respect for human dignity.**
- **All information is to be treated as confidential.**
- **Punctuality** at health facility visits. All facilities being visited have Staff performing their duties, set working times, and are rendering services. This has to be respected at all times.
- All fieldworkers must have their **PRISM User Guide, This Operational Manual** and their **cell phone** and their **project identification** with them at all times during field visits.
- Fieldworkers **must have excellent understanding** and **skill to complete the survey tools** as well as a thorough understanding of the **"PMTCT and Immunization data element and Definitions"** and the **"PRISM Survey instruments"**.

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- Data that is collected must be **accurate** and **factual** and captured as stated in the registers/records. Difficult cases should be discussed with supervisors and if necessary the project manager.
- **Professional team work** requires open communication, listening and respecting all team members. Treat people the way that you would like to be treated yourself.

Roles and responsibilities of the fieldworkers

Duties of Fieldworkers:

- Observe professional code of **conduct** and **dress** at all times;
- Locate selected facilities within their sub districts before commencing fieldwork;
- Be punctual when arriving at the facilities at the appointed time as agreed with the facility manager;
- Find the following registers: **Baby, Labour ward/Maternity/MOU, Antenatal Care (ANC) and Immunisation registers**, and correctly identify data elements from the registers, after which they should be returned back to the staff;
- Administer questionnaires to facility personnel
- Follow the data capturing processes and steps diligently as outlined in the PRISM User Guide;
- Refer to this **Operational manual** and the **PRISM User Guide** if not clear on any questions in the instrument, however if you are still not clear, discuss this with either the co-ordinator or the project manager;
- Attend weekly debriefing sessions (which may be telephonic);
- Liaise with supervisors regarding meeting times, transport, money claims or any other problems related to work.

Duties of the Supervisors:

In addition to the fieldworker duties above, the supervisors should:

- Gain access to registers and monthly reports by negotiating a working agreement with the facility managers and administrators;
- Locate the selected facilities within their sub-districts before commencing fieldwork;
- Co-ordinate activities within the team;
- Ensure that your team arrive at facilities on pre-arranged dates and times;
- Report access challenges or any other issues to the national co-ordinator;
- Establish good rapport and work ethic with the team and the facility staff;
- Ensure correct and fairly shared workload within the team;

- Ensure and maintain quality data capturing and collection;
- Advise fieldworkers on difficult cases and check with national co-ordinator if necessary;
- Submit photographic queries to national co-ordinator if necessary;
- Be familiar with Annexures I, II and III for administrative purposes;
- Plan, attend and oversee weekly debriefing sessions;
- Having daily debriefing sessions with co-ordinator/project manager (telephonically)
- Liaise with national co-ordinator with regard to on-going progress and any problems arising in the field.

Duties of the Fieldwork Co-ordinator:

- Liaise with relevant provincial authorities and facility managers;
- Manage and coordinate data collection teams and activities;
- To ensure on-going quality control of data collection;
- Address all fieldwork challenges and queries;
- Be familiar with all the policies and procedures related to the project;
- Provide on-going assistance to the teams and their supervisors;
- Keep Project Manager informed of on-going progress.

7. ETHICAL CONSIDERATIONS

Since information will be obtained from patient and facility records, informed consent from patients is not necessary. However, permission to access the data and health facilities has been granted by the relevant health authorities. Information about the study will be provided to health workers included in the study and consent must be obtained from them. Personal health details will not be collected in this study. Nonetheless, the **importance of confidentiality has been stressed during the fieldworker training and** a signed under-taking must be made by each fieldworker whereby they agree not to divulge any information that they view in patients registers/folders verbally, in writing, photo's or any other means of communication (Inquest Act 58, 1959) outside the scope of this survey. This means that fieldworkers may not discuss the details of any case with anybody other than their supervisor, and the Project Manager or in a de-briefing session. Fieldworkers must be aware that *sanctions will be taken if confidentiality is breached.* The study has been approved by the University of Stellenbosch Health Research Ethics Committee. (Ethics reference number: N10/10/322). See **Appendix III** for letters of approval from relevant health authorities.

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8. FIELDWORK ADMINISTRATION

Access to Health facilities

Permissions to enter the selected health facilities have been arranged and letters have been obtained from the Provincial Departments of Health. Copies of these letters are provided in each Supervisor Pack.

The supervisor of the team must make contact with the facility manager at least a day before the team plans to visit the clinics. The supervisor must indicate all the dates, times and duration of the visits as well as the number of team members that will be attending. The supervisor must contact the facility manager in advance to enquire if an electronic register is available at the facility. Arrangements should be made for a person to be available to help the team access information from the paper/computer based clinic register/Routine Monthly reports. Contact details for the facilities are provided in the Supervisor Pack.

All arrangements made with the facility managers need to be adhered to by the team. If for some reason the team cannot adhere to agreed arrangement, the supervisor is responsible for communicating with the facility manager beforehand and rescheduling the visit. Punctuality is to be observed at all times.

NB: Each team supervisor must have copies of the permission letters, i.e. the **Stellenbosch University Ethics approval**, and letters of approval from each of **the Provincial Departments of Health (KwaZulu Natal and the Western Cape).** You may be required to produce these at the health facilities.

Navigation to selected health facilities

The supervisor and their teams must discuss beforehand the collection points and what the collection times will be.

The directions to the selected clinics must be checked and routes planned in advance by the supervisor. Navigation maps for each clinics and a route map are included in each Supervisor Pack.

Checklist before leaving for Health facilities

- Phone battery is fully charged and that you have your phone with you
- You have the PRISM User Guide
- This Operational Manual
- You have sufficient copies of the questionnaires with you
- You have sharp pencils and a rubber
- Calculator/cell phone
- You have your project identification

Accident or injury

Safety is our primary concern. **Safe driving practices must be used at all times. Road regulations must be followed at all times.** Should there be an accident or an injury on duty, contact Ms Elize de Kock.

Safeguarding property

Cellular phones and vehicles used in the project are to be safeguarded and precautionary measures must be applied to ensure the safety of these assets during the project. MRC policy states that "the **user** will accept responsibility and undertake to exercise all reasonable precautions for the safety of all items in his/her care, whether used on or off site". Should there be a theft, contact Ms Elize de Kock and notify the police.

Financial Administration

Payment for the work is based on satisfactory completion of the questionnaires, in addition to the daily log sheet maintained by the supervisor, and the submission of a completed Contractors Claim form faxed to the MRC 021-938 0310 and marked attn Ms Elize de Kock (KZN), before the processing due dates (included in the contract package).

The work hours will be monitored in terms of the data captured. Time for travel cannot be claimed unless the travel time to the clinics is longer than 1 hour. In this case, the first half an hour will be considered usual time to get to work and cannot be claimed. Distances to clinics have been factored into the planning. An hour a week can be claimed for the compulsory debriefing session, and another hour for the supervisor in KZN to send the filled questionnaires to MRC, Cape Town by courier or registered mail. Mail costs can also be claimed.

Each team will be provided with the use of a car to transport everybody to the health facilities to collect the data. Each team will need to make transport arrangements with the supervisor each day. Supervisors will be given an advance for petrol. A travel log will be kept by the

supervisor. At the end of the fieldwork, a claim (MRC 33) with the travel log and all receipts must be submitted. This can be faxed to the MRC 021-938 0310 marked attn Ms Elize de Kock, and the original sent by courier or registered mail. Mail costs can be claimed. Should a second advance be required, the first advance needs to be reconciled (submit MRC 33 with evidence).

An initial airtime voucher (R55) will be provided to each Supervisor which may require top-up.

All receipts and documents for claims regarding

- Hours worked (refer to contractor's claim form in supervisor pack)
- Transport costs (refer to MRC33 in supervisor pack)
- Petrol (refer to MRC37 in supervisor pack)

remains the **joint responsibility** of the team supervisor and the fieldworker concerned to ensure that all the necessary slips, documentation and details are completed, checked and signed off.

Supervisors and fieldworkers are to implement a workable system among themselves that will allow for assurance on both sides that receipts and documentation exchanged hands and that the details were correct, complete and signed off. Standard claim forms are provided in the Supervisors Pack.

9. DATA MANAGEMENT AND QUALITY CONTROL

To ensure the quality of the field work, each team will be given a log sheet which should be signed by managers of facilities visited. The log sheet will include names of facilities visited; time spent in the facility, date of visit etc. For the Amajuba district sites, these sheets including the completed survey tools and copies of the routine monthly reports will be couriered fortnightly to Cape Town office. The project manager will go through the completed instruments and communicate any inconsistencies with the supervisor/fieldworkers to resolve any data quality problems that may arise during fieldwork.

10.   THE DATA COLLECTION PROCESS

1. Introduce yourself and arrange to get started with collecting data from the registers

- Introduce yourself to the facility manager and show any documentation that may be requested eg letter of permission or ethics approval. Explain that you wish to collect information from the registers and that you will want to interview the personnel involved with the Routine Health information system.

- With the help of a staff member, identify the following registers: **Baby, Antenatal Care (ANC), Labour ward/Maternity/MOU, and Immunization registers** and ask for a convenient work space to review the registers

- Record selected data elements (see **Appendix V**) for the months under review i.e. **January 2012** and **April 2012**

- Depending on the facility, the data element "baby PCR test around 6 weeks" is recorded in more than one register. Ask for and take your readings from the **Pink booklet** which documents (and a copy is attached to) all specimens that are sent to the lab. This booklet is more reliable.

- Take clear/sharp shots of the Immunization registers for the two months under review

- Make sure to return all registers and reports back to the staff

2. Copy the facility's reports that were sent to the sub-district

- Ask for photocopies of the facility's routine monthly reports *(RMR sent to the sub-district office)* for **January 2012** and **April 2012.** In situations where the photocopier is faulty or out of order, use your phone camera to take **clear/sharp** shots of the routine monthly reports

- Check whether the facility capture patient's data electronically, and if so, ask for a print out of the captured data and the tally and tick sheets

3. Interview the facility personnel

- Be sure to administer the right sets of instruments to each personnel
    - Survey instruments are colour-coded and numbered for easy identification
    - Section 11 lists the questionnaires and who they are to be administered to

4. Observe the use of information in the facility

- There are questions in instruments 3, 4, 5 & 6 that require physical observation of the facility; you are expected to make these observations and complete the questions

- The Management Assessment Tool (MAT) instrument contains questions about management processes and protocols and requires cross checking of relevant

documentations to ascertain whether these processes were in place at both the facility and the district offices. Request copies of all the meeting minutes for the months under review. It is much easier and cost effective to identify answers to these questions by personally checking for the responses from the meeting minutes once you are back in the office

- Use your phone camera to take **clear/sharp** shots of these documents in the absence of a photocopier.

Note: Refer to the PRISM User Guide for a step-by-step description on how to administer and complete the instruments. Also included in the guide are examples of completed instruments.

11. THE DATA COLLECTION FORM/SURVEY INSTRUMENT

Interview	Instruments
Facility Managers	1. Facility/Office Checklist **PINK** 3. Use of Information: Facility Assessment Form **DARK BLUE** 7. Organizational and Behavioural Assessment Tool (OBAT) **YELLOW** 9. Management Assessment Tool (MAT)– Facility **GREEN**
Sub-district HAST Co-ordinators	3. Use of Information: Facility Assessment Form **DARK BLUE** 7. Organizational and Behavioural Assessment Tool (OBAT) **YELLOW**
Sub-district Health information officers	2. Routine Health Information System Overview **PINK** 4. Use of Information: District Assessment Form **DARK BLUE** 6. Quality of Data Assessment: District Office Form **SKY BLUE** 7. Organizational and Behavioural Assessment Tool (OBAT) **YELLOW** 8. Management Assessment Tool (MAT)– District **GREEN**
Data Capturers/Facility information officer	3. Use of Information: Facility Assessment Form **DARK BLUE** 5. Quality of Data Assessment: Health Facility Form **SKY BLUE** 7. Organizational and Behavioural Assessment Tool (OBAT) **YELLOW**
District health information officers	2. Routine Health Information System Overview **PINK** 4. Use of Information: District Assessment Form **DARK BLUE** 6. Quality of Data Assessment: District Office Form **SKY BLUE** 8. Management Assessment Tool (MAT)– District **GREEN**

See **Appendix IV** for survey instrument

12. RHIS DATA ELEMENT DEFINITIONS

See **Appendix V & VI**

13. GRIEVANCE PROCEDURES

If a fieldworker has a grievance during fieldwork the procedure is as follows:

Stage one: The fieldworker should first confer with the field supervisor to settle the problem.

Stage two: If the fieldworker is still dissatisfied, s/he may contact the Project Manager (Mr Edward Nicol), within 2 days of making their grievance known to the supervisor. A signed written version of the grievance must be submitted by both the supervisor and the fieldworker writing. Mr Nicol will respond within 2 days of receiving the grievance with either a decision or recommendation or outcome depending on the nature of the grievance.

Stage three: If the fieldworker is still dissatisfied, s/he may contact the Manager of the Human Resources Department at the Medical Research Council (Mr Philip Swart) within one day after stage two has been complete. All signed written documentation complied during the first two steps must be sent to Mr Swart.

If the supervisor has a grievance the same procedure will be followed, however s/he will contact the Project Manager. If s/he is still dissatisfied, s/he may contact the Manager of the Human Resources Department at the Medical Research Council.

14.   DISCIPLINARY/TERMINATION PROCEDURE

If the field supervisor, the project management team thinks that a fieldworker is not meeting fieldwork standards, the matter will be discussed with the fieldworker and a record of the discussion will be entered into the fieldworker's personal file. If the prescribed changes in behaviour are not made, the fieldworker will be given a second written warning and in some instances dismissed due to the seriousness of the offence. Some examples of offences leading to immediate dismissal are fabricating data collection, abuse of hired vehicles /cell phones, theft, coming to work intoxicated and failure to follow MRC policies and rules regulating the health facilities.

Some other reasons which may lead to dismissal are: continual poor quality data collection, insubordination, inappropriate conduct (e.g. aggressive behaviour and sexual harassment), absenteeism, dishonesty and habitual tardiness.

Field staff, who become ill or have other personal problems that prevent the completion of the survey, are encouraged to withdraw completely from the survey and an adequate replacement would be sought.

Important notes to REMEMBER:

1. The *"no work, no pay"* principle will apply regardless of the disciplinary sanction.
2. The employee could be held liable for the repair cost of the vehicle and mobile phone during the field study, if found to be due to negligence.
3. The supervisors must keep contact details of their team members, the fieldwork co-ordinator and the clinic mangers at all times during fieldwork. These are included in the Supervisor Pack.

15. DEBRIEFING & SUPPORT

It is important to manage the emotional impact of what you have witnessed and experienced while collecting data at the health facilities. The empathy we feel as researchers creates a permeable link between ourselves and the research subjects, through which the trauma experienced can be transferred to the researcher. This can result in making us have feelings of anxiety or depression without our realising it.

We encourage each team to discuss the experiences of the week and any difficulties that members have experienced and how this has made them feel. Listening to each other is an important part of providing support and it allows you to discuss how you feel without "cooping-up" feelings. Letting off steam little by little can prevent long term emotional scars.

In your weekly debriefing session with the project manager, include a report of any concerning incidents that your team experienced.

Should you have a need for professional support or counselling?
Contact the MRC Employee Wellness call centre at the toll free number 0800 444 447. Follow the voice prompts which will guide you to **"Psychosocial Counselling".**

The call is **free from a landline. If a cell phone** is your only option, dial the toll free number to get through to psychosocial counselling and **request that they phone you back,** giving them the number you wish to be called on.

Should you fail to get the desired results from the call centre, please inform the project co-ordinator, who will assist further in ensuring that you get the counselling or support you need.

Appendix 1: Fieldwork plans for Phase I and Phase II of the study

Region	Health Facility	Duration	Start	Finish
(WC, KZN)				
	Contact the facility managers	7 days	Tue 12/07/17	Fri 12/07/20
City of Cape Town, Eastern SD	Bluedowns Clinic	1 day	Mon 12/07/23	Mon 12/07/23
City of Cape Town, Eastern SD	Satellite Fagan St Clinic (Gordon's Bay Clinic)	1 day	Tue 12/07/24	Tue 12/07/24
City of Cape Town, Eastern SD	Gordons Bay Clinic	1 day	Wed 12/07/25	Wed 12/07/25
City of Cape Town, Khayelitsha SD	Ikwezi CHC	1 day	Fri 12/07/27	Fri 12/07/27
City of Cape Town, Eastern SD	Kuils River Clinic (satellite)	1 day	Mon 12/07/30	Mon 12/07/30
City of Cape Town/Cape Metro	PMTCT Manager (city health)	1 day	Mon 12/07/30	Mon 12/07/30
City of Cape Town, Eastern SD	Eastern SD Manager	1 day	Tue 12/07/31	Tue 12/07/31
City of Cape Town, Eastern SD	Eastern SD Information Officer	1 day	Wed 12/08/01	Wed 12/08/01
City of Cape Town, Eastern SD	Dr Ivan Toms Clinic	1 day	Thu 12/08/02	Thu 12/08/02
City of Cape Town, Eastern SD	Russels Rest Clinic	1 day	Fri 12/08/03	Fri 12/08/03
City of Cape Town, Eastern SD	Sarepta Clinic	1 day	Mon 12/08/06	Mon 12/07/06
City of Cape Town, Khayelitsha SD	Satellite Driftsands (Mfuleni)	1 day	Tue 12/08/07	Tue 12/08/07
City of Cape Town, Eastern SD	Sir Lowrys Pass Clinic	1 day	Wed 12/08/08	Wed 12/08/08
City of Cape Town, Eastern SD	Eerste River Hospital	3 days	Fri 12/08/10	Tue 12/08/14
City of Cape Town, Eastern SD	Kleinvlei CDC	1 day	Wed 12/08/15	Wed 12/08/15
City of Cape Town, Eastern SD	Helderberg Hospital	3 days	Thu 12/08/16	Mon 12/08/20
City of Cape Town, Khayelitsha SD	Mfuleni CDC	1 day	Tue 12/08/21	Tue 12/08/21
City of Cape Town, Eastern SD	Gustrouw CDC	1 day	Wed 12/08/22	Wed 12/08/22
City of Cape Town, Eastern SD	Macassar CHC	6 days	Thu 11/07/21	Thu 11/07/28
City of Cape Town, Eastern SD	Wesbank CDC	2 days	Thu 11/05/26	Fri 11/05/27
City of Cape Town, Eastern SD	Strand CDC	1 day	Thu 12/08/23	Thu 12/08/23
City of Cape Town, Khayelitsha SD	Kuyasa CDC	1 day	Fri 12/08/24	Fri 12/08/24
City of Cape Town, Khayelitsha SD	Luvuyo CDC	1 day	Mon 12/08/27	Mon 12/08/27
City of Cape Town, Eastern SD	Matthew Goniwe Clinic	1 day	Tue 12/08/28	Tue 12/08/28
City of Cape Town, Khayelitsha SD	Nolungile Youth Centre	1 day	Wed 12/08/29	Wed 12/08/29
City of Cape Town, Khayelitsha SD	Mayenzeke clinic	6 days	Mon 11/05/23	Mon 11/05/30
City of Cape Town, Khayelitsha SD	Khayelitsha (Site B) CHC	2 days	Mon 11/07/18	Tue 11/07/19
City of Cape Town, Khayelitsha SD	Nolungile CDC	1 day	Thu 12/08/30	Thu 12/08/30
City of Cape Town, Khayelitsha SD	Site B TB	1 day	Fri 12/08/31	Fri 12/08/31
City of Cape Town, Khayelitsha SD	Town Two Clinic	1 day	Mon 12/09/03	Mon 12/09/03
City of Cape Town, Khayelitsha SD	Zakhele Clinic	1 day	Tue 12/09/04	Tue 12/09/04
City of Cape Town, Khayelitsha SD	Micheal Mapongwana CDC	1 day	Wed 12/09/05	Wed 12/09/05
City of Cape Town, Khayelitsha SD	Khayelitsha District (Tygerberg) Hospital	4 days	Thu 12/09/06	Tue 12/09/11
City of Cape Town/Cape Metro	Mop Up	7 days	Wed 12/09/12	Fri 12/09/21
City of Cape Town, Eastern SD	Somerset West Clinic	1 day	Thu 12/09/12	Thu 12/09/12
City of Cape Town, Eastern SD	Hillcrest Clinic	1 day	Thu 12/09/14	Thu 12/09/14
KwaZulu Natal				
Amajuba District, Newcastle SD	Amajuba HCT clinic	1 day	Tue 12/08/14	Tue 12/08/14
Amajuba District, Newcastle SD	Charlestown clinic	1 day	Wed 12/08/15	Wed 12/08/15
Amajuba District, Dannhauser SD	Durnacol clinic	2 day	Thu 12/08/16	Fri 12/08/17
KwaZulu Natal	Interview Provincial Information Officer (PMB)	1 day	Thu 12/08/16	Thu 12/08/16
Amajuba District, Dannhauser SD	Emfundweni clinic	2 day	Mon 12/08/17	Tue 12/08/17
Amajuba District, Newcastle SD	Greenock clinic	1 day	Wed 12/08/20	Wed 12/08/20
Amajuba District, Dannhauser SD	Groenvlei clinic	2 day	Thu 12/08/21	Fri 12/08/21
Amajuba District, Dannhauser SD	Ladybank clinic	2 day	Mon 12/08/22	Tue 12/08/22
Amajuba District, Newcastle SD	Madadeni clinic 1	1 day	Wed 12/08/23	Wed12/08/23
Amajuba District, Newcastle SD	Madadeni clinic 7	1 day	Thu 12/08/24	Thu 12/08/24
Amajuba District, Newcastle SD	Madadeni clinic 5	1 day	Tue 11/06/14	Tue 11/06/14
Amajuba District, Newcastle SD	Madadeni Hospital Gate clinic	2 day	Fri 12/08/27	Mon 12/08/28
Amajuba District, Newcastle SD	Madadeni Hospital	6 days	Wed 11/06/15	Wed 11/06/22
Amajuba District, eMandlangeni	Mndozo clinic	2 days	Tue 12/08/29	Wed 12/08/29
Amajuba District, Newcastle SD	Naas Farm clinic	1 day	Thu 12/08/30	Thu 12/08/30
Amajuba District, Newcastle SD	Newcastle PHC clinic	1 day	Fri 12/08/31	Fri 12/08/31
Amajuba District, Dannhauser SD	Nellies Farm clinic	1 day	Tue 11/06/21	Tue 11/06/21
Amajuba District, Newcastle SD	Newcastle Hospital Gate clinic	2 day	Mon 12/09/03	Tue 12/09/04
Amajuba District, Newcastle SD	Newcastle Hospital	3 days	Wed 12/09/05	Fri 12/09/07
Amajuba District, eMandlangeni	Niemeyer Memorial Hospital Gate clinic	2 days	Mon 12/09/10	Tue 12/09/11

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Amajuba District, eMandlangeni	Niemeyer Memorial Hospital	4 days	Fri 11/06/17	Wed 11/06/22
Amajuba District, Newcastle SD	Osizweni clinic 1	1 day	Wed 12/09/12	Wed 12/09/12
Amajuba District, Newcastle SD	Osizweni clinic 2	1 day	Thu 12/09/13	Thu 12/09/13
Amajuba District, Newcastle SD	Osizweni clinic 3	1 day	Fri 12/09/14	Fri 12/09/14
Amajuba District, Newcastle SD	Rosary clinic	1 day	Mon 12/09/17	Mon 12/09/17
Amajuba District, Newcastle SD	Stafford clinic	1 day	Tue 12/09/18	Tue 12/09/18
Amajuba District, Dannhauser SD	Sukumani clinic	2 day	Wed 12/09/19	Thu 12/09/20
Amajuba District, Dannhauser SD	Thandanani clinic	2 day	Fri 12/09/21	Mon 12/09/24
Amajuba District, Newcastle SD	Thembalihle clinic	1 day	Tue 12/09/25	Tue 12/09/25
Amajuba District, Dannhauser SD	Verdriet clinic	2 day	Wed12/09/26	Thu 12/09/27
Amajuba District	Mop up	7 day	Fri 12/09/28	Fri 12/10/05
Amajuba District	Debriefing and report writing	4 days	Mon 12/10/08	Fri 12/10/12

Appendix I: Formulae for calculating indicators from data elements

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Table 1.1: Diagnostic Tool –Summary of Data Quality Indicators					
Dimensions/indicators	Variable name	Calculation	Mean	Median	Min-Max
Data quality					
% of completeness by data ele-	FQ7,FQ8	FQ8/FQ7*100	50	50	0-100
% of facility coverage (completeness) by district	DQ3,4a,b	DQ4a/DQ3*100; DQ4b/DQ3*100	50	50	0-100
% of district having records of sub-	DQ9	Frequency DQ9			
% of timeliness by district by months	DQ7a,b, DQ4	DQ7a1/DQ4a*100;	50	50	0-100
% of data accuracy of specific data element by month Data accuracy level for A month A Data accuracy level for A month B Data accuracy level for B month A Data accuracy level for B month B Data accuracy level for C month A Data accuracy level for C month B Data accuracy level for D month A Data accuracy level for D month B	FQ4a,b,c,d	Facility FQ4Aa2]/[FQ4Aa1]*100 FQ4Ab2]/[FQ4Ab1]*100 FQ4Ba2]/[FQ4Ba1]*100 FQ4Bb2]/[FQ4Bb1]*100 FQ4Ca2]/[FQ4Ca1]*100 FQ4Cb2]/[FQ4Cb1]*100 FQ4Da2]/[FQ4Da1]*100 FQ4Db2]/[FQ4Db1]*100	50	50	0-100
% of data accuracy of specific data element by month at district	DQd10a,b,c	District DQ10Aa2]/[DQ10Aa1]*100 DQ10Ab2]/[DQ10Ab1*100 DQ10Ba2]/[DQ10Ba1]*100 DQ10Bb2]/[DQ10Bb1]*100 DQ10Ca2]/[DQ10Ca1]*100			
% of overall data accuracy by district		Aggregate all data elements and create a mean	50	50	0-100

Table 1.2: Diagnostic Tool –Summary of Use of Information Indicators					
Use of Information	Variable name	Calculation	Mean	Median	Min-Max
% of actual vs planned reports produced by district	DU3a2-e2, DU3a3-e3	[DU3A3]/[DU3A2]*100; [DU3B3]/[DU3B2] *100 [DU3C3]/[DU3C2] *100 ; [DU3d3]/[DU3d2] *100 [DU3e3]/[DU3e2]*100	50	50	0-100
% of actual vs planned reports produced by facilities	FU3a2-d2, FU3a3-d3	[FU3A3]/[FU3A2]*100; [FU3B3]/[FU3B2]*100 [FU3C3]/[FU3C2]*100;			
% facilities/district displaying use	FU5a3-d3	Frequency			
% of facilities/district having reports showing decisions by types of analyses	FU9a-d DU9a-d	(FQ9a+FQ9b+FQ9c+FQ9d)/ 4*100 ([DU9A]+[DU9B]+[DU9C]+ [DU9D])/4*100	50	50	0-100
% of facilities/districts reporting meetings with discussion on RHIS data	FU14a-b	(FQ14a+FQ14b)/2*100 ([DU14A]+[DU14B])/2*100	50	50	0-100
% of facilities/districts reporting decisions based on RHIS informa-	FU14c-d DU14c-d	(FQ14c+FQ14d)/2*100 ([DU14C]+[DU14D])/2*100	50	50	0-100
% of facilities reporting referral of problem for actions based on RHIS information	FU14e	Frequency			
% of activities related to promoting use of RHIS information at facility/district level	FU15,16,17,18 DU15,16,17,18	([FU15]+[FU16]+[FU17]+ [FU18])/4*100 ([DU15]+[DU16]+[DU17]+ [DU18])/4*100	50	50	0-100
% of example of information use	FU20	Frequency			

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Table 1.3: Diagnostic Tool –Summary of RHIS Processes Indicators					
RHIS Processes	Variable name	Calculation	Mean	Me-dian	Min-Max
% of facilities reporting presence of data	FQ15	Frequency	50	50	0-100
% of facilities reporting presence of Data	FQ5c&6c	(FQ5c+FQ6c)/2*100	50	50	0-100
% of facilities reporting presence of data	FQ5a&-6a	(FQ5a+FQ6a)/2*100	50	50	0-100
% of facilities reporting presence of data	FQ5b& 6b	(FQ5b+FQ6b)/2*100	50	50	0-100
% of facilities reporting presence of data processing process % of districts reporting presence of data	FQ9 DQ11	Frequency Tabulation of Yes re-sponses			
% of facilities showing display of demo-	FU6,7	Frequency			

% of districts displaying of data related to mother health
 	
% of facilities displaying of data related to mother health
	DU5a
	
	FU5a
		if(([DU5A21]+[DU5A22]+[DU5A23])>1,'True','False')
		
		if(([FU5A21]+[FU5A22]+			

% of districts displaying of data related to child health
 	
% of facilities displaying of data related to
	DU5b
	
	FU5b
		if(([DU5B21]+[DU5B22]+[DU5B23])>1,'True','False')
		
		if(([FU5B21]+[FU5B22]+[FU5B23])			

% of districts displaying of data related to facility utilization
 	
% of facilities displaying of data related to
	DU5c
	
	FU5c
		if(([DU5C21]+[DU5C22]+[DU5C23])>1,'True','False')
		
		if(([FU5C21]+[FU5C22]+[FU5C23])			

% of districts displaying of data related to disease surveillance
 	
% of facilities displaying of data related to
	DU5d
	
	FU5d
		if(([DU5D21]+[DU5D22]+[DU5D23])>1,'True','False')
		
		if(([FU5D21]+[FU5D22]+			

% of districts reporting presence of feed-back process % of facilities reporting presence of feed-	DU4 FU4	Frequency			

Table 1.4: Diagnostic Tool –Summary of Technical Determinants Indicators					
Technical determinants	Variable name	Calculation	Mean	Median	Min-Max
% of districts reporting types of analyses	DQ12a,b,c,d,e,f	Frequency			
% of facilities reporting types of analyses	FQ10a,b,c,d				
% of facilities reporting presence of procedure manual	FQ11				
% of district respondents reporting about that RHIS procedure manual and forms,	DQ13,14,15,16,17,18,19,20	Frequency			

Table 1.5: Diagnostic Tool –Summary of Supervision Indicators					
RHIS Supervision Quality	Variable name	Calculation	Mean	Median	Min-Max
% of facilities reporting frequency of su-	FU21	Frequency			
% of facilities reporting quality of RHIS supervision	FU22-26	Frequency (FU22+FU23+FU24+FU25+FU26)/5*100	50	50	0-100

Table 1.6: Management Assessment Tool					
Dimensions/indicators	Variables Items names	Indicator Calculation	Mean	Median	Min-Max
RHIS Governance	MATG1-MATG4	([MATG1]+[MATG2]+[MATG3]+[MATG4])/4*100 – for district ([MATG1]+[MATG3])/2*100 – for facility	50	50	0-100
Planning	MATP1-MATP3	([MATP1]+[MATP2]+[MATP3])/3*100	50	50	0-100
Training	MATT1-MATT3	([MATT1]+[MATT2]+[MATT3])/4*100	50	50	0-100
Supervision	MATS1-MATS3	([MATS1]+[MATS2]+[MATS3])/3*100	50	50	0-100
Use of quality/ Performance standard	MATQ1-MATQ3	([MATQ1]+[MATQ2]+[MATQ3])/3*100	50	50	0-100
Finances	MATF1-MATF4	([MATF1]+[MATF2]+[MATF3]+[MATF4])/4*100 ([MATF1]+[MATF3])/2*100– for facility	50	50	0-100

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Table 1.7: Organizational and Behavioral Assessment Tools indicators and scoring					
Indicators	Variables	Calculation	Mean	Median	Min-Max
A. Behavioral					
1. RHIS tasks competence			50	50	0-100
a. Knowledge of methods of checking data quality	U2	[U2]/3*100	50	50	0-100
b. Calculating indicators	C1,2,3,	([C1]+[C3]+[C4])/3*100	50	50	0-100
c. Plot data	C2a	[C2A]*100	50	50	0-100
d. Interpret data	C2b,C2c	([C2B]+[C2C])/7*100	50	50	0-100
e. Use of information	UD1,2,3,4	([UD1]+[UD2]+[UD3]+[UD4])/4*100	50	50	0-100
2. RHIS task confidence		Rating scale 0-100	50	50	0-100
a. Checking data quality	SE1	SE1	50	50	0-100
b. Calculating indicators	SE2	SE2	50	50	0-100
c. Plot data	SE3	SE3	50	50	0-100
d. Interpret data	SE4,SE5	SE4+SE5/2	50	50	0-100
e. Use of information	SE6,SE7	SE6+SE7/2	50	50	0-100
3. RHIS data demand	U1A,U1B,U1C	([U1A]+[U1B]+[U1C])/3/3*100	50	50	0-100
4. Motivation	BC1,BC2,BC5,BC3,BC4,BC6	([bc1r*]+[bc2r*]+[bc5r*]+[BC3]+[BC4]+[BC6])/7/6*100	50	50	0-100
5. Problem-solving skill	Total	([PSA]+[PSB1])/11*100	50	50	0-100
Defining problem	PSA	([PSA]*100			
Solving problem	PSB	([PSB1])/11*100			
*the item rating has been reversed due to the negative statement					

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Table 1.8: Organizational and Behavioral Assessment Tools indicators and scoring					
Indicators	**Variables**	**Calculation**	**Mean**	**Median**	**Min-Max**
B. Organizational		**Percentile scale 0-100**	50	50	0-100
1. Culture of information			50	50	0-100
Emphasis on data quality	S2, S6,S8	([S2]+[S6]+[S8])/7/3*100	50	50	0-100
Use of information	S5,P8,P9,P16	([S5]+[P8]+[P9]+[P16])/7/4*100	50	50	0-100
Evidence based decision making	D1,D2,D3,D4, D5,D6,D7	([D1r]*+ [D2r*]+ D3]+ [D4r*]+[D5]+[P6]+[D6]+ [D7])/7/7*100	50	50	0-100
Feedback from staff and community	S1,S3,S4,S7	([S1]+[S3]+[S4]+ [S7])/7/4*100	50	50	0-100
Sense of responsibility	P1,P3,P4,P5,P17	([P1]+[P3]+[P4]+[P5]+ [P17])/7/5*100	50	50	0-100
Empowerment and Accountability	P2,P13,P14,P15	([P2]+[P13]+[P14]+ [P15])/7/4*100	50	50	0-100
Promote problem-solving	P9,P10,P11,P12	([P9]+[P10]+[P11]+ [P12])/7/4*100			
Department provide reward for	P6	[P6]/7*100	50	50	100
Training	DD6	Frequency			
Socio-demographic characteristics	DD1,2,3,4,5,	Frequency			

*the item rating has been reversed due to the negative statement

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Appendix J: Interview guide

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(Objectives 1 & 2)

Burden of Disease
Research Unit

Evaluating the Process and Output Indicators for Maternal, Newborn and Child Survival in South Africa: a comparative study of PMTCT information systems in KwaZulu Natal and the Western Cape

Thank you for agreeing to answer these questions. This survey is part of a study to improve the Health Management Information systems supporting maternal and child health HIV/AIDS programmes. The objective of the survey is to help develop interventions for improving the routine health information systems and the use of information. Please express your opinion honestly. Your responses will remain confidential and will not be shared with anyone, except for presented table forms. We appreciate your assistance and co-operation in completing this study.

Semi-structured interviews

Information Use at the District & facility levels
Name of district
Sub-district:
Respondent's Name:
Function/Title:
Name of the Assessor:
Date of Assessment:
Information Use at the District & facility levels

1. What has been your experience as a health Information Officer/Facility Manager in terms of:
   - ○ data collection and
   - ○ Data usage?

(Probe further depending on the responses given)

2. What specific challenges have you experienced when it comes to producing (generating) and using data? *(Probe further)*

3. Will training of staff make a difference, and what will make training useful? *(Probe further)*

4. Do you feel the information you produce (generate) is used by decision makers? *(Probe further)*

5. What do you think are the barriers (*obstacles*) to the use of information? *(Probe further)*

Appendix K: Pilot facilities

Staff interviewed by district, sub-district and facility								
Staff	**Metro/City of Cape Town**				**Amajuba District**			**Total**
District Manager					1			1
District Info Officers	1				1			2
Data Capturers					3			3
	Khayelitsha Sub- District		*Eastern Sub- District*		*Newcastle Sub-District*	*eMandlangeni Sub-district*	*Dannhauser Sub-District*	
Sub-district HIOs	2							2
Facility Information Officer (FIO)					1	1		2
Data Capturers (other facilities)					1	1	1	3
PMTCT/HAST Co-ordinators	1		1			1		3
	Mayenzeke Clinic	*Khayelitsha Site B CHC (MOU)*	*Wesbank Clinic*	*Macassar CHC (MOU)*	*Madadeni*	*Niemeyer Memorial Hospital*	*Nellies Farm Clinic*	
					Hospital	*Clinic 5*		
Facility Managers	1	1	1	1		1		1	6
CEO					1		1		2
Data capturers	3	3	2	5		4	6	3	26
Total								50

Appendix L: Pilot schedule

Pilot Schedule

Date	Sites Visited	Interviews	Instruments
Monday 23th May	Khayelitsha Sub-district office Mayenzeke Clinic, Khayelitsha	 Facility Manager	 (1), (3), (7), (9), (10)
Tuesday 24th May	Khayelitsha Sub-district office Mayenzeke Clinic, Khayelitsha	Sub-district Health Information officer 2 x Data Capturers	(2), (4), (6), (7), (8), (10) (3), (5), (7)
Wednesday 25th May	Khayelitsha Sub-district office	Sub-district HAST Co-ordinator	(3), (5), (7), (10)
Thursday 26th May	Wesbank Clinic, Eastern Sub-district	Facility Manager 1 x Data collector & 2 x Data Capturers	(1), (3), (7), (9), (10) (3), (5), (7)
Friday 27th May	Eastern Sub-district office, Somerset West Wesbank Clinic, Eastern Sub-district	 1 x Data Capturer	 (3), (5), (7)
Monday 30th May	PGWC Office, Woodstock Mayenzeke Clinic, Khayelitsha	Sub-district Health information officer 1 x Data Capturer	(2), (4), (6), (7), (8), (10) (3), (5), (7)
Wednesday 1st June	Civic centre, City of Cape Town	District Health information officer	(2), (4), (6), (8), (10)
Monday 6th June	Eastern Sub-district office, Somerset West	2 x Sub district HAST Co-ordinators	(2), (4), (6), (7), (8), (10)
Monday 13th June	Amajuba District office. Newcastle	District Manager	
Tuesday 14th June	Madadeni Clinic 5, Newcastle	Facility Manager 1 x Data collector & 2 x Data Capturers	(1), (3), (7), (9), (10) (3), (5), (7)
Wednesday 15th June	Amajuba District Office, Newcastle Madadeni Hospital, Newcastle	PMTCT District Co-ordinator Facility Information Officer	(2), (7), (10) (2), (4), (6), (7), (10)
Friday 17th June	Niemeyer Memorial Hospital, Utrecht	Chief Executive Officer 2 x Data collectors & 1 x Data Capturer	(1), (3), (7), (9), (10) (3), (5), (7)
Monday 20th June	Amajuba District Office, Newcastle Madadeni Hospital, Newcastle	District Health Information Officer & 2 x Data Capturers Chief Executive Officer	(2), (4), (6), (10) (3), (5), (7) (1), (3), (9), (10)
Tuesday 21st June	Nellies Farm Clinic, Dannhauser	Facility Manager 2 x Data collectors & 4 x Data Capturers	(1), (3), (9), (10) (3), (5), (7)
Wednesday 22nd June	Amajuba District Office, Newcastle Madadeni Hospital, Newcastle Niemeyer Memorial Hospital, Utrecht	District Manager & 11 Data Capturers 2 x Data collectors 1 x Data collector	(1), (8), (10), & (7) (3), (5), (7) (7)
Monday 18-19th July	Khayelitsha Site B CHC	Facility Manager 3 x Data Capturers	(1), (3), (7), (9), (10) (3), (5), (7)
Thursday 21st, 25th, 28th July	Macassar CHC	Facility Manager 5 x Data Capturers	(1), (3), (7), (9), (10) (3), (5), (7)

Appendix M: Summary of problems identified with the PRISM tools during the pilot

	Instruments	Problems	Solution
1	Facility/Office Checklist		
2.	Routine Health Information System Overview	This tool was a bit difficult to understand without additional information	Guidelines were included in the tool explaining how the form is expected to be filled
3.	Use of Information: Facility Assessment Form		
4.	Use of Information: District Assessment Form		
5.	Quality of Data Assessment: Health Facility Form	One of the ways of assessing data quality outlined in the tool is to cross check indicators in registers against those captured on the system. So many data elements are collected in the facilities, and are captured electronically into PREHMIS (City Health, WC) or manually in registers, and sent to the next level. The default data elements in this tool are not PMTCT specific, making it difficult to locate data elements. Another issue with the tools were the facts that they didn't take into account the multiplicity of registers at the facility level. Some facilities capture data	The default data elements were changed and PMTCT specific elements were obtained from registers at the facilities and recorded on the column provided in the tool. Copies of all the monthly reports sent from the facility to the sub-districts and from the sub-district to the district were obtained for the months under review. This is necessary to minimise times spent in the facilities. The tools were adjusted to collect information from PMTCT specific registers For those facilities that

		electronically and manually.	capture patient's data electronically, a print out of the captured data and the tally and tick sheets were obtained to assess data quality
6.	Quality of Data Assessment: District Office Form	Same as above	Same as above
7.	Organizational and Behavioural Assessment Tool (OBAT)	There were some issues with the flow of questions in the tool The questions were not PMTCT specific, making it difficult for the respondents to understand the terms	The affected questions were rephrased and rearranged to allow for smooth flow These were adjusted by simply using PMTCT specific questions
8.	Management Assessment Tool – District	These Tools contains questions management processes and protocols and requires cross checking of relevant documentations to asserting if these processes were in place at both the facility and the district offices. The pilot revealed that the task was time consuming	Copies of all the meeting minutes for the months under review were obtained to facilitate the interview process especially with the Management Assessment Tools (MAT).
9.	Management Assessment Tool – Facility		It was much easier and efficient, in terms of time management, to identify some of the questions by personally checking for the responses from the meeting minutes, back in the office.
10.	Semi-structured interviews		

Appendix N: Ethics approval and approvals from relevant authorities

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UNIVERSITEIT·STELLENBOSCH·UNIVERSITY
jou kennisvennoot • your knowledge partner

21 February 2011

MAILED

Prof L Dudley
Division of Community Health
4th Floor
Teaching Block
Tygerberg
7505

Dear Prof Dudley

"Evaluating the process and output indicators for maternal, newborn and child survival in South Africa: A case study of PMTCT information Systems in Kwazulu Natal and the Western Cape."

ETHICS REFERENCE NO: N10/10/322

RE : APPROVAL

At a meeting of the Health Research Ethics Committee that was held on 20 October 2010, the above project was approved on condition that further information is submitted.

This information was supplied and the project was finally approved on 21 February 2011 for a period of one year from this date. This project is therefore now registered and you can proceed with the work.

Please quote the above-mentioned project number in ALL future correspondence.

Please note that a progress report (obtainable on the website of our Division: www.sun.ac.za/rds should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly and subjected to an external audit.
Translations of the consent document in the languages applicable to the study participants should be submitted.

Federal Wide Assurance Number: 00001372
Institutional Review Board (IRB) Number: IRB0005239
The Health Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).

Please note that for research at a primary or secondary healthcare facility permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Contact persons are Ms Claudette Abrahams at Western Cape Department of Health (healthres@pgwc.gov.za Tel: +27 21 483 9907) and Dr Hélène Visser at City Health (Helene.Visser@capetown.gov.za Tel: +27 21 400 3981). Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

21 February 2011 10:33

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Fakulteit Gesondheidswetenskappe · Faculty of Health Sciences

Verbind tot Optimale Gesondheid · Committed to Optimal Health
Afdeling Navorsingsontwikkeling en -steun · Division of Research Development and Support
Posbus/PO Box 19063 · Tygerberg 7505 · Suid-Afrika/South Africa
Tel.: +27 21 938 9075 · Faks/Fax: +27 21 931 3352

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jou kennisvennoot · your knowledge partner

Approval Date: 21 February 2011   ☐ Expiry Date: 21 February 2012

Yours faithfully

MS CARLI SAGER
RESEARCH DEVELOPMENT AND SUPPORT
Tel: +27 21 938 9140 / E-mail: carlis@sun.ac.za
Fax: +27 21 931 3352

Fakulteit Gesondheidswetenskappe · Faculty of Health Sciences

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UNIVERSITEIT·STELLENBOSCH·UNIVERSITY
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23 March 2012   **MAILED**

Prof L Dudley
Division of Community Health
4th Floor
Teaching Block
Tygerberg
7505

Dear Prof Dudley

"Evaluating the process and output indicators for maternal, newborn and child survival in South Africa: A case study of PMTCT information Systems in Kwazulu Natal and the Western Cape."

ETHICS REFERENCE NO: N10/10/322

RE : PROGRESS REPORT

At a review panel of the Health Research Ethics Committee that was held on 19 March 2012, the progress report for the abovementioned project has been approved and the study has been granted an extension for a period of one year from this date.

Please remember to submit progress reports in good time for annual renewal in the standard HREC format.

Approval Date: 19 March 2012   Expiry Date: 19 March 2013

Yours faithfully

MRS MERTRUDE DAVIDS
RESEARCH DEVELOPMENT AND SUPPORT
Tel: 021 938 9207 / E-mail: mertrude@sun.ac.za
Fax: 021 931 3352

Fakulteit Gesondheidswetenskappe · Faculty of Health Sciences

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Ethics Letter

02-Apr-2013

Ethics Reference #: N10/10/322
Title: Evaluating the process and output indicators for maternal, newborn and child survival in South Africa: A case study of PMTCT information Systems in Kwazulu Natal and the Western Cape

Dear Professor Lilian Dudley,

At a meeting of the Health Research Ethics Committee that was held on 20 March 2013, the progress report for the abovementioned project has been approved and the study has been granted an extension for a period of one year from this date.

Please remember to submit progress reports in good time for annual renewal in the standard HREC format.

Approval Date: 20 March 2013 Expiry Date: 20 March 2014

If you have any queries or need further help, please contact the REC Office 0219389207.

Sincerely,

REC Coordinator
Mertrude Davids
Health Research Ethics Committee 2

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Ethics Letter

23-Sep-2014

Ethics Reference #: N10/10/322
Title: Evaluating the process and output indicators for maternal, newborn and child survival in South Africa: A case study of PMTCT information Systems in Kwazulu Natal and the Western Cape

Dear Professor Lilian Dudley,

At a review panel meeting of the Health Research Ethics Committee that was held on 17 September 2014, the progress report for the abovementioned project has been approved and the study has been granted an extension for a period of one year from this date.

Please remember to submit progress reports in good time for annual renewal in the standard HREC format.

Approval Date:17 September 2014 Expiry Date: 17 September 2015

If you have any queries or need further help, please contact the REC Office 0219389207.

Sincerely,

REC Coordinator
Mertrude Davids
Health Research Ethics Committee 2

HEALTH
KwaZulu-Natal

Health Research & Knowledge Management sub-component
10 – 103 Natalia Building, 330 Langalibalele Street
Private Bag x9051
Pietermaritzburg
3200
Tel.: 033 – 3953189
Fax.: 033 – 394 3782
Email.: hrkm@kznhealth.gov.za
www.kznhealth.gov.za

Reference	: HRKM174/10
Enquiries	: Mrs G Khumalo
Telephone	: 033 – 3953189

17 November 2010

Dear Mr E Nicol

Subject: Approval of a Research Proposal
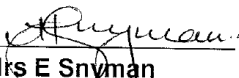
1. The research proposal titled **'Evaluating the process and output indicators for maternal, newborn and child survival in South Africa: a comparative study of the prevention of mother-to-child transmission of HIV (PMTCT) information systems in KwaZulu-Natal and Western Cape'** was reviewed by the KwaZulu-Natal Department of Health.

   The proposal is hereby **approved** for research to be undertaken at **Amajuba District**.

2. You are requested to take note of the following:
   a. Make the necessary arrangement with the identified facility before commencing with your research project.
   b. Provide an interim progress report and final report (electronic and hard copies) when your research is complete.

3. Your final report must be posted to **HEALTH RESEARCH AND KNOWLEDGE MANAGEMENT, 10-102, PRIVATE BAG X9051, PIETERMARITZBURG, 3200** and e-mail an electronic copy to hrkm@kznhealth.gov.za

For any additional information please contact Mrs G Khumalo on 033-3953189.

Yours Sincerely

Mrs E Snyman
Interim Chairperson, Health Research Committee
KwaZulu-Natal Department of Health
Date: _19/11/2010_

---

uMnyango Wezempilo . Departement van Gesondheid

Fighting Disease, Fighting Poverty, Giving Hope

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DEPARTMENT of HEALTH
Provincial Government of the Western Cape

COMPONENT

healthres@pgwc.gov.za
tel: +27 21 483 9976; fax: +27 21 483 9895
1st Floor, Deneys Reitz House, 8 Riebeek Street, Cape Town, 8001
www.capegateway.gov.za

REFERENCE: RP 03/2011
ENQUIRIES: Dr N Peer

Burden of Disease Research Unit
South African Medical Research Council
Francie Van Zyl Drive
Parow Valley
Cape Town
7500
Fax: 021 9380310

For attention: Dr Edward Nicol

Re: Evaluating the Process and Output Indicators for Maternal, Newborn and Child Survival in South Africa: a comparative study of the Prevention of Mother-To-Child Transmission of HIV (PMTCT) information systems in KwaZulu Natal and the Western Cape

Thank you for submitting your proposal to undertake the above-mentioned study. We are pleased to inform you that the department has granted you approval for your research. Please contact the following people to assist you with any further enquiries.

Eerste River Hospital	Dr Tim Visser	Tel: (021) 902 8001
Kleinvlei	EH Strydom	Tel: (021) 904 3421
Helderberg Hospital	Dr E Erasmus	Tel: (021) 850 4704
Macassar	Sr Alexander	Tel: (021) 857 2330
Mfuleni	Ms PB Hintsho	Tel: (021) 909 3138
Gustrouw	Sr Aisha Salie	Tel: (021) 845 8383/4
Strand	Ms WC Libbe	Tel: (021) 853 3380
Khayelitsha (Site B)	Ms Notshe	Tel: (021) 361 3816/3470
Michael M	Ms Matlyela	Tel: (021) 361 3353
Nolungile	Sr S McCloen	Tel: (021) 387 1107/1200
Khayelitsha District H	Dr A Kharwa	Tel: (021) 9386540

Kindly ensure that the following are adhered to:
1. Arrangements can be made with managers, providing that normal activities at requested facilities are not interrupted.
2. Researchers, in accessing provincial health facilities, are expressing consent to provide the department with an electronic copy of the final report within six months of completion of research. This can be submitted to the provincial Research Co-ordinator (healthres@pgwc.gov.za).

The Afrikaans or Xhosa version of this document is available on request.   page 1 of 2

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3. The reference number above should be quoted in all future correspondence.

We look forward to hearing from you.

Yours sincerely

MR J LEDWABA

CHIEF DIRECTOR: HEALTH PROGRAMMES

DATE: 15-04-2011

CC   DR G PEREZ   DIRECTOR: EASTERN/KHAYELITSHA DISTRICT

The Afrikaans or Xhosa version of this document is available on request.

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Civic Centre	Iziko IoLuntu	Burgersentrum
12 Hertzog Boulevard	12 Hertzog Boulevard	Hertzog-boulevard 12
Cape Town 8001	Cape Town 8001	Kaapstad 8001
P O Box 2815, Cape Town 8000	P O Box 2815, Cape Town 8000	Posbus 2815, Kaapstad 8000
Ask for: Dr G H Visser	**Cela: Qrh G H Visser**	**Vra vir: Dr G H Visser**
Tel: 021 400-3981	Umnxeba: 021 400-3981	Tel: 021 400-3981
Cell: 083 298 8718	Cell: 083 298 8718	Sel: 083 298 8718
Fax: 021 421-4894	Ifeksi: 021 421-4894	Faks: 021 421-4894

CITY OF CAPE TOWN | ISIXEKO SASEKAPA | STAD KAAPSTAD

E-mail: helene.visser@capetown.gov.za
Website: http://www.capetown.gov.za
Ref:
Filename: G:\Research\Enicol10211.docx

CITY HEALTH — Specialised Health

2010-12-15

re: Research Proposal: Evaluating the Process and Output Indicators for Maternal, Newborn and Child Survival in South Africa: a comparative study of the Prevention of Mother-To-Child Transmission of HIV (PMTCT) information systems in KwaZulu Natal and the Western Cape (ID NO: 10211)

Dear Mr Nicol,

Permission has been granted to do your research as per your protocol in the Eastern and Khayelitsha Sub Districts. You need to liaise with the Sub District Managers to identify sites where you can pilot the questionnaire.

Eastern Sub District:
Contact People

Dr P Nkurunziza (Sub District Manager)
Tel: (021) 850-4315 / 084 800 0644

Khayelitsha Sub District:
Contact People

Dr V de Azevedo (Sub District Manager)
Tel: (021) 360-1258/ 083 629 3344

Please note the following:
1. All individual patient information obtained must be kept confidential.
2. Access to the clinics and its patients must be arranged with the relevant Manager such that normal activities are not disrupted.
3. A copy of the final report must be sent to the City Health Head Office, P O Box 2815 Cape Town 8001, within 3 months of its completion and feedback must also be given to the clinics involved.
4. Your project has been given an ID Number (10211). Please use this in any future correspondence with us.

Thank you for your co-operation and please contact me if you require any further information or assistance.

Yours sincerely

DR G H VISSER
MANAGER: SPECIALISED HEALTH

cc.   Dr Nkurunziza
       Dr Azevedo
       Dr K Jennings

THIS CITY WORKS FOR YOU   ESI SIXEKO SISEBENZELA WENA   HIERDIE STAD WERK VIR JOU

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Appendix O: Themes emerging at the facility level

Selected Theme	Selected category	Examples of quote
Data quality issues	Perceptions of the level of "poor quality data"	*Data collection is <u>poor</u>, I am not sure if it's because of training or logistics but it's poor, even at this stage ... (BF80)* *A <u>major problem</u> which we actually found was that, there were about 6 discharges in the <u>paediatric ward</u>, and maybe I don't know whether the lady (nurse) was drowsy or something, she will put that 6 under 1 death; you see now that's a HUGE problem. (BF73)* *...data collection I would say is quite <u>problematic</u>, what we need to focus on is <u>the source where data is initiated</u>, where data moves from two different points (BF84)* *Data accuracy is always a challenge and the challenge is that you would teach or show people how the data collection is supposed to be done and then you don't see any improvement. (AF58)* *<u>The staff don't record properly.... people omitting and not collecting data due to lack of resources ...(AF60)</u>*
Reasons for poor data collection	Carelessness, human error in data collection and recording	*...sometimes the professional nurses <u>will not document some of the things that they have done,</u> (AF49)* *<u>Carelessness or</u> maybe lack of information especially about the importance of data.... Or that what is captured is not what was given from the source... (BF80)* *So my understanding is that if the on<u>e that is collecting the data does not know what to do about the very same data t</u>hen it is the same as when you feed the computer. (BF84)* *The staff <u>don't record properly</u>.... They don't comply with the tally sheet...And sometimes we don't <u>get enough time to check thoroughly and then I sign them and the statistics goes to the next level and you find that there are mistakes which were overlooked..</u>. sometimes other registers are not counted by mistake, which means we don't count everything that we have done for that month (BF86)* *Sometimes they (nurses) forget what to put where, when they do data collection. Then there are also human errors of course, you count 10 people, and*

		then write 11 by mistake...for example in the paediatric ward there were about 6 discharges, and maybe I don't know whether the lady (nurse) was drowsy or something, she will put that 6 under deaths...(AF73)
		They are omitting some things...that is like caused in-discrepancies. I cannot say it is lack of information; sometimes it is carelessness or maybe lack of information especially about the importance of data... (AF60)
	Manpower issues: Professional nurses' job overload/ staff turnover	*It is difficult to keep accurate stats, because the same person who is taking the stats is the same person who has to give the tablets, it's the same person who has to find the folder, the same person who must listen to the entering patient, you see. So I don't think it gives the true reflection. (AF49)*
		...We don't have enough resources. Sometimes we have a shortage of staff (AF60)...
		..Staff rotation, whereby you teach somebody, like certain names for the PMTCC program for example. Then now a time comes when that person has to work in the TB, and then somebody new, then that person is not into it. (AF58)
		There is only one professional nurse in the structure but now they are having more than 1800 clients and those clients are too much for just one professional nurse to attend to. (BF80)
		...you can't be teaching one person this month, and after three months it's someone else...they must just appoint people as data capturer…(AD87)
	Lack of trained data capturers/ clerks	*I give them training on how to record several times but you know because of this shortage of staff sometime people are just rushing things and then sometimes they think that recording is just waste of their time (BF86)*
		If you keep changing people like underwear, you know, this one that's the boss today will tell you this and you try and implement. The next day, the one that gave you that kind of information is no longer there, it is somebody else (BF84)
		The hospital is actually supervising 16 clinics, so that's a huge number of clinics and I only have one data capturer. They (nursing staff) rotate...that actually has come with its own problems in terms of data collection. (AF73)

		The challenge of manpower; we don't have clerks to help the data capturer, so you will find that the data capturer has to do everything even the work that is to be done by the clerks (AF69) *...I was so upset when I learnt about people that were actually trained to be data capturers; one was working in the kitchen, the other one was working there as a cleaner, and I was worried that when anyone can just be pulled to come and do data capturing...(AD87)*
	Lack of resources due to the legacy of previously disadvantaged hospitals	*There's no proper format (*for data-collection*) I should think that emanates from the fact that the systems and the structures of the different hospitals are not the same....but I will blame it on the structural arrangement ...(BF84)*
	Lack of basic equipment for recording (3 out of 8)	*...not having computers, not having enough data capturers, not all of us being trained -not all of us have computer skills as well(BF84)* *They don't have a computer that they can use for the clinic: there is one but I am not sure if it's for the sister in charge. Maybe it's for the clinic, I don't know but the data capturers don't have computer to capture all this information. We don't have, everything is done manually...sometimes we run short of paper; we don't have paper for photocopying the tally sheets. So we find that we have to wait for them (head office) before we start doing the capturing. (AF69)* *This is a big building; my manager sometimes has to run because she cannot access the internet in her office, so she has to come to the reception (AF60)*
	Computer literacy and skills for recording and analysing data	*If he (data-capturer) is not there sometimes I get the problem because he is the one to use the computer to retrieve this information...I'm not that computer literate (BF86)* *...staff don't know how to use the internet....(AF60)* *(*Interviewer: In other words you have adequate skill to do stats, simple stats like getting the rates, the percentages and the rest of that) P*ercentages? No ...only the tally sheets!* *This DHIS data base is good but the problems it presents is much ...Pivot table information too slow... the tables themselves. When you look at the data you find that there are mistakes; mistakes that shows that a lack of understanding of what the data is: the indicators and all that. Then those are the*

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		things you would think more training still needs to be done… (BF73).
		My understanding is that if the one that is collecting the data does not know what to do about the very same data then it is the same as when you feed the computer. (BF84)
	Lack of skills for validation	*I don't have skills to sit down and say that and be confident that this is what it is... nobody with the skills in the facility. The only thing that I can validate is the pap smears, because we have the register for the pap smears. So if the Premise statistics says, we had 29 then I can count on the Pap smear to say there are really 25…29... (AF49)* *You know it's quite embarrassing actually. …confusing to look at that PMTCT document and validate it, especially when there are sometimes confusing figures... since I cannot tell whether this is correct or not, my data capturers will never know what is right and what is wrong (BF73)*
	Limitations of supervisory visits/ monthly audit	*During the supervisory visits, sometimes the programs manager will pull a few folders to look at what we are doing, but it does not give the true reflection because two folders cannot give you the true picture...because the folders might all be correct (AF49)*
	Not <u>owning the process</u> of health information recording and analysis /attitudinal issues	*<u>The people on the ground</u> (nurse) from their point of view do not understand the importance of the data…which is the output of their effort, the work that they do down there ...it shows that the person is really not internalising the whole issue, he's just working for the month to come to an end. (AF58)* *If I'm not willing, if I regard the job given to me as burdensome then obviously at the end of the day I'm not going to… I'll be negative. I'd say, this thing...it is a barrier (BF84)* *What's the point of using the data you have when you are not sure if the data you have is the accurate one? And then you end up being sceptical about everything to say can I make use of this information. (BF 84)* *<u>If they (nurse) know how important the statistics is, whether on increasing the staff competence or whatever, then they will be alert on whatever they are doing</u>. So it would be different than doing the stats to submit, but they will make sense of it (AF49)*
Limitations of data	Software issue (Prehmis)	*The computer Programme shuts down at a certain age. For instance if the child comes at 1 year 4*

collection/ recording instruments		*months, when you want to enter it, we don't have a place to capture that. Because if the child receives the 18 months dose but is 6 years old then that child health's column just closes; you cannot put anything there (AF49)*
Feedback	Data interrogation	*But then if you can interrogate the data and you go back and check you can see that there were flaws in the data… But it is out of looking at the data that you are able to see that this was not correct and you go back and correct and even phone the facility, even before you can punch the data in your computer (AF58)*
Use of information	Selective use	*Yes, in a way, it's being used, although it may not being used to what I think needs to happen, …(AF49)* *…at this point in time, better than in the past, it can still be better…, (AF60)* *You can have information but you will find that they (management at head office) cannot budget according to what you have given them…if the information is used, they should be able to pick up that the facility needs more hands.(BF80)* *…especially if by decision makers, you mean decision makers at the district and provincial level, yes. Because quiet recently there was some issue that had to be addressed that emanated from the data that was presented in one of the meetings at the district office…(BF73)*
Barriers to use of information	Incorrect information provided by patient	*I don't know why people lie about where they live,.. that is one of the barriers, people losing documents due maybe to a fire or being robbed or misplacing it completely...we have foreigners, quite a number of Somalia's, Ugandans and Kenyans coming in and there is a language barrier at times (AF60)*
	Ripple effect of lack of staff at facility level, lack of accurate data and lack of planning and use of info...	*You don't have any right to blame the nurses that collect the data if the workload on them is much and nothing is done....I am having a serious problem and I can see that the way that we are not doing well in terms of data collection emanates from the fact that we are short staffed. Then they will say: OK fine, you need to create a post, you need to appoint people ASAP, but make a submission...When the budget is allocated,...it is allocated in terms of the warm bodies that you have (BF84)*
	Inaccurate information	*…Information is not accurate, it's useless and the issue of it not coming on time.., and when you go back to correct it, the time gets delayed and stuff like that, so that is the ripple effect I am talking about. (AF73)*

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	Lack of culture of information use	*I think most of the time it's not correct... I cannot blame them (management at head office) because even <u>if they want to use it but most of the time you find that the data is not right.</u> (BF80)* *...lack of understanding or perhaps if somebody doesn't have a vision for the program or a vision for whatever he's doing because it is the data that is going to drive you to do, or come up with new innovations, and new changes... (AF58)* *...if we can emphasize the use of data to the nurses, doctors, everyone in the health institution to make them aware as to why the data is important so that everyone can put an effort to ensure that they are collecting and submitting the correct data; these will help. (BF80)*
	Willingness and attitude of users	
	Timeliness of information	*...everything has some sort of a time frame...if my office is having a problem producing a report that is required...it becomes a bit of an obstacle for whoever needs the information if it's not submitted... the timeous presentation of information, which means if the information is not accurate, that is also an obstacle (BF73)*

Appendix P: Themes emerging at the sub-district/district levels

Selected Theme	Selected category	Examples of quote
Poor data quality	Perceptions of the level of "poor quality data"	*From our perspectives the major challenge has been <u>to have good data... (BD18)</u>* *...we had an experience lately with the <u>accuracy</u> of data. I discovered that BCG immunization was not given <u>(AD87)</u>* *I can still put <u>five over ten (for data accuracy)</u> reason being that we had lots of challenges with the database. And some of the information we have to do it manually. B<u>ut most of the managers use the information from the pivot table from the database –DHIS</u> (AD83)* *Probably say about <u>six (out of 10)</u> I would say fair. It's just that, I <u>wouldn't say that the quality is poor.</u>(BD 63)* *...now I have stronger <u>feeling that the information that is being reported can be trusted...(BD40)</u>*

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	One participant ambivalent on quality?	*There is no tradition of using information because the information has been so poor. They just don't trust the information. There are many managers out there; they will very proudly tell you that they don't border with the information because it is just rubbish and they are very proud of saying this (BD40)*
Reasons for poor quality	Clinicians unprepared /lack of skill for data-collection at facility level	*The biggest problem is on the definitions...some clinicians are not clear with the definitions on the routine monthly report data....a lot of the times the clinicians and nurses are just expected to collect data. They haven't really been inducted into what are the elements, and what are the definitions. (BD19)* *....a lot of the times the clinicians and nurses are just expected to collect data. They haven't really been inducted into what are the elements, and what are the definitions.(BD19)* *...often they (clinicians and nurses) don't know what they should tick...and some of the elements are really confusing, and they don't make sense. The staff have not been trained... (BD66)* *The staff have not been trained; it could be that there is a lack of equipment. (BD 66)*
	Lack of capacity	*I think there is not enough attention paid to it and often decision are being made in a way that does not consider the important little aspects required when collecting data and I think it's a lack of maybe understanding people when it comes to managing a facility. First of all people don't even understand what a percentage is. They don't understand what it is going to be used for. (BD40)* *A child was weighing 4.5kg and when one is having diarrhea we use the formula of 20ml per kg. Sisters couldn't calculate that; they would calculate with 5kg, make it to the nearest! You may be endangering the child's life by given him an over dose. (AD 87)*
	Carelessness of clinicians /attitude of non-care	*...some clinicians either forget or willfully don't tick off the relevant data (BD18 -sub-district manager)* *some people don't even bother to fill the tally sheets in, and then like that or if it's a register it's filled in, maybe it's not filled in. (BD19*

		... it could be there is staff attitude, like someone saying "it's not my job kind of thing, it's someone else's" (BD66)
	Rotation of staff and turnover of staff	*Challenges are there because we get new people all the time... where people don't have SOPs.... new person (clinic manager) comes in (resumes work), she is not sure what to do, how it is done. (BD67)*
	Lack of manpower and capacity	*... we have people that are using or collecting the data that are actually admin clerks who are appointed as admissions clerks, who deals with the patient and sees them with regards to forms and that but then they have information management as an added function onto their job description. (BD63)* *majority of the facilities don't have information clerks and now you have to rely on the facility managers sometimes to provide the reports and they also have a lot that they need to do and sometimes the report comes late. It's not always on time and there are gaps and so on.* *Some facilities who still uses data capturers and these data capturers are in the interim contract for about a year and they are replaced every year*
Validation issues	Lack of validation at facility level, burden on higher levels	*...information is not being verified and validated before it is sent from facilities...* *Validation is supposed to start from the facility (clinic) level. But what happens is that you find that they send information to the district level, and we capture it here. Before we capture it we do like verification then after that we do the validation (AD83)* *... at sub-district they validate facility level data, (BD18)* *What we do here (sub-district level) is a support service to our staff in the facility, to our clinical staff, to our practitioners, (regarding validation) that is all we do.*
	Snowball effect of non-validation at facility level -Extent of validating and coordinating overwhelming at district level	*..because of the deadlines (for facilities) by the 7th here to submit the data, you find that the data from the facility go through the facility supervisor, maybe the M&E, who just sign for it and sends it to the district without validating the data* *That's not what we're supposed to do at the provincial level because that data is supposed to have already been checked at the facility level, sub-district and district level. But we do check it because at the end of the day we do pick up that*

		there are errors and mistakes in the data. So we <u>do validate that data and then send</u> monthly reports to the district offices and regional offices plus the central hospitals to correct that data. (BD17) *It's a lot of information and the Metro is very big and you <u>have to keep tabs on all the information that comes in; it can get a bit overwhelming at times...</u> you need to make sure you get what you need from the people and you need to maintain relationships because people need to report to the next level at a certain time (BD12 district health director)*
	Issues relating to paper-based and electronic data-collection tools	*Data <u>comes to the sub-district in a paper format, because they draw the reports,</u> it's brought to the sub-district where the information officer will then capture it onto the pr<u>ovinces data base, Sinjani.</u>* *I think issues really r<u>elate to paper based and then there's also the electronic data.</u> So the paper based data in the facilities.* *You find that the c<u>ollection tools they are not talking to the registers at the clinics,</u> (Interim measures taken and tools to be adapted*
	Cooperation and coordination with City of CT	*...we have the <u>City which is a part of our district really but they're under another authority</u> so it's a bit difficult to get things from them; so we need their buy in that they're going to provide us with information.* *We have a monthly session where the city people come together. Well we try to get the city people on board. We've developed an SOP (standard operating procedures) now so they need to basically come on board (BD12)*
	System improvement/ review meetings improved data-quality and retrieval	*In 2008 we looked at our systems and we looked at the number of meetings that we have as a sub-district concerning the data and we named those meetings, "Data review" meetings. The people that sit in that meeting are the Sub-district manager, the TB/HIV coordinator, the programs manager, the Health Information officer. So five of us sit together and look at the data after <u>we have received it from the facilities (clinics), clean up the data and feed it back to the facilities, identifying gaps</u> (BD67)*
Electronic systems issues	DHIS and Sinjani elements not synchronized	*DHIS is supposed to be exactly the same as Sinjani. But it's not 100% the same. There are a lot of discrepancies. As I said to you, any changes that is done on DHIS, I am supposed to do the same changes on Sinjani. Sinjani has got its own*

		limitations. For example, at the beginning of financial year they normally change the elements.
		Another challenge that we are having, is the elements, there's this <u>difference between Sinjani and DHIS elements,... the two information systems use different wordings, so that's a challenge we are facing.</u> Because at the end of the day, I <u>have to manually link those different facilities plus the different elements to each other when I'm doing the import. (BD17)</u>
		Things like outliers which are based on ranges and some of those ranges don't make sense, and they never get revised. And we've been asking for some to be revised for years, and what it does is that it makes people stop bothering to give real comments. They just say oh, it's correct.
		We've had a bit <u>of challenges with Sinjani of late,</u> because they (province) changed their minimum data set (PIDS). (BD18)
		It is disappointing that sometimes you will catch something it is there on capturing screen but on the <u>pivot table it's not there...</u>with the <u>formulas in the DHIS,</u> you find that there's a new element and the formula is still using the old element and you try to find out what is the problem here? And some of the indicators we calculate it manual (AD83)
		We only use DHIS for campaigns. That's a much easier system to use for me, but unfortunately we have to use Sinjani (AD63)
		You find that the collection tools they are not talking to the registers at the clinics, (Interim measures taken and tools to be adapted
Training for data-collection and capturing/ validation	Structure and content of the training to be interactive and experiential in nature	*Depends ...is it purely didactic which is utterly boring or is the <u>training interactive (BD19)</u>*
		I would prefer o<u>n the job training.</u> I believe on the job training is more meaningful than a classroom session whereby they are just happy that they are out of their workplaces.
		Immediate support even if it could be a central training but immediate support at a facility level to see that, because it's practice that will make you perfect.
		<u>And I do think that it is very important to strengthen people's understanding of the reason why data is collected (AD87)</u>
		My experience is that no matter how much training they have, <u>people don't r</u>eally listen; they only hear

		what they are expecting to hear…Only when you start comparing and showing them that they are actually doing something different from the others,… (BD40) *I'm tired of training. I would prefer on the job training. I believe on the job training is more meaningful than a classroom session whereby they are just happy that they are out of their workplaces…(AD87)*
Barriers to use of information	Mistrust in data accuracy for planning	*Because the data is incorrect, the data cannot be used … (AD87)* *…the validity of that information,(BD18)* *Most of the managers, they don't trust the information that has come from our database… (AD83)* *There is no tradition of using information because the information has been so poor. They just don't trust the information. There are many managers out there; they will very proudly tell you that they don't border with the information because it is just rubbish and they are very proud of it …(BD40)*
	Lack of skill to interpret data for planning and use	*When you talk of use of data. See if I do not understand the data myself. I don't know what the stats are saying. There is no how I can use it. So I think it's probably a lack of skills on the parts of the CEOs. They don't know what these figures represent. Now they just collect the data and send them through to head office… (AD83)* *We give the information to the senior managers. They are able to use the information for planning. And there are other people also from other institutions that are using our information. They come and request it. (AD83)*
Use of information	Selective use of information for Monitoring outcomes for politically purposes Reporting and campaigns	*Data is used for monitoring target numbers outcome and not to address limitations of access and staff numbers (BD67)* *They want the figures, they use the figures as to say our program is doing very, very well... We have HH and MK hospitals that are in the middle of nowhere. There are no taxis going that direction. What are the heads of the department doing, or the government? What is the government doing about that? Are they providing any transport to say there is a transport system for patients? (BD67)* *We use the data here (sub-district); they send it to us on the routine monthly report monthly and then we will capture it on our information systems and*

		so on. And then we report the data to them in terms of graphs and other reports that we use.
		I don't think all, if it is used by policy makers...but we have evidence of data which is used. I mean if you look at the TB data we collected few years back, we had a TB, I think it was a <u>provincial initiative to have a TB action plan, which drew from the data we had, you know the cure rates</u> ...(BD18)
	Detachment from information on facility level	*People believed that you collect information you send it to district, to province, national then <u>national will see what they want to do with that information</u> (AD83)*
		We need to capacitate managers on the ground on how to use that data. And then to ensure that all the managers, actually now we got a new protocol, will actually sign off the data to ensure it is valid, and to hold managers accountable for decisions taken.(BD18)
	Selected different perspective on quality data for the use of data (health manager BD 40)	*We ar<u>e just planning for where we have got poor performance</u> but we should really be planning for the best utilization of resources...stronger ....u<u>sing poor information that is unreliable and undependable, is always the starting point, ...</u>and it is only in the process of analyzing it, making sense of it and giving feedback to the people that produced it so that they understand what the data is used for, that <u>you really get information to be good. (BD40)</u>*

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Appendix Q: Themes emerging from PMTCT programme managers and coordinators

Selected Theme	Selected category	Examples of quote
<u>**Issues**</u> **for accurate data recording - staff coordination**	Staff at different levels involved in several registers for one program	*<u>There are Issues at different levels of data collection and reporting...</u>* *...<u>different people on the ground are responsible for different registers</u> and in fact for some registers, you need more than one provider. So for example the HCT register is done by counsellors and they also need the nurses to provide some of the information. And so I think one of the problems is that they don't actually work in the register, they have bits of paper and they put the various bits together in the register later on. (BD20)* *..Data would not tally with what is in the DHIS. <u>Sometimes it would be because the clinics have recorded wrong data or the data is recorded correctly in the clinic, but when it comes to the district, it's captured wrongly</u> (AD71)* *I don't think it is one thing. I think what happens in the facilities contributes... they still sometimes bring wrong data, and then that wrong data is captured in the system. But also, correct data is captured and it says other things, and also if wrong data is brought, someone that is capturing should be able to see that this is abnormal. (AD71)*
	Cooperation between staff at facility level	*Sometimes there's a bit of a struggle between the <u>health care workers, the health and the counselors</u> as to who is responsible for the register...you will get to a register where a certain section will be very poorly completed, and then it's usually a matter of the well completed part is, let's say the counselor who's doing the testing, completing everything up until the point where you need CD4 counts and WHO staging, which the health care professional should complete. But now the counselor's got the register in that room and I'm working in this room, or it's a matter of who's responsible and accountable. (BD13)*
	Coordination and integration of data flow -metro and city (See also doc 3)	*So what happens with PMTCT, the City facilities provide the baby follow up form, or service, and we do the labour ward. So, currently the City of Cape Town is not capturing the PMTCT on Sinjani. So what they do is on a monthly basis. They send it to us here at the district office, and we capture it here. (BD12)*
	Clinical SOPs are not user friendly	*...the clinical staff aren't always clear what they supposed to do. So we've got different guidelines, we've got the PALSA plus and we've got the national guidelines, but I think as a person who's done*

		training and working with staff, I don't think either of them are that user friendly...(BD20)
Staff not equipped and skilled for correct recording of data	Three data-collection tools for one program	<u>*PMTCT is a fairly big program with three main data collection tools...registers; ... antenatal, labour and postnatal; so apart from all the stationery and folder having to be filled in, there are three registers for one program. Um, it's different levels so it's different staff completing the registers but still, a lot of data (BD13)*</u>

<u>*At the SH clinic the problem was that the person in the baby clinic was not even a professional nurse. So it was a staff member who wasn't adequately qualified anyway to do the job, and he certainly didn't understand the register ....In the facilities the staff had never had any training on the use of registers ...and there was actually a new baby follow up register, and they didn't fully understand how to use it...(BD20).*</u>

<u>*People do not understand the data and interpret the data correctly... there's a kind of numeracy mental block....*</u>*So they will take what is given to them by information management as the final result without interrogating the data. And then report on data without realizing the issues that specific data set has. (BD20)*

...he didn't have anything to refer to; so he di<u>dn't have any of the tools to do the job, let alone capturing the data to record what he was doing..</u>.(BD20)

Data is captured in the hospitals and then it's reported to the districts and we have a lot of <u>problems with that data...what I have on the data is not what is happening in the facilities. (AD71)</u> |
| | lack of accountability | *Baby follow-up – missing data...lots of outstanding results and some babies weren't tested; it seems as if it concerned the staff member; I think he thought his job was to hand out free tins of formula milk. That was his job. He didn't see the whole picture...(BD20)* |
| | Lack of Feedback/data interrogation | *...it's almost like they choose what to take seriously...I think it's because of all sorts of issues, training, and accountability. The labour ward register is also slightly confusing...why they don't fill it in at the beginning is that...they sort of think it's not my problem anyway.(BD20)*

I don't think there's nearly enough feedback to people on the ground...it's taken us many months ourselves to sort of work out how the data flow works...I'm |

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		seeing more and more the importance of giving feedback...but I don't think it happened very much at all. (BD20) *But then if you can interrogate the data and you go back and check you can see that there were flaws in the data... and people can see where they are doing well and doing bad and where they need to make an improvement. (A58)*
Training as option for accuracy of data	Experiential training/ applied learning based on adult learning principles as preferred option Relevance	 *I think training that is applied training, not theoretical training that says you use this register like this but this is why you use this register. I don't know if applied training is the right word, but you know what I mean (AD71)* y*ou can't really have a one size fits all (BD13)*
	Participative Learner-centered	*I think what you actually have to do is to find a way to package the information, in digestible way, like sugar coats it almost. You know I think a lot of people aren't used to looking at data. I mean and I felt it myself and I could see the PMTCT coordinator, you know we'd be given all the provincial data and then there's just these excel spread sheets and there are numbers everywhere...(BD20)* *...But I also think people just aren't used to it, it's a paradigm thing of using data to track quality of care (BD20)*
	Ownership	*Training staff will make a difference because it will give the staff a bigger picture, like the numbers that "I palpated five mothers". What is the meaning of that? They must put this to their work load, they must be able to relate this to their workload...But now because I think their knowledge is limited, they are just working, "today I have just come to work", like pushing a wheelbarrow, like a labourer. They do not own it as in their enterprise, (AD71)*
	Staff turnover challenge in training	*In certain districts you have quite a high staff turnover which makes it very difficult, and even though we have a lot of people at district level, you can only train every X amount of weeks or months. (BD13)*

Limitations of data collection/ recording instruments	No provision for exceptional cases	*An example... mother default ART 2 weeks before labour... look at the register, with the column saying whether she's on ART or not you need to say 'no', because currently she's not on ART, even though she was. Then with your four steps for mothers who weren't on ART, you tick whether she had adequate AZT antenatal then the three different drugs intra-partum. She won't have the antenatal AZT so that's 'no' and three "yeses" but then the summary of the intra-partum care and antenatal care will be a 'no' because you've missed one of the four...(BD13)*
	Change of data tools is "a step back..."	*...We introduced in April, this register, the ANC register and then we are taking a step back because when I visited the clinics, I found that the "WHO staging" is not recorded, l saw that the CD4 count is not recorded. So the <u>numbers that they are feeding to the DHIS are obviously wrong numbers,</u> so I need to go back now and correct from April and that is my problem there (AD71)*
Challenges with the cohort design	Access to /tracing all babies born into the cohort	*You first have a bit of an issue to get all the infants born into that cohort.*
	Follow up issues Results not captured Unknown reasons for lack of babies follow up	*And then to get everyone who enters into that cohort to actually have a six month result, written in that register... Because often they do the test but somehow the result never ends up in the register, then it seems as if we're not testing all infants. And then of course you're not always aware of anything that happens in between; did the mother move away or did the infant die? Because you're basically working with a cohort at a baby wellness site, but something happens and the infant ends up in Tygerberg hospital and never comes back. (BD13)*
	Migration of parents/mothers	*Lot of moving around. Rural does have similar challenges with seasonal workers. So you'll often find that with seasonal workers they'll be there three months in Overberg, and then they go for three months to west coast and then they go for three months to Cape Winelands. So pregnant mom is in Overberg, mom gives birth in Cape Winelands and then… (BD13)*
Validation of data - System or staff recording issue?	DHIS (resistance?) and data accuracy	*<u>Using Epi Info. In that program we had accurate data</u> and the feedback was good and you could generate reports for the different clinics, but then it needed to be on DHIS and when it came to DHIS, I would say my experience now is not so good but I would say since now we are working together we're getting there.*

		I could see that the validation rules in the DHIS pick up these, so I don't understand why we get wrong data at the district, 150% or something, that I don't understand but there will be a day that I would be able to explain that to you. But I don't understand it.
	No proper data validation at sub district levels	*Data is supposed to have already been checked at the facility level, sub-district and district level (BD17) we do pick up that there are errors and mistakes in the data. So we do validate that data and then send reports, monthly reports to the district offices and regional offices plus the central hospitals to correct that data*
Use of information	Selective use for reporting	*...varying degrees... I don't think the data is completely accurate but I think its like; it's definitely giving you a sense of what needs to be addressed. (BD20)* *...I think at district level we are looking at our cash flow, we use so much and relate it to...maybe we initiated so much people in ART. We have not been working like that, I think. And with top management I don't know how they will be operating but it's the sense that I get...(AD71)* *I think it is used because, I see it when they allocate us budget. I see that when our numbers are low our budget is reduced. So I think they use it, they estimate and use it because they are also aware that it's not correct data...(AD71)* *I report on about 5 different platforms, most of the PMTCT data. So, lots of the information I use for reporting purposes, many of them measuring output and program performance, but then some of them more quality. And then in terms of business plan and budget there's some of them where, especially feeding options, whether we need to procure less or more milk. Um, ART initiations and policy, whether we need to procure or budget for more or less AZT, more or less lifelong ART etc.(BD13)* *...at district and sub district level they also meet, I think quarterly, where they report only their little data set, and report, interpret, identify bottlenecks, and go back: what are we going to do, how are we going to solve this. So there's definitely a feedback mechanism from district to substructure to facility.(BD13)*
Barriers to use of information	Lack of understanding of the data and interpret the data correctly	*...people do not understand the data and interpret the data correctly... So they will take what is given to them by information management as the final result without interrogating the data. And then report on data without realising the issues that specific data set has...(DB13)*

		...people sometimes report data without thinking about the data. Um, I've been to many sessions where people will report data where the indicator was not calculated correctly. ...(DB13)
		...at facility level, I would say that maybe it's the clinic manager not practicing her managerial role and they cannot use information obviously, it's just daily routine coming to the clinic...(AD71)
	Data not trust	*...Then you would question the integrity of the data...this does not look as if it is correct, really. At times you can't trust the data because people can just tick and tick and tick and yet something is not done and you are not there to look at it. (A58)*
	Packaging of information	*I think that a lot of people are slightly nervous of figures. There's a kind of numeracy mental block...you have to find a way to package the information, in digestible way, like sugar coat it almost. You know I think a lot of people aren't used to looking at data...(BD20)*
	Lack of skills to use data	*...we knew what the target was and we got the feedback but the M&E manager sort of packaged it in a way that she'd show us these graphs of that and a few other things....we had someone who could distil and interpret and give it to us, so if anyone asked practically anyone in the program, nurses, counsellors...they could tell you (BD20)*
	Lack of culture of information use	*...we'd be given all the provincial data and then there's just these excel spread sheets and there are numbers everywhere, and I think numeracy mental blocks are far wider spread than we realise. ...(BD20)*
	Accountability for accurate data	*...I also think people just aren't used to, it's a paradigm thing of using data to track quality of care. I think it's something that almost has to be instilled in people...(BD20)*
		I think managers need to take responsibility and be accountable for their districts and for their sub districts. And making sure that what they are signing off on a monthly basis is correct, so they must make sure that the information that they are providing to the next level is correct....(BD12)

Appendix R: Difference between registers and RMR for six PMTCT data elements
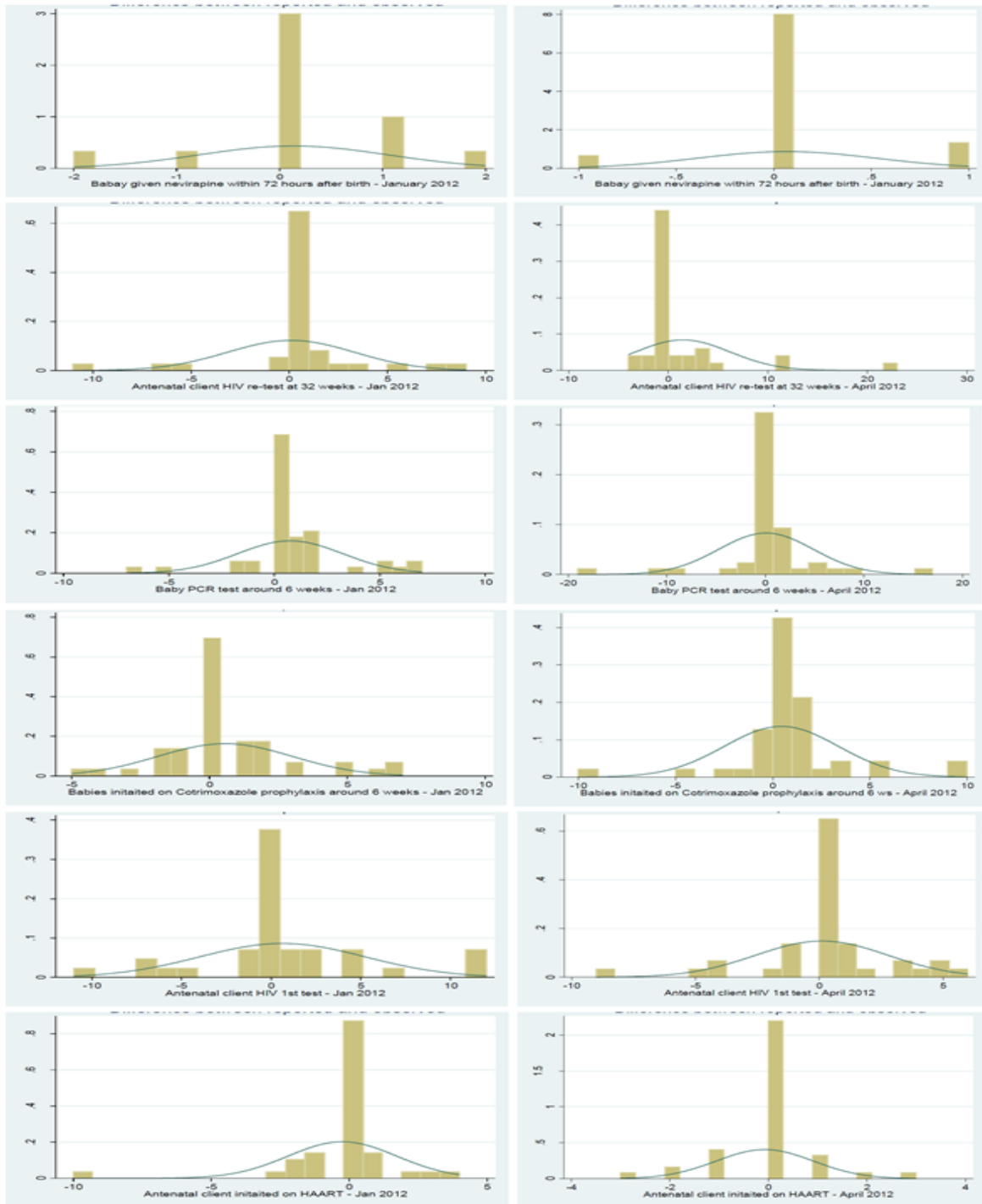
Appendix S: Modelling data accuracy using the PRISM framework

Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Authority	Authority	Authority	Authority	Authority	Authority	Authority
	Staff characteristics	Staff characteristics	Staff characteristics	Staff characteristics	Staff characteristics	Staff characteristics
			Organisational factors	Organisational factors	Organisational factors	Organisational factors
				Information culture	Information culture	Information culture
				Resources	Resources	Resources
					Behavioural factors	Behavioural factors
						Processes