THE DISTRICT HEALTH INFORMATION SYSTEM (DHIS) AS SUPPORT MECHANISM FOR STRENGTHENING THE HEALTH CARE SYSTEM

by

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DEDICATION

In memory of my father and mother, Neels and Miems van Helsdingen, who provided me with love and stability. They taught me to be caring and committed....and to have high levels of determination.

My father and mother, Barney and Arthur-Lee van der Walt, who motivated and supported me.

My husband and my children who blessed me with unconditional love and endless dedication

- *Manie van den Bergh*
- *Marius, Adéle and Malan (grandchild) van den Bergh*
- *Crizelle and André Nel*
- *Crizaan van den Bergh and Paul Oosthuizen*
- *Crizette van den Bergh*

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DECLARATION

I declare that **THE DISTRICT HEALTH INFORMATION SYSTEM (DHIS) AS SUPPORT MECHANISM FOR STRENGTHENING THE HEALTH CARE SYSTEM** is my own work and that all the sources used or quoted have been indicated and acknowledged by means of complete references. This work has not been submitted before for any other degree at any other institution.

..... 1 March 2009 .....

Christa van den Bergh **Date**

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I am grateful to God for giving me the ability to complete this study.

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ABSTRACT

The purpose of this study was to show how information from the District Health Information System can be used to empower managers to make evidence-based decisions that will strengthen the health care system to reduce the under-five mortality rate.

A quantitative, contextual, exploratory evaluative and descriptive approach was followed and a data extraction framework, based on systems theory, was developed to guide the process of extracting existing routine data.

A results-based approach was used to measure under-five mortality related health care in terms of impact, outcomes, outputs, processes and inputs. The study has highlighted that proxy indicators obtained this way places health care managers in the position to monitor progress towards achieving the Millennium Development Goal for child mortality in the interim periods between large population surveys.

The findings displayed in the diagnostic performance profile revealed that drastic interventions are required to reduce the under-five mortality rate.

KEY CONCEPTS

Health care system, district health information system; evidence-based management; routine health information; under-five mortality; health systems research.

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ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
ANC	Antenatal Care
APP	Annual Performance Plans
ASSA	Actuarial Society of South Africa
BBA	Born Before Arrival
CFR	Case Fatality Rate
CHC	Community Health Centre
CHCs	Community Health Centres
CYPR	Couple Year Protection Rate
DHIS	District Health Information System
DHS	District Health System
DTP	Diptheria-tetanus-pertussis vaccine
DTP-Hib 1st dose	Diptheria-tetanus-pertussis & Heamophilus Influenza Vaccine 1st dose
HCS	Health Care System
HCSs	Health Care Systems
HIV	Human Immunodeficiency Virus
IMCI	Integrated Management of Childhood Illnesses
IMR	Infant Mortality Rate
LBWR	Low Birth Weight Rate
MDG	Millennium Development Goal
MDGs	Millennium Development Goals
MMR	Maternal Mortality Rate
NDoH	National Department of Health
NNMR	Neonatal Mortality Rate
M&E	Monitoring and Evaluation
NHA	National Health Act
NHIS/SA	National Health Information System of South Africa
PHC	Primary Health Care
PMTCT	Prevention of Mother to Child Transmission (of HIV)
PNMR	Perinatal Mortality Rate
SBR	Still Birth Rate
StatsSA	Statistics South Africa
TOP	Termination of Pregnancy
Tet Tox	Tetanus Toxoid
U5MR	Under-five Mortality Rate
U5MRs	Under-five Mortality Rates
UNAIDS	Joint Program of United Nations on HIV/AIDS
UNICEF	United Nations Children's Fund
WHO	World Health Organization

CHAPTER 1

ORIENTATION TO THE STUDY

1.1 INTRODUCTION

One of the purposes of international strategies and long-term statements of intention such as the Millennium Development Goals (MDGs) is to address health inequities in terms of the main causes of morbidity, disability and mortality. One of the MDGs focuses on child mortality and each country is expected to report annually on the progress they have made in achieving this goal to the World Health Organization (WHO), the United Nations Children's Fund (UNICEF) and the Joint Program of United Nations on HIV/AIDS (UNAIDS) (Kekki 2003:3-4).

The focus on collecting evidence for public health decision-making emerged in the late 1990s, and this interest was intensified when *The World Health Report 2000* drew attention to the limited evidence that was available for making informed decisions about the organising, financing and management of health systems (Murray, Mathers & Salomon 2003:715).

Several surveys, such as *Demographic and Health Surveys, Living Standards Measurement Studies, Census Surveys* (Global Equity Gauge Alliance 2003:11) and research studies are conducted internationally and nationally to obtain the kind of sound evidence and data on which policy makers and health care professionals need to base their decisions. Although population-based surveys are the primary sources of data in most low-income countries (Bryce, Terreri, Victora, Mason, Daelmans, Bhutta, Bustreo, Songane, Salama & Wardlaw 2006:1068), there is increasing evidence that up-to-date and reliable routine health information is essential for ensuring adequate health system performance.

The ineffectual utilisation of health information constitutes a serious obstacle to effective health system management and performance, both in South Africa and throughout the world. It is therefore necessary to improve the performance of current routine health information systems so that they will be in possession to provide whatever evidence health managers may need for monitoring health system performance effectively and efficiently (Campbell 2003:3; RHINO 2001:1; Shaw 2005:635; WITFOR Health Commission 2003:1).

While UNICEF uses the *under-five mortality rate (U5MR)* as an indicator of how effective social and economic progress and development are (Solarsh & Goga 2004:104), the *U5MR* is also used as an indicator of the effectiveness of health systems world wide (WHO 2006a:2). Since South Africa is not being successful in achieving the Millennium Development Goal (MDG) on child mortality, it may be argued (from a systems perspective) that health care inputs and

processes are inadequate. It can also be plausibly argued that in those facilities, sub-districts, districts and provinces where the mortality rate or incidence of specific priority conditions (such as pneumonia in children under five years of age) is inequitably distributed, or higher than the target or the average for that specific area, health interventions are not being implemented in an effective way (WHO 2003b:35-36).

According to Gray and Pillay (2006:7) 75% to 80% of the South African population is dependent on the health care that is provided at public health care facilities. The proper use of evidence to identify and address specific child health care shortcomings in the public health care sector may therefore contribute toward enabling South Africa to meet its MDG on child mortality.

Chapter 1 provides background information on Primary Health Care (PHC) service provision, international health priorities, the South African District Health System (DHS) and the District Health Information System (DHIS). Chapter 1 also outlines the rationale for the study and briefly describes the objectives, methodology and limitations of the research.

1.2 BACKGROUND TO THE STUDY

In order to understand how routine health information can be used to assist managers in strengthening the health care system (HCS) to reduce the *U5MR*, strategies to monitor and address priority health problems and under-five mortality are discussed below.

1.2.1 Strategies to address main health problems

Extensive PHC services, a basic hospital structure and a decentralised DHS constitute the core WHO strategies to address the main global health problems, equity in health care delivery, and Health for All (WITFOR Health Commission 2003:1).

PHC in the new millennium is defined as integrated, comprehensive, needs-based health care delivered at all levels of the HCS. PHC within the DHS includes seamless and integrated promotive, preventive, curative and rehabilitative interventions that are designed to mitigate the main risk factors and causes of morbidity, disability and mortality (Declaration of Alma Ata 1978:1, WHO 2003a:1, 5).

The South African National Health Act (NHA) (Act 61 of 2004) provides the framework for a structured and uniform DHS that is based on the principles of PHC and that emphasises equal access to quality, comprehensive health care services, as well as effectiveness, efficiency, sustainability and local accountability (NHA 2004:2, 4, 40). The DHS of South Africa serves a population of 47.9 million people who live in nine provinces which are divided into six

metropolitan municipalities and 46 district municipalities. These 52 health districts are further divided into sub-districts or local municipalities (Barron, Day, Monticelli, Vermaak, Okorafor, Moodley & Doherty 2006:ixx; StatsSA 2007b:2).

The main international health priorities that should be achieved by 2015 are specified in the MDGs. South Africa was one of the 189 countries that adopted the MDGs in 2000 (Murray et al 2003:716) and that reports on the health-related indicators that were selected by the WHO to measure progress towards achieving the MDGs (Kekki 2003:3-4, 12).

Equity in health care may be defined as health services that are fairly distributed in terms of inputs, processes and outputs (in proportion to need), in different areas and with regard to different social groups. Health equity also implies equity in terms of the effectiveness and efficiency of health care interventions and management processes (Katzenellenbogen, Joubert & Karim 1997:149-150). International concern about inequities in health is not new – equity was one of the key principles of the Declaration of Alma Ata in 1978 and was reemphasised by the Millennium Declaration in 2000.

Monitoring, evaluation and reporting form the basis of effective health system management and effective management in turn results in effective health service delivery (RHINO 2003:2, 4; WITFOR Health Commission 2003:1).

1.2.2 Health care monitoring and evaluation

Population-based surveys are the primary sources of data in most low-income countries (Bryce et al 2006:1068). Although the data obtained from surveys is extremely valuable, it is usually generalised to country and provincial levels. Results-based management, on the other hand, requires the availability of health care data for districts and local areas (Murray et al 2003:716). An increasing amount of evidence suggests that timely and reliable routine health information is essential for ensuring the continuance of adequate health system performance and that routine health information systems should be strengthened to support effective and cost-effective monitoring (Campbell 2003:3; RHINO 2001:1; Shaw 2005:635; WITFOR Health Commission 2003:1).

Although routine DHIS data (like all other methods of data collection) has certain limitations, the biggest advantage it presents to managers in South Africa is that routine data can support evidence-based management at all levels of the HCS, from facility to national level. Regular updates also enable the early identification of specific problems in particular communities down to the level of service delivery. This can provide a basis for implementing whatever corrective measures will make the most effective impact, while at the same time supporting the continuous measurement of inequities and definable progress towards established targets.

The NHA stipulates the responsibilities that the National Department of Health (NDoH), the provinces and districts bear for the establishment and maintenance of a comprehensive national health information system. The DHIS was adopted as the routine health information system of South Africa in 1999, and it contains essential data from all PHC programmes and hospitals. The DHIS feeds data from all public health facilities into a comprehensive district information database. This database enables the monitoring and evaluation (M&E) of each facility, sub-district, district and province, as well as the entire country in terms of priority health programmes and interventions (DHIS 2007; NHA 2004:76; SA 2003:2-3).

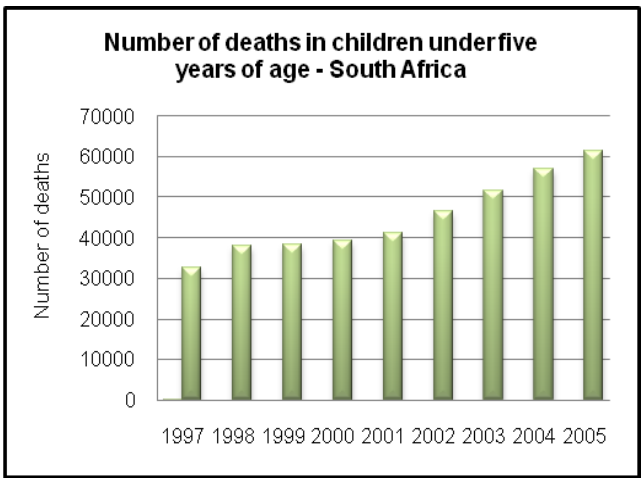
In spite of this, DHIS data is not used effectively in South Africa (Burn & Shongwe 2004:38; Pillay, Rohde & van den Bergh 2002:4). This is in line with many other countries in the world in which the poor utilisation of health information (especially routine health information) has been documented as an obstacle to effective health system management and performance (Cibulskis 2005:637; Africa Commission 2004:11).

1.2.3 Under-five mortality rate in South Africa

The goal to reduce the *U5MR* between 1990 and 2015 by two thirds has been identified as the most difficult MDG to achieve at the current rate of progress, especially in Sub-Saharan Africa (European Commission 2004:19). There is international concern about the predictions that more than half of the countries that adopted the MDGs in 2000, will fail to reach their targets by 2015 if they continue at the rate of progress which was reported in 2006 (European Commission 2004:4).

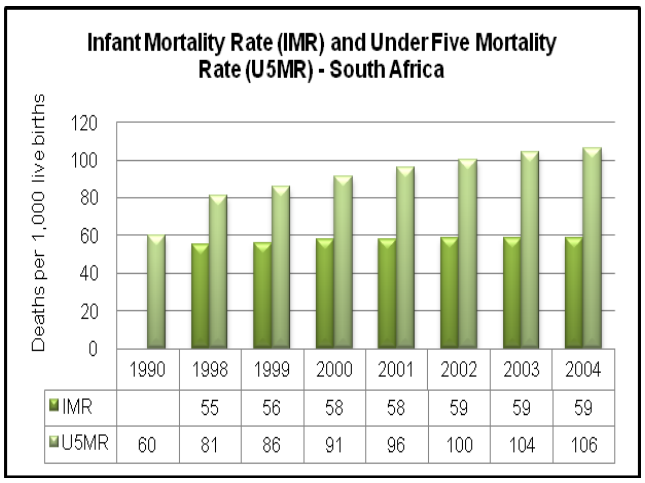
South Africa was among the 60 countries in the world with the highest rates of child mortality in 2004 (Bryce et al 2006:1068). It was also identified as one of the nine countries in the world where the child mortality rate continues to increase (Thom 2007:1).

While South Africa's *U5MR* target for 2015 is 20 deaths per 1,000 live births (Bryce et al 2006:1071), the number of under-five deaths reported in Statistics South Africa (StatsSA) (2007a:9, 38-39) and illustrated in Figure 1.1, nearly doubled between 1997 (32,468) and 2005 (61,461). Figure 1.2 sets out the *infant mortality rate (IMR)* as well as the *U5MR*, indicating an *U5MR* of 106 deaths per 1,000 live births in 2004 (Presidency 2007:34). It should be noted that this 2004 *U5MR* was five times higher than the anticipated 2015 target. Because the *U5MR* is a "common health status indicator used to assess [health care] system effectiveness" (WHO 2006a:7), the high and annually increasing *U5MR* raises serious questions about the effectiveness of the South African HCS.



(StatsSA 2007a:9, 38-39)

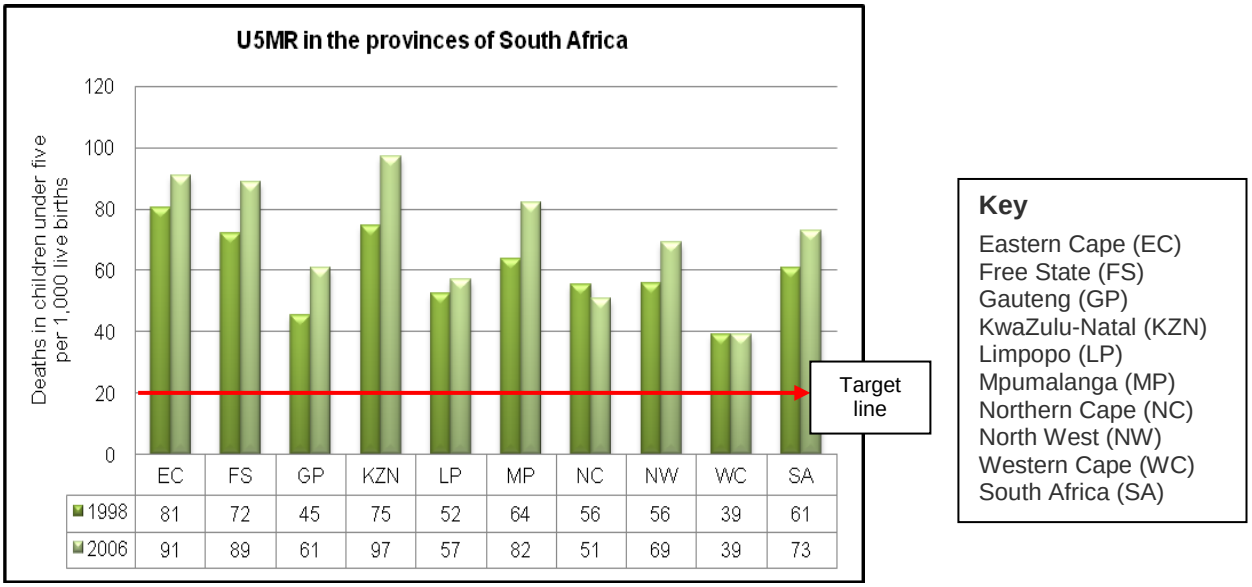
Figure 1.1 Deaths in children under five years of age (South Africa)



(Presidency 2007:34)

Figure 1.2 Infant and under-five mortality rates (South Africa)

While the rising *U5MR* is a major problem that policy makers, health managers and health care providers in South Africa are forced to deal with, inequity in the *under-five mortality rates (U5MRs)* between South Africa's nine provinces, as illustrated in Figure 1.3, is a further cause for concern.



(Day & Gray 2006:493)

Figure 1.3 Under-five mortality rate in the nine provinces of South Africa

The NDoH in South Africa has adopted and implemented several strategies to improve child and maternal health and to reduce mortality among the most vulnerable groups. These strategies include termination of pregnancy (TOP), the integrated management of childhood illnesses (IMCI) programme, the prevention of mother to child transmission (PMTCT) of the human immunodeficiency virus (HIV), baby-friendly hospitals and kangaroo mother care (Saloojee 2007:103), as well as "A World Fit for Children" (Solarsh & Goga 2004:101, 109). The NDoH also prioritised strengthening the maternal, child and women's health programmes as

one of the five national health system priorities for the years between 2007/08 and 2009/10 (SA 2007a:25).

In the face of indisputable evidence that certain inequities and various kinds of underperformance do affect child mortality rates, where do health care providers and managers in resource-restricted environments even begin to address problems? Why is the DHIS, which contains a wealth of data and information about child health, not being used by managers for evidence-based management?

These questions are difficult to answer. The complexity of this situation is aggravated by the fact that many determinants of child health occur outside the HCS and that many children die outside health facilities, while the DHIS only contains data for public health facilities. However, according to StatsSA (2007a:14), 43.4% of all deaths in 2005 were reported by *hospitals*, and there is ample evidence to show that an unacceptable number of children die in public hospitals (Cullinan 2007a:1; Cullinan 2007b:1; Cullinan 2007c:1). It is crucial to ensure the best possible care, within the limits of available resources, for the 75-80% of the South African population (Gray & Pillay 2006:7) and the 85% of the Free State population that is dependent on public health care (Day & Gray 2007:319).

Can the kind of public health facility data that is readily available in the DHIS be used for management decisions which are directed at reducing the *U5MR* in South Africa?

1.3 RESEARCH PROBLEM

In line with global strategies for addressing main health problems and equity in health care delivery, South Africa is committed to PHC, has a well established DHS, implements several strategies to improve child health and has a standardised routine health information system. But in spite of all these measures, South Africa is clearly not on track toward achieving the MDG on child mortality.

Managers do not use the information that is available in the DHIS for evidence-based decision-making. Although there are several factors that contribute to the underutilisation of health information, it is not clear whether:

- The data and indicators contained in the DHIS meet the needs of managers to make decisions for reducing child mortality in the public health care sector.
- DHIS data is made available to over-burdened managers (who are not information specialists) in a user-friendly format that will readily support evidence-based decision-making.

1.4 AIM OF THE STUDY

This study explores how evidence from the DHIS can be used to help managers to improve the HCS so that the MDG for child mortality will be realised in the Free State province. The idea is to identify key features, constraints and processes of the system that are open to improvement, and which, when they have been improved, will transform the DHIS and the DHS in such a way that it will be able to exert an identifiable effect on child mortality rates. The research identifies potential indicator shortcomings in the DHIS, explores how available evidence can be used for corrective action and describes how progress can be measured.

The outcomes of this study are intended to raise issues about how to use routine data for further improvements in the HCS, as well as in health care intervention options that are designed to reduce child mortality. The outcomes of this study will also put managers in a position to plan and implement the kind of actions that will address child health inequities in communities within as well as between districts, sub-districts and facilities of the public health care domain. It may also create opportunities for shared learning about the way in which policies and strategies for reducing child mortality are being implemented and may provide useful information about which interventions seem to be working and which do not.

1.5 OBJECTIVES OF THE STUDY

The overall aim of this research will be realised through achieving the following objectives:

- A careful and critical consideration of whether data and indicators in the DHIS are appropriate and sufficient for monitoring equity in *U5MR*-related PHC.
- An exploration of how existing DHIS data can be used to help managers to strengthen the HCS so that it becomes more effective in reducing the *U5MR*.
- The development of a performance profile that will be available to support managers when they engage in evidence-based decision-making.

1.6 THEORETICAL FRAMEWORK

Several authors have equated the HCS, of which the health information system is a sub-system, to an industrial system because it can be analysed in terms of inter-dependant inputs, processes, outputs and outcomes (Heavens 1999:14, 48; Katzenellenbogen et al 1997:151; WHO 2001a:6; WHO 2003b:12).

In this regard, Kusek and Rist (2004:57) emphasise a results-based application of the systems approach and state that “building the system is basically a deductive process in which inputs,

activities and outputs are all derived and flow from the setting of outcomes". In other words, inputs and processes are implemented with the intention of attaining certain outcome targets. Where this has been done but the system fails to produce the envisaged outcomes, it becomes necessary to evaluate all the original inputs and processes that were put in place and, by so doing, to identify possible causes for the failure of the system to produce the intended outcomes (WHO 2003b:35). Within a systems context, feedback and control mechanisms provide a basis for generating information to evaluate all components of the system and sub-systems (Heavens 1999:14).

The researcher has utilised the systems theory, as applied to health care in Katzenellenbogen et al (1997:151) and the results-based implementation of such health care applications that are described in Kusek and Rist (2004:57), to determine the appropriateness of the DHIS for results-based M&E of the HCS in terms of child mortality.

1.7 THE RESEARCH DESIGN

Research involves a systematic and rigorous exploration and description of selected phenomena in order to solve some problem or to answer some question. A research design describes the overall plan for the research, the methodology that will be used and the research strategy that will be pursued to obtain answers to problems or research questions (Kumar 2005:20, 84).

This study has used a quantitative, contextual, exploratory, evaluative and descriptive approach to conduct research into health systems in general as well as into specific problematic areas of the South African health system.

The use of the **quantitative** approach in this study is justified by the fact that the variables in the DHIS are in numerical format. These numerical variables include the number of patient visits, the number of children vaccinated and the number of deliveries conducted in health care facilities in a particular geographical area during a specified period. The values for the standard system-generated indicators in the DHIS are presented mostly in the form of percentages, ratios, frequencies and rates (Brink & Wood 1998:5; Kumar 2005:12; DHIS 2007).

The study is also **contextual** because it was predicated on public health facilities in the Free State, which is one of the nine provinces of South Africa.

This study is **exploratory** in design because it explored the relationships between indicator values in different districts, sub-districts and hospitals so that it would be in a position to identify

best practices as well as possible shortcomings in attempts to reduce child mortality (Brink & Wood 1998:15).

The study is **descriptive** because it aimed to describe the strengths and shortcomings that emerged from existing DHIS data in a systematic way. It also constructed new meanings or interpretations by describing how this data can be used to support the implementation of evidence-based management that will have the effect of reducing the *U5MR* in one of the nine provinces of South Africa (Brink & Wood 1998:15; Kumar 2005:12; WHO 2001b:16-17).

This study is **evaluative** because it measured the usefulness of the DHIS in evaluating equity in *U5MR*-related PHC services. It also evaluated how well the DHIS accomplishes its purpose of supporting evidence-based health care management that aims to achieve national and international goals (Barron, Buthelezi, Edwards, Makhanya & Palmer 1997:6; Brink & Wood 1998:124-125; Katzenellenbogen et al 1997:147; Kumar 2005:274-275; Polit & Beck 2006:499).

This study is presented as a **health systems research** study because it fulfils all the conditions for being applied, problem-based, operational research. The research enabled a careful scrutiny of the HCS and information system components and activities so that findings would ultimately be in a position to provide rational support for the kind of decision making that would improve operations at all levels of the HCS (Barron et al 1997:2; Katzenellenbogen et al 1997:147, 152).

The research design is discussed in more detail in Chapter 3.

1.8 RESEARCH METHODOLOGY

The research methodology describes the steps and procedures that a particular researcher has followed during the process of collecting and analysing data in a systematic way (Polit & Beck 2006:509).

The emphasis in this study has been placed on evaluating the appropriateness of the DHIS data for supporting evidence-based management and for explaining how results and existing data can be used to strengthen the DHS so that it becomes successful in reducing the *U5MR*. The researcher deliberately selected straightforward and simple research methods so that public health care providers, information processors, district managers, health programme administrators and other managers will all be able to understand and use the findings.

1.8.1 Study population and sampling

The study or target population is an entire set of clearly defined and described individuals or other elements that meet the sampling criteria. Sampling is defined as the selection of a group of people or other subjects who are suitable or qualified to participate in a research study. A study in which an entire population is studied is referred to as a *population study* or a *census* (WHO 2001b:71-72; Wikipedia [online] 2008).

Because an exploration of the appropriateness of the DHIS for measuring equity in PHC in all the 52 health districts of South Africa would have required resources far beyond the limitations and scope of this study, only data from the Free State province was selected for use. The researcher decided to select the Free State province because the routine information that was available from this province appeared to be of good quality, the provincial staff showed an interest in being able to use the findings of the study for strengthening their HCS, and the head of the Department of Health in the Free State readily granted permission for the Free State province's DHIS data to be used.

Since data from all the public health care facilities in the Free State was included in this study, this study qualifies as a population study or census.

The research population will be extensively discussed in Chapter 3.

1.8.2 Research instrument and collection of data

Data collection techniques commonly used for quantitative studies include observations, interviews and self-reporting instruments such as questionnaires (Polit & Beck 2006:294).

A data extraction framework (Annexure 3) was developed to guide the processes of summarising and selecting indicators and the extraction of existing routine data from the DHIS. This instrument was based on systems theory and its purpose was to summarise *U5MR*-related indicators for measuring child health care in terms of inputs, processes, outputs, outcomes and impact.

There was no need to pre-test the instrument because no data was collected directly during the course of the study.

1.8.2.1 Validity and reliability of the research instrument

While "valid" means based on sound reasoning or well grounded in truth and logic, "validate" means proving, showing, demonstrating and confirming that something is true or correct. "Reliable" means very likely to be correct or trustworthy (WordNet [online] 2008). The validity

and reliability of the study instrument are enhanced by the fact that it was based on an existing, well-researched theory that has been acknowledged as sound and trustworthy by several researchers in the health system and in other contexts (Heavens 1999:14,48; Katzenellenbogen et al 1997:151; WHO 2001a:6; WHO 2003b:12).

1.8.2.1.1 Validity of the research instrument

"Instrument validity" refers to whether an instrument is capable of accurately measuring what a researcher has planned to measure. There are two approaches that can be followed to establish the validity of a research instrument. These are logic and statistical evidence (Polit & Beck 2006:512; Kumar 2005:153). While face validity refers to the logical connection between the questions and the objectives of the study, content validity refers to whether the questions cover the full range of what is being measured. Predictive validity is regarded as the degree to which an instrument can make valid predictions about the future. Outcome and concurrent validity are judged by how well an instrument compares with a second assessment that is conducted concurrently with the research, while construct validity is based on statistical procedures (Kumar 2005:153-156).

The validity of the research instrument (the data extraction framework) was enhanced by the facts that it was based on the systems theory (which had been in use for many years) and that mainly international indicators (that had also been tested and proven to be reliable over a period of many years) were used in the study. The validity of the instrument and study data were further confirmed by the inclusion of all the public health care facilities in the Free State province in the study, by an analysis of all the monthly data that had been collected by health professionals over a six year period and by including inputs for refining the tool from study supervisors at UNISA.

The final study indicators were selected on the basis of principles and criteria that were identified during the literature review, as well as on inputs obtained from paediatric experts working in academic and public health care environments. Inputs were also obtained from information and M&E experts by means of direct and indirect communication. The key aspects that were taken into consideration during the selection of the final indicators are summarised in section 3.5.2.

1.8.2.1.2 Reliability of the research instrument

The reliability of an instrument indicates the ability of the instrument to produce consistent measurements when it is used repeatedly under similar or equivalent conditions. The reliability of a measuring instrument is an indispensable prerequisite for quantitative data collection and

the less variation an instrument produces in repeated measurements of a specific attribute, the greater is the reliability of the instrument concerned (Kumar 2005:156; Polit & Beck 2006:508).

The reliability of the research instrument was enhanced by the fact that the researcher used mostly existing standardised international and national indicators (such as *antenatal care (ANC) coverage*) to extract existing data that had been collected by health professionals in all the Free State's public health facilities over a period of six years. Because the documented data consists of counts of activities and incidences (such as the administration of vaccines, the number of deliveries conducted or the recording of deaths), it was not possible for the physical settings, the nature of interactions, the respondents' moods and attitudes, and the regression effect to influence the reliability of the instrument (Kumar 2005:159).

Before the instrument was finalised, the researcher also obtained inputs from experts who included paediatricians, a statistician, a DHIS database manager and study supervisors at UNISA.

1.8.3 Data analysis

Data analysis entails the methods that are used to organise data in such a way that research questions can be answered (Polit & Beck 2006:495).

Data analysis was carried out by making use of the DHIS software. Although the DHIS software is not a statistical package, it enables analysis because it organises and categorises raw data, it calculates standardised pre-set indicators and displays results in a way that supports meaningful presentation.

The research methodology is discussed in greater depth in Chapter 3.

1.9 PERMISSION TO DO THE RESEARCH

Permission to conduct the research using existing official data was requested from the head of the Free State Department of Health by means of a letter (Annexure 1) to which the proposal and research instrument were attached. The letter confirming the approval of the head of the Free State Department of Health is attached in Annexure 2.

1.10 SIGNIFICANCE OF THE STUDY

Significance refers to the reasons why a study is important or "significant" and how it contributes to the existing base of knowledge in its field (Polit and Beck 2006:434, 512; WHO 2001b:148). This study is significant, not only from a purely scholarly point of view, but also because it can make a considerable contribution to the improvement of current health care in South Africa. This attribution is based on the assumption that its findings can be used to:

- Promote and support the utilisation of routine health information in evidence-based management that will result in a reduction in child mortality rates in South Africa (this is especially important at the time of writing because the world is currently midway between the MDGs that were set in 2000 and the MDG target date of 2015 and also because the 30th anniversary of the Declaration of Alma Ata is celebrated in 2008).
- Improve the effectiveness of the routine health information system so that it will be more useful to managers as they attempt to monitor and evaluate progress towards meeting the MDG for child mortality.
- Encourage managers and students to use DHIS data for undertaking evaluations and health systems research with the purpose of identifying and solving specific health service delivery problems that are being experienced in specific geographical areas of South Africa.
- Guide the thinking and planning of those who set priorities for monitoring and for allocating the very limited resources that are available for optimising the health status of children under five years of age.
- Create a basis for challenging current assumptions in health care, re-thinking those processes that play hardly any role at all in the improvement of the HCS and devising ways of supporting managers as they strive to realise international and national health-related targets and goals.

1.11 LIMITATIONS OF THE STUDY

Limitations refer to restrictions in the methodology of a study that may decrease the possibility of generalising the findings (Kumar 2005:203). This study focused on only one province in South Africa and no generalisation was planned.

Although the following items may be regarded as limitations in this study, the researcher also provided suggestions for ways in which each of these limitations can be mitigated:

- Because of the wide range of PHC and basic hospital child health services that are offered in South Africa, it was impossible to evaluate all features of child health service

provision in this country. But by focusing on the main causes of child mortality and on core PHC principles, the researcher has been able to suggest ways in which managers can be trained to identify and address priority problems and thus strengthen the child HCS.

- Only data available from the DHIS was used. While this DHIS data might in some cases be open to questions about its quality, one of the objectives of the study was to identify data and indicator gaps and deficiencies in the existing routine health information system.
- Although the data from the DHIS is sourced only from public health care facilities, these public health care facilities (which form part of the public health care sector) are responsible for meeting the health needs of South Africa's most poor and vulnerable people in an equitable way. Those outside the public health care sector, who constitute approximately 20% of the South African population, belong to medical insurance schemes and are serviced by private health care facilities.
- While the population-based indicators in the DHIS are based on the total (insured and uninsured) population in each of the health districts, only data from public health care facilities is contained in the DHIS. It is valid to argue that it would have been advisable to use the uninsured population because it is this uninsured population that uses public health care facilities. But since data for the uninsured population is not available in South Africa at any level other than provincial level, such data could not be incorporated into the DHIS. The use of total population data may cause system-generated population-based indicator values to be slightly lower than they would have been if only the uninsured population had been used. But since only a small percentage of South African citizens are insured, the use of total population data in the study should not exert any major impact on population-based indicators – especially where the purpose is to identify and address inequities in terms of child health care.
- Data from only one of the nine provinces in South Africa (the Free State) was used. But since the data elements and indicators used in the study are standardised in the DHIS, element and indictor shortcomings that were identified are also applicable to the eight other provinces. In addition to this, it will be easy to replicate the study in any of the other provinces should such a need be identified.
- Only quantitative data was used for the study. While routine quantitative data can help managers to identify what the main problems are in terms of magnitude, additional qualitative data may be required to develop effective intervention strategies.

1.12 OPERATIONAL DEFINITIONS

Some of the terms used in the study are defined below. Where the operational study definitions are different from the definitions that were obtained from literature, the study definitions were described.

Benchmark

A benchmark refers to a reference point or standard (the performance achieved in the recent past by other comparable organisations in similar circumstances) against which performance or achievements can be assessed. Benchmarks in the study were obtained from provincial or national averages and/or directly from experts in the field where national targets were not available for the selected indicators (Kusek & Rist 2004:225).

Census

A census is the process that is used to obtain information about every member of a population. One may therefore contrast a *census* with *sampling* which sets out to obtain information only from a subset of a population. A census is a method for accumulating statistical data for research and planning purposes (Wikipedia [online] 2008).

Child mortality

Refer to the definition of the *under-five mortality rate (U5MR).*

Conclusion

Conclusions are the final statements from a set of carefully constructed arguments based on data that has been collected and analysed using a predetermined research methodology. Conclusions are used to determine whether the research question has been answered, and to indicate the extent of intended and unintended results as well as possible strengths or weaknesses in the methodology or structure of the initial assumptions (Kusek & Rist 2004:224).

Coverage indicators

Coverage indicators refer to the percentage of a population that received services or specific interventions in relation to those who are in need of such services. Thus, *full immunisation coverage* for example, indicates the percentage of children under one year of age for whom vaccination schedules have been properly completed (WHO 2003b:12). Health coverage indicators are used to measure the outputs of the HCS.

District health information system (DHIS)

The DHIS, like any other information system, is comprised of five key components: hardware, software, data, processes and people (Shelly, Cashman & Rosenblatt 2001:1, 5). The DHIS was adopted as the routine health information system of the Republic of South Africa in 1999 because it was regarded as a suitable instrument for monitoring the country's health service

provision in an integrated way (SA 2002:5; Shaw 2005:632). The software component of the DHIS was developed by the Health Information Systems Program as a tool for monitoring the effect of PHC service provision on the health status of the people of South Africa. The DHIS software, which contains a summary of the monthly data provided by each public health care facility, was first introduced into the South African HCS in 2000 (SA 2002:2). The abbreviation "DHIS" is used interchangeably in published literature (and therefore also in this study) for the DHIS and the DHIS software.

Drill down

The DHIS pivot tables enable its users to view data for different levels of the HCS by selecting the relevant level from a drop-down list. The data may thus be viewed:

- for the country as a whole
- for each or all of the provinces in the country
- for each or all of the districts in each or all of South Africa's provinces
- for each or all of the sub-districts in each or all districts
- for each or all of the facilities in each or all of the sub-districts

When one begins to examine data first on the higher levels and then gradually moves down to the lower levels with the purpose of identifying best practices or potential shortcomings, this process is referred to as "drilling down" in the data.

Evaluation

Evaluation is the systematic and objective assessment of an ongoing or completed project, programme or policy from the initial design and planning stage to the ultimate stages which consist of setting out results, conclusions and recommendations and then implementing recommendations. An evaluation should provide useful and credible information about relevance, the fulfilment of objectives, effectiveness, impact, worth and significance, as well as the lessons that have been learned and the sustainability of a project (Kusek & Rist 2004:225).

Effectiveness

Effectiveness is defined as the extent to which the main objectives of an intervention have been attained and whether the results of the intervention are sustainable (Kusek & Rist 2004:225).

Efficiency

Efficiency is a measure of how economically resources or inputs (such as funds, expertise and time) have been converted to results (Kusek & Rist 2004:225).

Evidence and evidence-based management

Evidence is defined as proof of an assertion or allegation, or as information that is considered to be true based on available facts (WordNet [online] 2008). Booth (2005:1) describes evidence-based health management as using evidence to support evaluations to make better-informed

operational, strategic and policy decisions. The practice of evidence-based management requires strong and up-to-date evidence, the effective dissemination of evidence to decision-makers and an ongoing evaluation of results.

Health care system (HCS) and health system

A HCS consists of a collection of people (clinical and support staff, patients and communities), things (buildings, vehicles, medications, money, rules and plans) and events (consultations, meetings, procedures and evaluations), all of which are integrated for the purposes of promoting health, preventing and treating illnesses and assisting those who are in need of health care (Katzenellenbogen et al 1997:148). A health system is a set of components and activities that function together to promote, restore and maintain the health of a population. A health system consists of cultural beliefs about health and health care procedures, as well as an institutional framework for health service delivery. Health systems are also involved with other sectors such as the education system (Katzenellenbogen et al 1997:148; WHO 2006a:3).

The focus in this study is on the public HCS. The concepts of a *health care system* and *health system* (terms that are used interchangeably in the literature) should be regarded as part of the public HCS as a sub-system of the whole South African health system.

Health equity

Health equity is characterized by health services that are fairly, justly and equally distributed in terms of inputs, processes and outputs (in proportion to need) in different areas and for the benefit of different sectors of the population. Health equity also implies equity in terms of the effectiveness and efficiency of the health care interventions that are provided and the management processes that control them (Katzenellenbogen et al 1997:149-150). Improving health equity is the main objective of any health system. In other words, a HCS can only be improved in an equitable way when resources are fairly distributed in terms of health care inputs, when efficient use is made of the financial, human and other resources and processes, and when outputs, outcomes and impacts are carefully monitored to ensure equity in all these aspects of the system concerned (WHO 2006b:3).

Indicator

An indicator is a quantitative or qualitative variable that provides a simple and reliable measurement of performance, achievement or change. One of the most widely known and internationally used indicators is the *U5MR* (Kusek & Rist 2004:226).

Inequity

Inequity means a state of unfairness, injustice or departure from rules, while equity means a state of fairness, justice and conformity with rules or standards that have been designed to promote all of these qualities (WordNet [online] 2008). “Inequity” in this study refers to major differences in indicator values among different geographical areas and hospitals in situations

where such values should have been approximately the same. Since the national *ANC coverage* target is 90%, one would expect that the indicator values for all the provinces, districts and sub-districts should range between 80% and 100%. Since some of these geographical areas have reported values below 80%, it can be argued that *ANC coverage* has been inequitably distributed.

Infant mortality rate (IMR)

The *IMR* is defined as the number of children under one year of age who die in a particular year for every 1,000 live births that take place during that year (Day & Gray 2006:496-497).

Intervention

An intervention is an interaction, procedure or set of techniques that are implemented to bring about a desired change, while a health intervention is an interaction, procedure or set of techniques that promotes good health (Wikipedia [online] 2008).

Monitoring

Monitoring or performance monitoring is a continuing activity that makes use of data (specific indicators) to provide management and/or the main stakeholders in a situation with reliable indications of the progress that has been made towards the achievement of particular objectives (Kusek & Rist 2004:227).

Outlier

An outlier is an observation that is numerically distant from the rest of the data (a very high or very low value, for example). Statistics derived from data sets that include outliers may be misleading (Wikipedia [online] 2008).

Proxy indicator

A proxy indicator is an indirect or substitute indicator that is used when data for direct indicators is not available or when the collection of specific data will be too costly (Kusek & Rist 2004:70). The *U5MR*, for example, is used internationally as a proxy indicator for measuring health system performance (WHO 2006a:2).

Rapid assessment

A rapid assessment process is a fast and convenient method for investigating complicated situations in which the issues have not yet been well defined or where there is not sufficient time or other resources for long-term, traditional research. A rapid assessment is conducted to develop a preliminary understanding of a situation (Rapidassessment [online] 2008).

In this study, “rapid data quality assessment” refers to the quick assessment that was conducted to obtain an indication of the quality of the Free State DHIS data because there were insufficient time and resources to conduct a full data quality assessment. The experience of the researcher

and the implicit purpose of the study indicate that a full data quality assessment would not have been efficient in terms of either time or cost.

Results-based management

Results-based management is a management strategy that focuses on the performance and achievement of outputs, outcomes and impacts (Kusek & Rist 2004:225).

Routine health information and routine health information system

RHINO (2001:2) defines routine health information as "information that is derived at regular intervals of a year or less through mechanisms designed to meet predictable information needs". The routine health information system is an aspect of local service delivery that has been created to capture data about health care provision, management, service delivery, administration and financing, as well as data about morbidity, births and deaths routinely.

Routine health information is defined for the purpose of this study as information derived from data that has been collected by health care professionals at public health care facilities at daily intervals. Routine health information includes information such as PHC visits and vaccines administered to children. This data is summarised for each public health care facility and is entered into the DHIS monthly.

Under-five mortality rate (U5MR)

The *U5MR* indicates the number of children under five years of age who died in any particular year for each 1,000 live births that occurred during that year. The *U5MR* includes infant deaths (children under the age of one year) and the deaths of children between one and four years of age (Day & Gray 2006: 496).

The terms *U5MR* and child mortality are used interchangeably in published literature and therefore also in this study.

1.13 ETHICAL CONSIDERATIONS

The necessary ethical principles and precautions that are routinely observed in this kind of study were adhered to. They include obtaining permission from the relevant authorities, managing resources honestly, fairly acknowledging those who contributed guidance or assistance, communicating results accurately, reflecting on the consequences of the research for society and adherence to the canons and conventions of scientific research such as honesty, probity and intellectual rigour (Kumar 2005:303-304; Polit & Beck 2006:499).

No human subjects were directly involved in this study because the source of data, the DHIS, contains only aggregated data. The specific ethical codes, standards and procedures that are

compulsory when dealing with human subjects or volunteers were therefore not relevant to this study.

1.14 ORGANISATION OF THE STUDY

- Chapter 1 contains an orientation to the study.
- Chapter 2 contains a discussion of the theoretical framework and the results of the literature review.
- Chapter 3 describes and substantiates the research methodology.
- Chapter 4 contains the data analysis and presents the results of the study by means of descriptive statistics.
- Chapter 5 contains a summary of the research, a synthesis of the findings into an *U5MR* performance profile, and a discussion of the study's limitations, conclusions and recommendations.

1.15 SUMMARY

Chapter 1 provides an orientation to the study with a particular emphasis on the background, the key concepts, the research problem, the aim and objectives of the study, the theoretical framework and the significance and limitations of the study.

South Africa is not currently on track for achieving the MDG on child mortality in 2015. The WHO originally identified extensive PHC, a basic hospital structure and a decentralised DHS as fundamental requirements for all countries which need to achieve the MDGs. Because PHC in the new millennium has been defined as integrated, comprehensive health care which addresses the main causes of mortality, managers at all levels of the HCS need integrated data (evidence) about the health care needs of specific communities, as well as interventions provided at health care facilities. They need this kind of data in order to provide the health care that each community needs and in order to achieve specific goals such as the reduction of child mortality rates.

This study introduces and describes the South African DHS, the DHIS, the concept of equity in PHC and the realities of child mortality rates in South Africa. It also identifies iniquities in child mortality rates between the nine provinces of South Africa and discusses the use of routine information for measuring health equity. This leads on to a critical discussion of the possible reasons why managers do not use available evidence or data as the basis for their management decisions.

Although the research design and methodology were discussed briefly in this chapter, they are described in detail in Chapter 3.

In a discussion about the significance of the study, it is proposed that the findings of this research could be useful to health service providers and managers at all levels of the South African HCS. The ultimate beneficiaries of this research would be those communities in which health- and equity-related problems pose obstacles to the reduction of the unacceptably high child mortalities.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In order to contextualize a research problem researchers need to familiarise themselves with existing knowledge. Existing information can be obtained from a critical review of literature on the subject, by discussions with experts in the same field of work or by communicating with researchers who have concerned themselves with similar problems. A literature review involves finding, reading, understanding, forming conclusions and making critical summaries about information that has been published on a particular topic, as well as the relevant information about the methodologies and instruments used in previous studies (Kumar 2005:30; Polit & Beck 2006:503; WHO 2001b:148).

According to Bryce et al (2006:1071), the 2015 target for *U5MR* in South Africa is 20 deaths per 1,000 live births. The Presidency (2007:34), however, reported a 2004 *U5MR* of 106 deaths per 1,000 live births - a figure more than five times higher than the target identified by Bryce et al.

From a systems point of view it could be argued that the high *U5MR* (which is the final result of health care provided to children under five), is caused by inadequate health care inputs and processes (WHO 2003b:35-36). In a results-based systems approach, the results of health care, namely its outcomes and impacts, inform the development or strengthening of a system in terms of inputs, processes, activities and outputs (Kusek & Rist 2004:57). Because of this, health care managers need evidence about the impact and outcomes of child health care services, as well as information about existing inputs, processes and outputs, if they are to identify and address HCS deficiencies that contribute to the high *U5MR.*

2.2 PURPOSE OF THE LITERATURE REVIEW

This chapter details the findings of a literature review that was conducted to identify the routine evidence (data) that managers need to measure progress towards the MDG on child mortality. It also explains how existing DHIS data can be used to improve the HCS so that it becomes effective in reducing the *U5MR*.

The specific themes investigated in this literature review include:

- The HCS and strengthening of the HCS.

- The systems theory and results-based M&E.
- Interventions to reduce the *U5MR* and priority indicators for measuring progress towards the MDG on child mortality.
- Potential constraints in child health services.
- Potential constraints in the use of routine health information for evidence-based child health care management decisions.

2.3 STRENGTHENING HEALTH SYSTEMS

A **health system** includes all activities (also those undertaken by departments other than the Department of Health) whose primary purpose it is to promote, restore or maintain health. A **health care system** (HCS) is a collection of people, things and events that are integrated to promote health, prevent and treat illnesses and assist those in need of health care (Katzenellenbogen et al 1997:148; WHO 2006b:3). According to the WHO (2006a:6), "Health systems form the backbone of a country's health effort." The best measure of a health system's performance is its impact on health outcomes. The *U5MR* is one of the most commonly used health status indicators for assessing a particular health system's effectiveness (WHO 2007:iii).

The **goal of a health system** is to improve health and health equity through achieving greater access to and coverage of effective health interventions (WHO 2007:2). However, according to the WHO (2006a:10) "health systems have failed to adequately address preventable causes of morbidity and mortality". Much of the suffering and many premature deaths are unnecessary and preventable because effective and affordable interventions are available for prevention and treatment (WHO 2007:iii). According to WHO (2007:1), "failing or inadequate health systems are one of the main obstacles to scaling-up interventions to make achievement of internationally agreed upon goals such as the MDGs a realistic prospect". When one considers how much is being spent on global health, the most obvious question that springs to mind is: "Why aren't health systems working better?" (WHO 2007:7).

It is important to identify the HCS's constraints that underlie persistently high levels of preventable causes of morbidity and mortality. It is crucial to strengthen the system as a whole to remedy the constraints that act as obstacles to the achievement of health goals. Any improvement to a health system must be preceded by a systematic analysis of the problems, as well as the consequences of existing problems, available resources and the ways in which the system can be monitored. Improvement of a health system requires the improvement of each individual aspect (the inputs, processes and outputs) of the system. If this is done effectively, the outcomes will be both equitable and sustainable.

A well-functioning and equitable health system is one that grants equal access to essential health care interventions and effective health service delivery. Health equity is characterised by health services that are equitably distributed (in proportion to need) in terms of health care inputs, processes, outputs and outcomes. This means that those who work in the system make all the advantages of the system equally and fairly available to all their clients irrespective of aspects such as culture, race, age, ethnicity and economic status (Katzenellenbogen et al 1997:149-150; WHO 2006a:4, 6-7, 10-11; WHO 2006b:3).

Effective health service delivery is concerned with the manner in which inputs and services are organised and managed so that access to quality health care is equitably distributed across different locations by means of care packages that include the prevention, promotion and treatment of priority acute and chronic conditions (WHO 2007:14-15).

The generation and informed use of information is indispensable for evidence-based management and improvements to any health system. The WHO (2007:30) identified one of the requirements for strengthening health systems as "improved country data collection systems that capture health system inputs, services and outcomes, using validated tools, at national and sub-national level". This definition emphasises that improvements to a health system and the establishment of health equity can best be achieved by paying attention to how well the HCS operates at its lowest level. According to the WHO (2003a:12): "Shortages of adequate health information…contribute to the potential collapse of some health care systems and threaten the long term viability of others."

A well-functioning health information system has been described as "one that ensures the production, analysis, dissemination and use of reliable and timely health information on health determinants, health system performance and health status" (WHO 2007:vi). Before a health system can be improved, effectively and efficiently functioning health information systems are needed to:

- Identify the health needs of all client populations but especially the health needs of poor and vulnerable people.
- Ensure that health programmes reach those who are most in need of them.
- Measure the effect/results (outcomes and impact) of interventions.
- Assess and improve performance.
- Inform strategic decision-making by health care policy makers.
- Evaluate what works and what does not work.

Tools and structures for obtaining, organising, sharing and using information are vital for strengthening health system performance. Therefore strengthening of integrated health

information systems at local, district, provincial and national levels is required to deal effectively with health threats and to achieve the MDGs (WHO 2003a:12-15).

The strengthening of health systems aims to improve health equity, achieve a fairer distribution of resources and make the most efficient possible use of human, financial and other resources (WHO 2006b:3). HCSs can only be improved if they are robustly and rigorously monitored and evaluated by using frameworks that provide reliable indicators of change and readily comprehensible measures of progress (WHO 2007:v-vi, 4, 20). Improvements to a health system should be guided by the core principles of PHC. These include universal access and coverage on the basis of need as well as health equity (WHO 2003a:1). A health system based on the fundamental guiding principles of PHC will:

- Build on the principles of equity, universal access and community participation that were delineated in Alma Ata.
- Also focus on broader population health issues and public health functions.
- Prioritise effective service provision to poor, vulnerable and excluded groups.
- Organise and integrate the provision of health services in such a way that prevention, acute and chronic care are linked across all components of the HCS.
- Continuously evaluate and improve performance on the basis of evidence (WHO 2003a:5).

There are many different ways in which one can approach the analysis of health data to identify "evidence-based" health system weaknesses and obstacles to the improvement of service delivery (WHO 2007:28). In any results-based approach, the desired health outcomes are used as a starting point for identifying health system constraints (in terms of inputs, processes and outputs) that impact on health status (WHO 2007:27, 29).

The main steps in an operational framework for improving a health system will include initiatives designed to:

- Identify important outcomes against which "success" can be assessed.
- Set benchmarks against which progress may be measured.
- Obtain reliable information that will identify the key deficiencies in a health system that prevent the achievement of desired health goals.
- Develop a strategy for overcoming systemic constraints.
- Measure progress and disseminate information about constraints as well as information about what actually works in practice and why it does so (WHO 2006a:15-16; WHO 2007:vii).

Before embarking on measures to improve the performance of a health system, it is crucial to agree on a set of indicators that will be able to measure whether the performance of a health system is actually improving. Such indicators will enable decision-makers to:

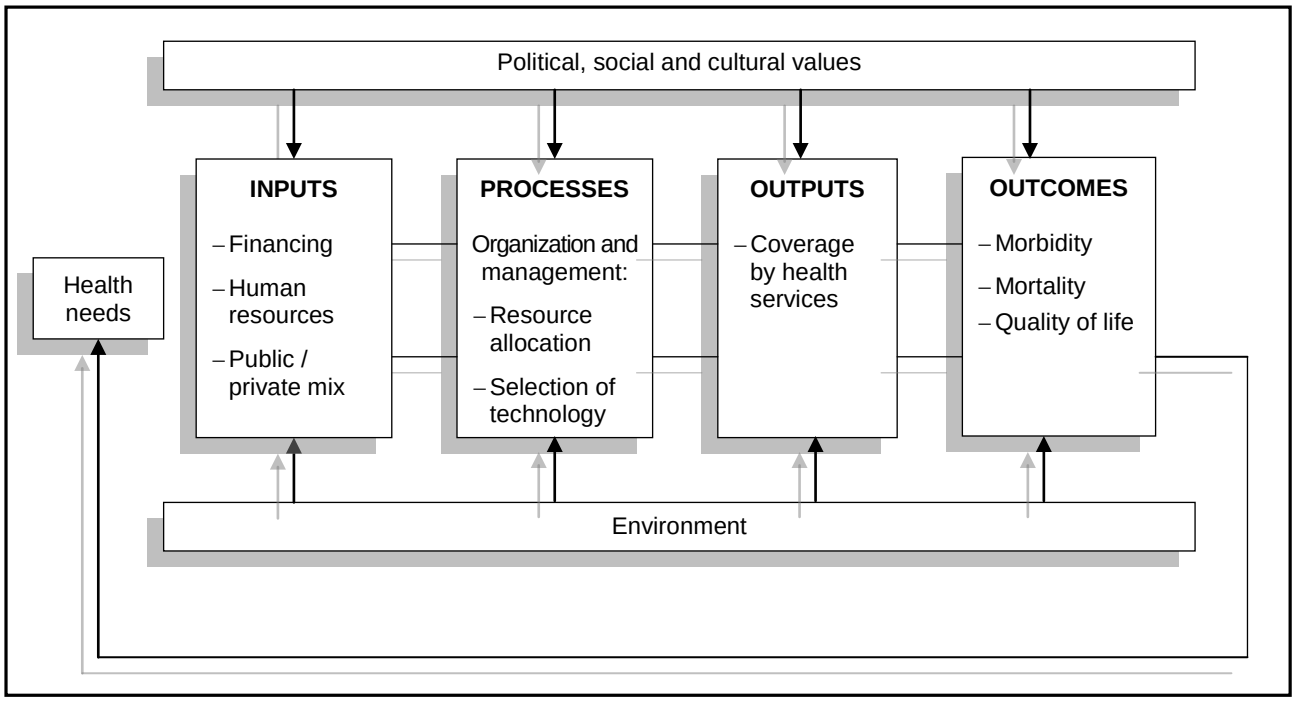
- Measure their own performance.
- Analyze variations in health care performance.
- Understand the factors that contribute to variations.
- Respond more effectively to the needs of the people whom they serve.
- Track the progress of the HCS over time.
- Take appropriate action when and where it is needed (WHO 2006b:6; WHO 2007:31).

Several authors have equated health systems, of which the health information system is a sub-system, to an industrial system with interdependent inputs, processes, outputs and outcomes. These components must all function together if they are to be effective because changes in one component or area of a system influence all other components. Since this is the case, improvements in one area cannot be achieved without remedial action in the other crucial areas and throughout the system as a whole (Heavens 1999:14, 48; Katzenellenbogen et al 1997:151; WHO 2001a:6; WHO 2003b:12; WHO 2007:5).

2.4 THE SYSTEMS THEORY AS THEORETICAL FRAMEWORK

Although different descriptions of the systems theory are given in the literature (Heavens 1999:14, 48; Katzenellenbogen et al 1997:151; Kusek & Rist 2004:57; WHO 2001a:6; WHO 2003b:12), the principles remain essentially the same. A system consists of interdependent inputs, processes, outputs, outcomes and impacts and changes to one component of a system will influence all the other components.

The health systems model (Figure 2.1) described by the WHO (2001a:6), illustrates the interdependence between inputs, processes, outputs and outcomes (no impacts are included in this model). It also illustrates the fact that health systems co-exist and interact with the political, social, economic and environmental fields that surround them.



(WHO 2001a:6)

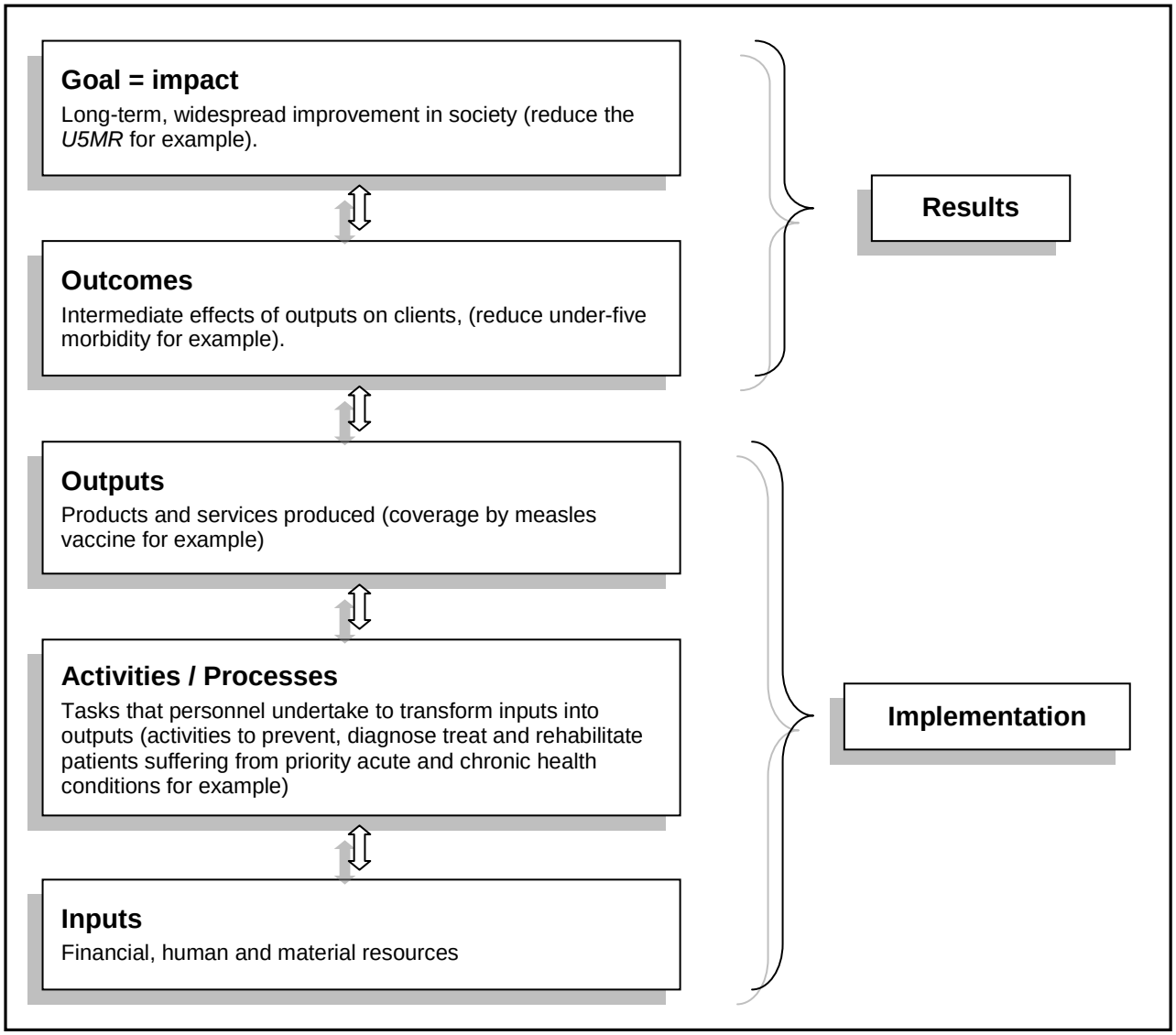
Figure 2.1 World Health Organization Health System Model

Kusek and Rist (2004:17-18) applies the systems theory to a results-based M&E approach which is characterised by asking the "So what?" question. One may use as an example the addition of further health resources to an already existing system. Once additional resources had been added, managers and funders are entitled to ask, "What additional activities took place and what outputs were counted because of these additional resources"? A results-based systems approach focuses on the differences made in terms of health outcomes because of changes to the system. It also asks questions such as:

- What goals are the inputs and processes intended to achieve?
- Have these goals been achieved?
- How can one prove that the goals had been achieved? (Kusek & Rist 2004:16).

According to a results-based systems approach, system development (and the improvement/strengthening of a system) is a deductive process in which all inputs, activities, and outputs are derived from an initial setting of outcome goals. Indicators, baselines and targets are all crucial elements of a performance framework and they are all derived from the outcome goals that were set at the beginning of the process (Kusek & Rist 2004:57).

Figure 2.2 provides a conceptual overview of how one can apply a results-based systems approach to the *U5MR*.



(Adapted from Kusek & Rist 2004:18, 99, 104)

Figure 2.2 A results-based monitoring and evaluation system

The monitoring of progress towards goals (which are the final results of all activities and interventions) requires information from all levels and stages in the system. Monitoring enables informed decisions to be made by those responsible for achieving the goals throughout the existence of the project, programme or policy. This kind of monitoring is dependent on continuous streams of data flowing out of the system in the form of feedback and information about consequences. Kusek and Rist (2004:18-21) regard broad public access to trustworthy and timely information about the performance (both successes and failures) of programmes or projects as essential components for developing strategies to ensure greater accountability on the part of managers.

Kusek and Rist (2004:23-24, 65) suggest the following steps to build a results-based M&E system:

- Formulate goals and outcomes.
- Select indictors to monitor progress with respect to inputs, activities, outputs, outcomes and impacts.
- Gather baseline information on the current problem.
- Set specific targets to reach and set target dates for reaching them.
- Regularly collect data in order to assess what progress has been made towards reaching the targets.
- Analyse and report the findings in terms of the successes that have been achieved and the areas in which improvements may be required.
- Utilise the findings to make the necessary improvements.

The use of results-based M&E systems can help bring about major changes in the ways in which organizations and governments operate. When results-based M&E systems are properly executed and sustained, they can increase accountability and transparency, improve performance and generate useful knowledge (Kusek & Rist 2004:24). According to Kusek and Rist (2004:26), “results-based M&E systems are powerful public management tools in helping governments and organizations demonstrate impacts and outcomes to their respective stakeholders, and to gain public support”.

According to Katzenellenbogen et al (1997:151), there are different ways (Table 3.1) of looking at HCSs. One can look at them as products of the health care sector (the public or private sector, for example), the level of the healthcare sector (the provincial or district level, for example), the unit (clinics or hospitals, for example), the stage (inputs, processes and outputs), and the element (effectiveness or equity, for example). One or more of these HCS components can be the subject of health systems research. Such research is usually applied, problem-based and action-orientated and it usually offers practical and manageable solutions for improving the function of the system concerned.

Evaluative health systems research is discussed in more detail in Chapter 3.

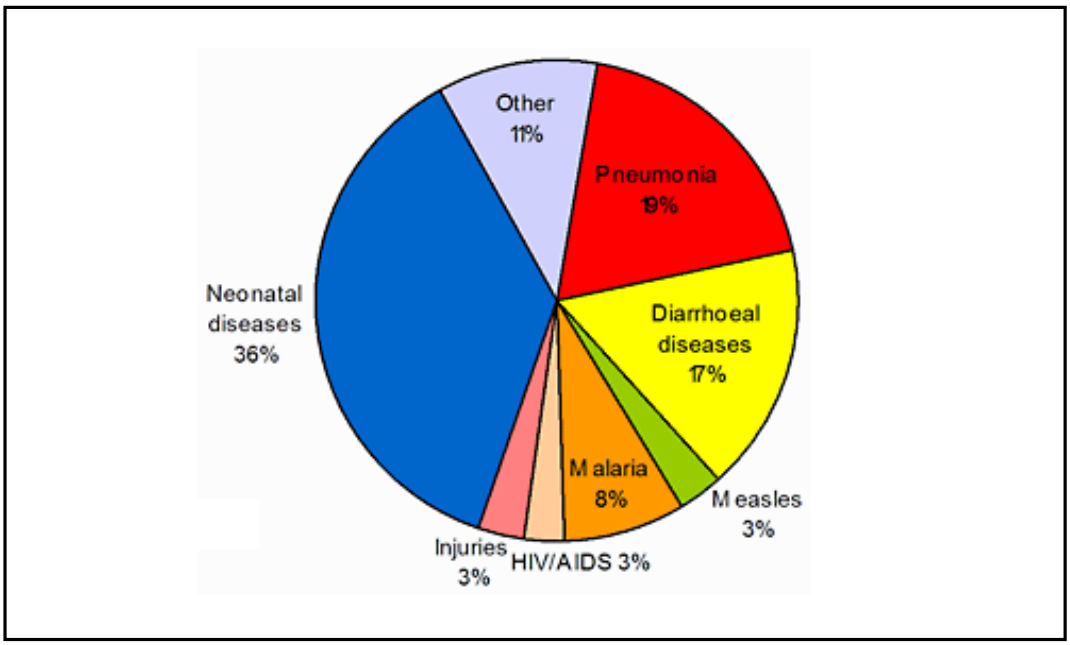
2.5 CHILD MORTALITY

Child mortality rates are crucial for policy development and for the monitoring of public health interventions that are designed to improve the health status of children. While UNICEF uses the *U5MR* as an indicator of human development and economic processes (Solarsh & Goga

2004:104), it is also used to assess the effectiveness of health systems (WHO 2006a:2). The goal to reduce the *U5MR* by two thirds between 1990 and 2015 has been identified as the most difficult MDG to achieve at the current rate of progress, especially in the countries of Sub-Saharan Africa (European Commission 2004:4, 19).

2.5.1 Under-five mortality in the world

The Inter-Agency Child Mortality Estimation Group estimated that 9.7 million children who were under five died during 2005. Figure 2.3 shows that the major causes of global under-five mortality during 2005 were preventable conditions such as pneumonia, diarrhoea, malaria and neonatal causes of death (WHO 2008:1).



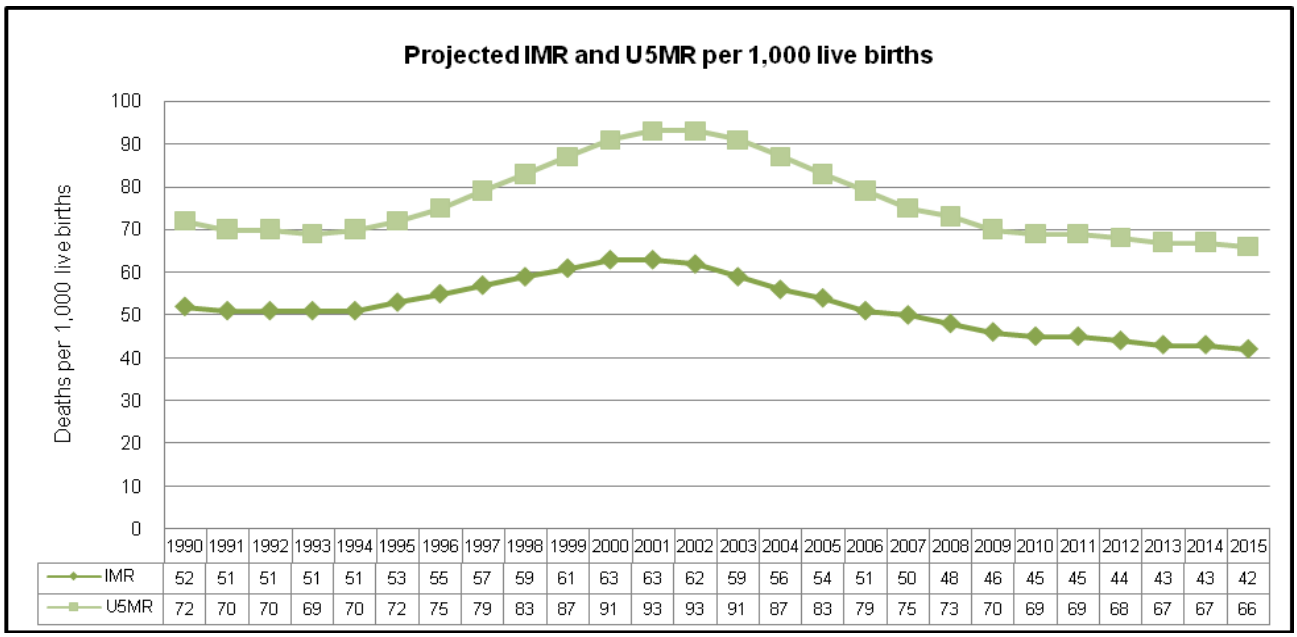
(WHO 2008:1)

Figure 2.3 Leading international causes of under-five mortality

2.5.2 Under-five mortality in South Africa

According to Day and Gray (2006:384), various sources for *U5MR* data in South Africa "yield quite a range of uncertainty and in most cases data are not available at disaggregated level" to support managers who need to identify and address service delivery problems. Registration of deaths in South Africa increased from 69% in 1997 to 85% in 2005 (StatsSA 2007a:3) but the statistics for the incidence of deaths in South Africa are still hampered by limitations such as the failure on the part of individuals to register deaths and ill-defined or generalised causes of death (StatsSA 2007a:1). In spite of these difficulties, calculations that are based on the available data provide an estimate for child mortality indicators (Day & Gray 2006:384).

All childhood mortality data provided for South Africa since 1998 has incorporated some degree of modelling. The Actuarial Society of South Africa (ASSA) 2002 model indicated a rise in the *IMR* and the *U5MR* until 2001, followed by a decline in the same rates from 2002 onwards (Figure 2.4), mainly as a result of the assumed impact of the PMTCT programme (Dorrington, Johnson, Bradshaw & Daniel 2006:22-23).

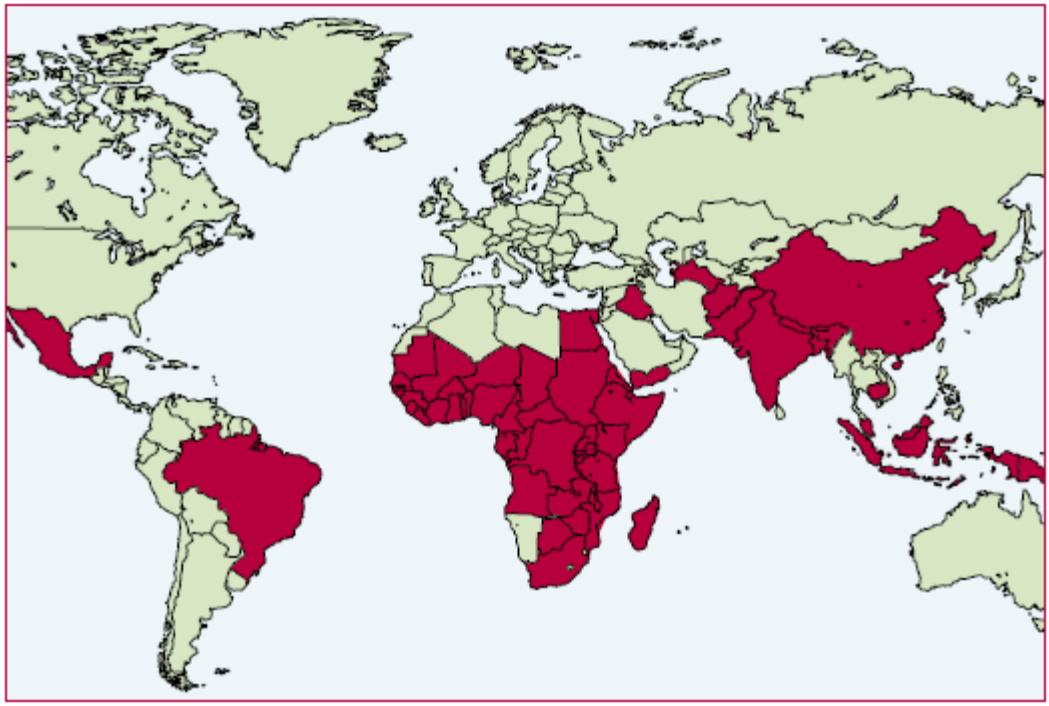


	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
IMR	52	51	51	51	51	53	55	57	59	61	63	63	62	59	56	54	51	50	48	46	45	45	44	43	43	42
U5MR	72	70	70	69	70	72	75	79	83	87	91	93	93	91	87	83	79	75	73	70	69	69	68	67	67	66

(Dorrington et al 2006: 22-23)

Figure 2.4 Historical and projected infant and under-five mortality rates for South Africa

There is, however, evidence that the *U5MR* in South Africa has not begun to decline. In fact, the reported deaths of children under five (Figures 1.1 and 1.2) increased to 61,461 in 2005 – nearly double the number of 32,468 which was reported in 1997. Even though this increase in child mortality may be partly attributed to population growth and improvements in death registration methods (StatsSA 2007a:8-9), South Africa was identified in 2004 as one of 60 countries (Figure 2.5) with the highest child mortality rates in the world (Bryce et al 2006:1068).



(Bryce et al 2006:1068)

Figure 2.5 The 60 countries with the highest child mortality in the world

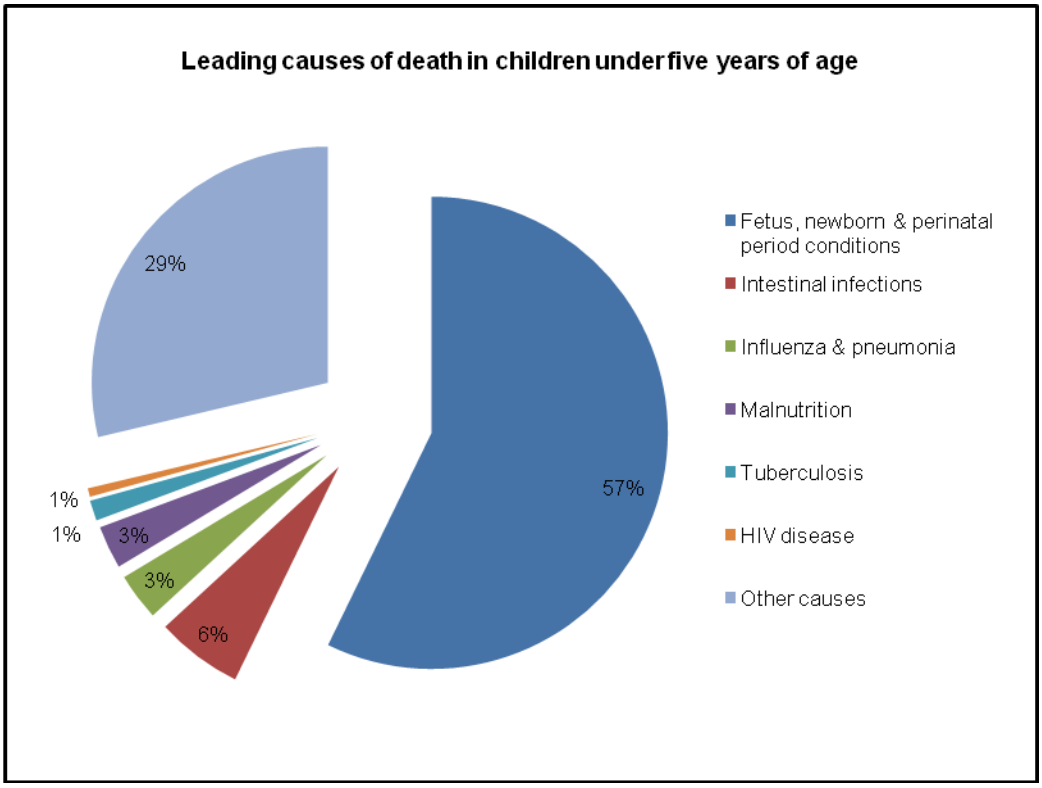
Saloojee (2007:96) stated that “not a single of the 14 national child health goals set by the (South African) *Primary Health Care Strategy for 2000* was achieved by 2005”. Professor Nigel Rollins, head of the Centre for Maternal and Child Health at the University of KwaZulu-Natal, has stated that “South Africa is one of only nine countries in the world where the child health mortality rate is increasing instead of decreasing, mainly as a result of HIV-related deaths” (Cullinan 2007a:1). Doctor Harry Moultrie, director of the Harriet Shezi Children’s Clinic at the Chris Hani Baragwanath Sanatorium, has noted that one third of all children in South Africa die before their first birthday (Thom 2007:1). At the time of writing, the South African public health services have also been in the news several times for the unacceptable number of newborn babies dying in hospitals (Cullinan 2007a:1; Cullinan 2007b:1; Cullinan 2007c:1; Thom 2007:1).

Apart from the 61,461 reported deaths (StatsSA 2007a:1), 21,096 stillbirths were reported by public health care facilities in South Africa in 2005 (Day & Gray 2006:22). This means that 82,560 children who had the potential of living full lives, died in South Africa during 2005.

Why are so many children dying and why is South Africa failing to reduce child mortality rates?

Figure 2.6 depicts the leading causes of under-five mortality in graphic form (StatsSA 2007a:9, 23). Foetal, newborn and perinatal period conditions were the cause of 35,182 of the 61,461 child deaths in 2005. The primary causes of perinatal deaths were intrapartum asphyxia, birth trauma and spontaneous preterm delivery. It is estimated that 34-63% of all asphyxia or birth-trauma-related deaths are preventable by better ANC and an improvement in the management

of deliveries (Solarsh & Goga 2004:110). Diarrhoea, pneumonia and malnutrition were identified as other priority disease-specific causes of death in children under five.



(StatsSA 2007a:23)

Figure 2.6 Leading causes of under-five mortality in South Africa in 2005

It should, however, be noted that HIV-related mortality rates are drastically underreported and that 49% of the under-five deaths were misclassified as being unrelated to HIV in 2000 and 2001. The Child Problem Identification Program estimated in 2001 that 60% of deaths in children were caused by complications arising from HIV-related conditions (Meyers, Moultrie, Sherman, Cotton & Eley 2006:239).

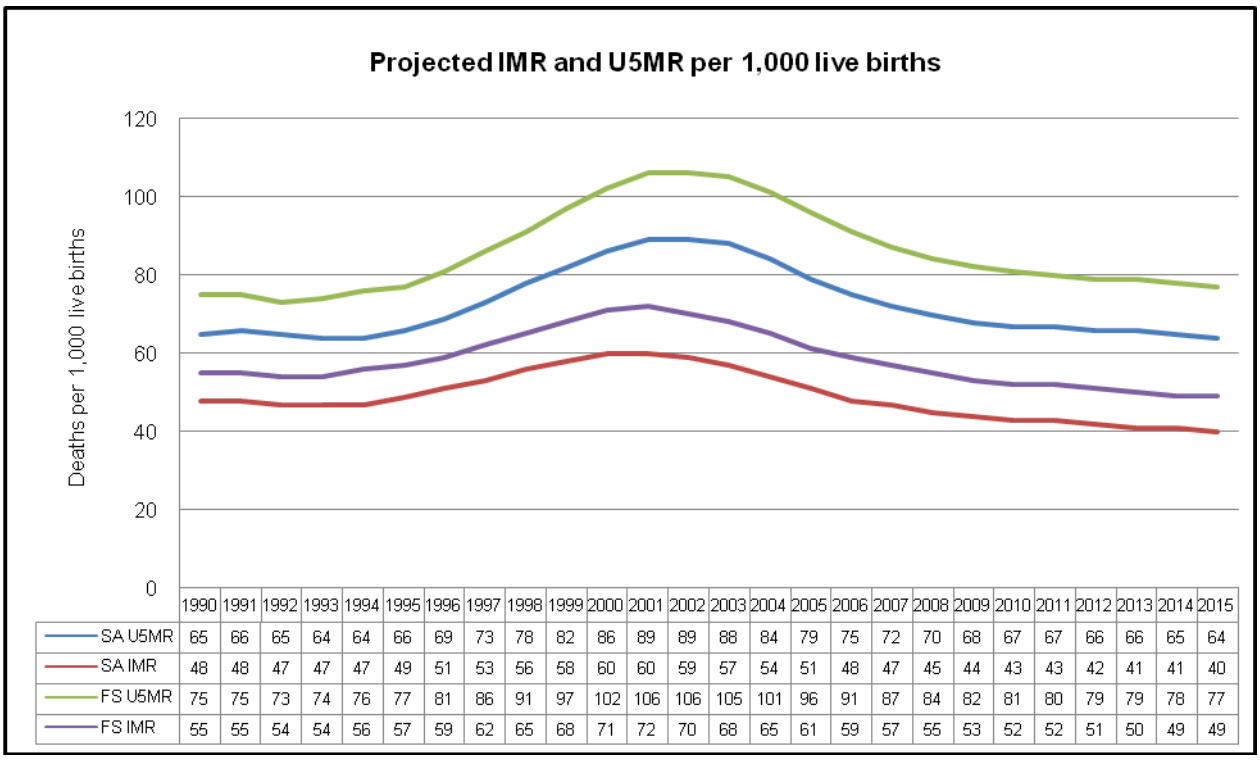
From the data set out above it can be inferred that interventions to reduce still births and the *U5MR* in South Africa should aim at improving ANC, delivery and postnatal services, as well as interventions that will have the effect of preventing, diagnosing and effectively treating HIV and Acquired Immune Deficiency Syndrome (AIDS), diarrhoea, pneumonia and malnutrition in children under five years of age.

2.5.3 Under-five mortality in the Free State province

The profiles for the 2005 Free State population structure and the causes of death were similar to the national one, with both the *IMR* and *U5MR* being higher than those reflected in figures for the country as a whole since 1990 (Figure 2.7). The high child mortality rate in the Free State

province can be attributed mainly to a combination of HIV/AIDS and other communicable diseases, perinatal conditions and nutritional deficiencies. HIV/AIDs accounted for 41% of deaths in children under five while diarrhoea accounted for 11% of child deaths in the Free State in 2000 (Bradshaw, Nannan, Laubscher, Groenewald, Joubert, Nojilana, Norman, Pieterse & Schneider [Sa]:10). According to Dorrington et al (2006:43), 59,000 uninfected and 2,500 HIV-positive children were born in the Free State during 2006 while 1,700 babies were subsequently infected with HIV through breastfeeding. The Free State *IMR* was 59 deaths (in children under one year of age) per 1,000 live births while the *U5MR* was 91 deaths (in children under five years of age) per 1,000 live births in 2006 and the population growth rate was 0% from 2003 (Dorrington et al 2006:43, 46).

Figure 2.7 makes it clear that the estimated South African *U5MR* of 84 deaths per 1,000 live births in 2004 differs from the rate of 106 deaths per 1,000 live births reported by the Presidency (2007:34) for the same year. It is not within the scope of this study to debate the causes for differences between the mortality rates presented in different reports - whatever the source one uses, it is obvious that the *U5MR* is way above the MDG target and that urgent intervention is required to rectify the situation.



	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
SA U5MR	65	66	65	64	64	66	69	73	78	82	86	89	89	88	84	79	75	72	70	68	67	67	66	66	65	64
SA IMR	48	48	47	47	47	49	51	53	56	58	60	60	59	57	54	51	48	47	45	44	43	43	42	41	41	40
FS U5MR	75	75	73	74	76	77	81	86	91	97	102	106	106	105	101	96	91	87	84	82	81	80	79	79	78	77
FS IMR	55	55	54	54	56	57	59	62	65	68	71	72	70	68	65	61	59	57	55	53	52	52	51	50	49	49

(Dorrington et al 2006:23, 47)

Figure 2.7 Projected infant and under-five mortality rates for the Free State province compared to that of South Africa

In 2005 the Free State province reported that only 40% of the ANC clients had been tested for HIV and that only 31.3% of HIV-positive mothers (the lowest rate in South Africa) took nevirapine to prevent mother-to-child transmission of the HIV virus. The *still birth rate (SBR)* of

31 per 1,000 births, and the *perinatal mortality rate* (*PNMR)* of 40 per 1,000 births was the second highest in the country while the rate of children who did not gain weight (namely, 3.4% of children under five) was the highest provincial figure reported in South Africa. But the Free State province performed well in terms of immunisation - the *full immunisation coverage* was 91% and the drop-out rate of 1.9% between the first and third doses of vaccination was the lowest recorded in South Africa during 2005 (Barron et al 2006:116).

Current health policies and programmes have clearly not produced the desired results and outcomes in South Africa or in the Free State province. Unless drastic corrective measures are implemented soon, neither South Africa nor the Free State province will meet the MDG target of 20 deaths per 1,000 live births in 2015 (Bryce et al 2006:1071).

How can the factors that hinder progress in this field be corrected? How can failure be turned into success or how can obstacles to progress be removed? How will health professionals and managers know when they are on the right track and how can progress be measured (Kusek & Rist 2004:3)?

Monitoring, evaluation and reporting form the basis of effective health system management and effective management in turn produces effective service delivery (RHINO 2003:2, 4; WITFOR Health Commission 2003:1). If managers are to carry out effective evidence-based management, they need valid and reliable data about all the stages and dimensions of the HCS in a format that is readily accessible and comprehensible. It is only when information is reported in this way that it can be used to remedy the defects of a national HCS and the way in which it operates at local levels.

2.6 INTERVENTIONS TO REDUCE UNDER-FIVE MORTALITY

Bryce et al (2006:1067) contributed to the Lancet series on child survival by stating that “a set of about 20 proven interventions could reduce child mortality by over 60% if they are made available to all mothers and children who need them”. These interventions include exclusive breastfeeding, immunisation, Vitamin A supplementation, the provision of safe water, improvements in sanitation, the prevention of malaria, the effective case management of newborn health, swift and robust care provision in cases of pneumonia, diarrhoea and malaria, interventions to prevent or reduce the incidence of still births and neonatal deaths, the prevention of unwanted pregnancies and effective ANC and delivery services to optimise the health of mothers and babies (Bryce et al 2006:1071).

2.7 PRIORITY INDICATORS FOR MEASURING PROGRESS TOWARDS REDUCING THE UNDER-FIVE MORTALITY RATE

Since health is regarded as a human right, there is growing consensus in the modern world that better health systems are essential for the improvement of health outcomes (WHO 2006a:2, 7, 10; WHO 2006b:2-3, 5).

According to Kusek and Rist (2004:57) one can only improve and maintain a HCS by recognising that health care is a process in which inputs, activities and outputs arise out of predetermined outcome goals and targets. In those cases where the outcomes and impact targets are not being met, it becomes necessary to evaluate the inputs, processes and outputs related to such targets in order to identify and remedy the causes of inadequate and inefficient services (WHO 2003b:35-36). For this to happen, one needs standardised parameters and indicators for measuring the impact, outcomes, outputs, processes and inputs related to the main causes of death.

Indicators are variables that provide simple and reliable ways of measuring performance, achievements or changes (Kusek & Rist 2004:226). It is important to take into consideration that it is the selection and use of indicators that determine the effectiveness of the HCS and the health information system for identifying health problems and health priorities (Stancefield 2005:562).

2.7.1 Measuring child health care impact: Mortality

The impact of the HCS is measured mainly in terms of life expectancy at birth and levels of mortality related to the main health problems of a country (WHO 2001a:6; WHO 2003b:12). Examples of standardised international indicators that measure the impact of health care services in general are the *IMR*, the *U5MR* and *life expectancy at birth* (Katzenellenbogen et al 1997:16, 20; Kekki 2003:4). Disease-specific or cause-specific mortality rates indicate the impact (or lack of impact) made by specific health care interventions or programmes. Thus, for example, the measles mortality rate provides the final indication of the effectiveness of interventions that have been designed to prevent measles (Solarsh & Goga 2004:105; WHO 1981:36).

2.7.2 Measuring child health care outcomes: Effectiveness, efficiency and quality

Outcomes are measured in terms of effectiveness and efficiency (Katzenellenbogen et al 1997:149). **Effectiveness** measures success in producing a given result and **efficiency** indicates the optimal use of inputs in monetary terms. Since the 1950s the systems approach

has emphasised effectiveness and efficiency so as to ensure optimal outcomes for organisational inputs (Heavens 1999:45-48).

Outcome evaluations measure whether the best possible quality of health care is provided at optimal cost, or, in other words, whether management and interventions are effective and efficient in terms of finance, human resources and health gains (Heavens 1999:45, 47). Examples of indicators for measuring the effectiveness and efficiency of health care for children under five in terms of health gains include the *SBR*, the *low birth weight rate* (*LBWR)*, the *mother to child transmission (of HIV) rate* and the incidence rates of pneumonia, malnutrition and diarrhoea. Examples of indicators for measuring the effectiveness of financial and human resource management are *per capita expenditure* and *nurse clinical workload* (Day & Gray 2006:496, 501; Saloojee & Bamford 2006:195; Solarsh & Goga 2004:102).

2.7.3 Measuring child health care outputs: Coverage by specific interventions

HCS outputs can be measured in terms of the quantity of services provided (also called *coverage*) as a percentage of the population that has received services in relation to those who need such services in specific geographic areas (WHO 2003b:12). Coverage indicators are only meaningful if they relate to specific priority services or interventions that are intended to address leading health problems (WHO 1981:28). High coverage rates are an indication that interventions have been delivered successfully while low coverage rates indicate that such services have not been successfully delivered. Underperformance requires careful and meticulous investigation into why such interventions are not reaching those who need them.

If the *U5MR* is to be reduced, it will be necessary to achieve adequate coverage by interventions that are effective in the prevention, diagnosis and treatment of the main identified causes of mortality in children under five years of age. Examples of *U5MR*-related output/coverage indicators are *measles coverage* (which measures the proportion of children younger than one year old who were vaccinated against measles) and the *proportion of births attended to by skilled health personnel* (Kekki 2003:4; APP 2006:39; Bryce et al 2006:1071).

2.7.4 Measuring child health care processes: Acceptability and utilisation

Processes are the activities, interactions and interventions whereby inputs are applied to meet specific needs and to achieve specific results (Katzenellenbogen et al 1997:149). Process evaluations are aimed at determining how well health care services are accepted and used by communities in specific geographical areas (WHO 1981:18-21, 26; WHO 2001a:6; WHO 2003b:12).

Process evaluations should be conducted on specific health care interventions, procedures, treatment protocols and other specific activities. Overall health care processes can be measured in terms of utilisation rates that reflect on the acceptability of general health care processes (Katzenellenbogen et al 1997:149-150).

Acceptability is defined as the proportion of a population in need of specific interventions who regard the services provided for them as relevant to their needs, socially acceptable (in terms of language and the attitude of health workers, for example) and of an adequate quality and standard (Katzenellenbogen et al 1997:150).

Utilisation is defined as the proportion of a population that is using available services or facilities in relation to those who need such services (WHO 1981:26).

Utilisation rates can be measured in terms of specific health care interventions. The *delivery in facility rate*, for example, indicates the proportion of pregnant women who used facility-based delivery services in a given time period.

Effective health care services cannot of course be provided unless the necessary resources are available, accessible and well managed.

2.7.5 Measuring child health care inputs: Availability and accessibility of health care resources

Input evaluations are used to determine whether health care inputs are available, accessible and equitably distributed to the people in specific geographical areas where they are needed (Heavens 1999:14, 48; Katzenellenbogen et al 1997:149; WHO 2001a:6; WHO 2003b:12).

Health care inputs include resources such as finance, facilities, equipment, drugs, staff and the availability of specific interventions such as caesarean sections and TOP services in specific geographical areas. Bryce et al (2006:1069) also list policies, political commitment and equity between the poorest and the richest populations in a country as determinants of health care.

Availability is the ratio between the population of an administrative unit (such as a district, province or country) and health care resources (Katzenellenbogen et al 1997:150). Examples of indicators to measure availability and equitable distribution of health care services include the following:

- **The availability and distribution of health care facilities** in terms of the number and type of facilities in relation to the population in specific geographical areas. An example of an indicator to measure such availability and equitable distribution would be *district hospital beds per 1,000 uninsured population* (APP 2006:55).

- **The availability and distribution of personnel** such as doctors and nurses in relation to the population. An example of an indicator to measure such availability and distribution would be *medical doctors per 100,000 uninsured population* (APP 2006:71).
- **The availability and distribution of interventions** such as specific promotive, preventive, diagnostic, curative and rehabilitative interventions and procedures to address the most important health care problems that afflict a population (WHO 1981:26; WHO 2001a:6). An example of an indicator to measure such availability and distribution would be *the proportion of fixed PHC facilities offering PMTCT services* (APP 2006:30).
- **The availability and distribution of essential drugs** to treat priority conditions. An example of an indicator to measure such availability and distribution would be *the proportion of a population with access to affordable essential drugs on a sustainable basis* (Kekki 2003:4; WHO 2003b:47).
- **The availability and distribution of funds.** An example of an indicator to measure such availability and distribution would be *the percentage of DHS expenditure on PHC* (Day & Gray 2006:488).

Accessibility has been described as the proportion of a population who are successful in using health care facilities or services, given that various barriers to access exist in many situations. These barriers include **geographical access** (such as distance from a treatment facility and the travelling time needed to reach appropriate facilities), **financial access** (such as expenses associated with travelling costs, health care fees charged by a hospital, clinic or other facility), and **hours of service delivery** (such as the days or times when needed services are open and available to the public) (Katzenellenbogen et al 1997:150; WHO 1981:26-27, 31, 40, 58).

WHO (2003b:19) uses the following two indicators as **proxy** or **substitute indicators** for measuring the availability and accessibility of vaccination and delivery services:

- **DTP 1 vaccine coverage*, measured as ***DTP-Hib 1st dose coverage* in South Africa (DHIS, 2007), is used as a proxy indicator for the availability and accessibility of immunisation services.
- *The percentage of births that occur in health facilities*, also formulated in the words *delivery in facility rate* (DHIS 2007), is used as a proxy indicator for measuring access to delivery services.

* Diptheria-tetanus-pertussis vaccine

** Diptheria-tetanus-pertussis & haemophilus influenza vaccine

The indicator values for *DTP-Hib 1st dose coverage* and the *delivery in facility rate* will probably be high if facilities rendering these services are available and accessible to the communities

they serve. *Coverage* in such cases will probably be low if there are an insufficient number of facilities available to the public, or if the facilities that are available cannot be reached. *DTP-Hib 1st dose coverage* is a useful indicator for assessing equity in terms of the availability and accessibility of comprehensive health care services in South Africa. Because South Africa aims to provide comprehensive and integrated PHC services by making use of the "one-stop" approach, one may expect facilities that provide vaccination services also to provide a variety of other priority services and interventions for dealing with the priority health problems of the population is (SA 1997:36-38)

If the *DTP-Hib 1st dose coverage* is, for example, 85% and the *delivery in facility rate* is 80% in sub-district X, while the *Tetanus Toxoid (Tet Tox) coverage* for pregnant women is 30% in the same district, one may make the assumption that there are sufficient facilities in sub-district X and that these facilities are accessible to mothers and babies. The low *Tet Tox coverage* in such a context may therefore imply existence of specific and possibly isolated intervention shortcomings such as a Tet Tox vaccine shortage (an input shortcoming) or a lack of clinical knowledge about the Tet Tox protocol (a process shortcoming). An evaluation would then have to be conducted in terms of these specific services and interventions would have to be developed, implemented and monitored as remedial actions.

2.8 HEALTH CARE SYSTEM CONSTRAINTS

Before a manager or researcher can create or select indicators for measuring progress in child health care services and the use of health information for evidence-based management, it would be necessary to identify the constraints or deficiencies that afflict the HCS.

2.8.1 Constraints with regard to child health care services

According to Saloojee and Bamford (2006:197) the majority of the constraints identified in the delivery of child health care stem from the health system as a whole rather than from the child health programmes. These constraints include the restructuring of the health services, the referral systems, staff and capacity deficiencies, inadequacies in training and various challenges associated with monitoring, evaluation and health information systems. Measuring different system stages and activities and correcting health information system problems should therefore constitute a major form of support for managers and health professionals as they struggle to strengthen the HCS. Problems can only be corrected once they have been recognised and accurately measured.

2.8.2 Constraints with regard to using routine information for evidence-based management decisions

There are many reasons why managers do not use data for monitoring equity and taking management decisions. Data-related problems include incompleteness, poor quality, insufficient information to inform decisions, inaccessibility and data that does not become available in time (Burn & Shongwe 2004:38).

Pillay et al (2002:4) have noted that although public health facilities throughout South Africa routinely collect data, very little of it is ever used at the level of national decision-making. The truth of this assertion was confirmed two years later in the *Strategic Priorities for the National Health System 2004-2009* (SA 2004:6) in which it was indicated that, although minimum data sets for PHC and hospitals have been implemented with some success, the quality of data and the utilisation of information by managers and clinicians need to be improved. Burn and Shongwe (2004:38) have emphasised that hospital managers do not use information, that there is a lack of capacity in information management at national, provincial and facility levels, and that managers are not well served by information specialists. Solarsh and Goga (2004:123-124) have noted that the lack of regular, reliable data makes the assessment of the effect of health care programmes on child health problematic if not impossible. They have emphasised that, among other data, there is a critical need for reliable data about perinatal, neonatal and cause-specific child mortality and morbidity.

Many of the obstacles that prevent the use of routine health information for evidence-based management were clarified by the findings of the 2007 Free State health information audit which identified numerous health information system problems together with deficiencies and challenges in the use, maintenance and strategic deployment of hardware, software and human resources (Loveday, Smit, Barron & Haynes 2007:4). In the Free State province, for example, only 11% of health information personnel were appointed in official health information posts, while the remaining 89% were appointed in various administrative and nursing posts, while also being made responsible for health information management. It was also found that 25% of health information staff had been in their posts for less than one year, that 63% were found to be spending less than half of their working time on health information work and that approximately 25% of all health information officers were inadequately trained for their work.

Shortcomings have also been identified in terms of the use, maintenance and capability of the computers at the disposal of the health information staff. Many information officers, for example, do not have access to e-mail, intranet or the Internet. All of these problems compromise the availability, accessibility and quality of data in the DHIS and therefore undermine effective health management, service delivery and health system performance. According the NHA (2004:76), managers at different levels of the HCS are responsible and accountable for

establishing and maintaining a comprehensive health information system. It is therefore up to the respective managers to address and solve these problems as a matter of extreme urgency. But even if the present shortcomings of the system and the administration are resolved, one cannot be certain that the managers concerned will be able to use the information in the DHIS for decision-making, unless their specific priority health information needs are met in a user-friendly way and unless they are sufficiently trained to interpret and utilise the information they receive.

2.9 SELECTION OF INDICATORS

According to Stancefield (2005:562), “choices made in the collection and use of information will determine the system’s effectiveness in detecting health problems, defining priorities, identifying innovative solutions and allocating resources to improve health outcomes”. The selection of indicators, as well as the choice of an intelligible format for returning performance feedback to managers, health professionals and policy makers, are therefore of crucial importance for improving the performance of any HCS.

The health information system and indicators need to produce a sufficient amount of valid and reliable evidence to identify HCS defects and to justify changes, but it is not necessary to provide a detailed picture about all aspects of health care and inequities in the system. The presentation of too much evidence at any one time may well obscure the clear and concise messages about the most critical needs. Indicators should be selected on the basis of the most important problems where evidence can be used to facilitate action for reducing priority health inequities and the mortality rate in children under five years of age (Global Equity Gauge Alliance 2003:13).

According to Katzenellenbogen et al (1997:23-24), a standard set of indicators, which are easy to collect and interpret, should be made available to health care managers so that they will be in a position to compare key health care outcomes in the areas for which they are responsible at regular intervals. Indicators should always be kept to a minimum and should be predicated on priorities and predetermined principles because monitoring of all aspects of all health programs and health services would consume too many resources and would result in vast quantities of information. Indicators will be most useful if they focus on specific problems (such as the *U5MR*) which, if tackled with those resources that are already available, could be radically improved. Katzenellenbogen et al (1997:23-24) conceptualise the “ideal indicator” as possessing the following characteristics: they are useful, important, practical, reliable, appropriate, valid, easy to calculate, sensitive, simple, and cost-effective to collect.

But indicators rarely comply with all these criteria. If indicators are expected to enable meaningful comparisons between facilities, sub-districts, districts and provinces, they need to be selected so that they reflect all dimensions of health care, namely inputs, processes, outputs, outcomes and impact (Global Equity Gauge Alliance 2003:13). Numerous usable indicators were identified from the international and national literature and a set of indicators suitable for this study had to be selected. Since the ”users” of this health systems research study are overburdened and overextended service providers and health managers, the study indicators had to be practice-based, easy to understand and effective for informing conclusions and decisions. The indicators selected for the study had to be suitable for daily routine data collection by service providers working in facilities, while existing data had also to be taken into account.

Managers will be unable to use a results-based systems approach to remedy the problem of a high and inequitably distributed *U5MR* unless they use sound and reliable evidence to identify and address inequities and shortcomings in child health care inputs, processes, outputs, outcomes and impact.

To measure the extent to which implementation of the NHA has taken place in the DHS, managers require sound and reliable evidence about the accessibility, equity, effectiveness and efficiency of the HCS, right down to the local service delivery level. In order to measure child health parameters within the DHS, managers also need data about the main causes of under-five mortality, as well as mortality rates for each of the main conditions that contribute to under-five mortality. Managers further need evidence about the preventative, screening, diagnostic, treatment, and rehabilitative interventions provided at all types and levels of health care facilities to identify problems and to measure the effectiveness of integrated, comprehensive needs-based health care.

Table 2.1 summarises the potential study indicators from the literature. The rationale for the selection of the final indicators for this study is discussed in Chapter 3.

2.10 SUMMARY

The literature review confirmed that neither South Africa as a whole nor the Free State province is on track for reaching the *U5MR* MDG target of 20 deaths per 1000 live births by 2015.

The main causes of mortality in infants and children under five years of age were identified to enable the selection of a suitable set of indicators for evaluation in this research, as well as for formative evaluation over the next seven years until 2015, which is the target date for achieving the MDGs. The causes of still births and deaths in infants and children under five indicate that

the health care priorities and interventions that need to be tracked are: the prevention of unplanned pregnancies, ANC and delivery services, the prevention and treatment of malnutrition, intestinal infections and pneumonia in children under five years of age and HIV/AIDS in pregnant women, infants and children.

The literature review also established that results-based management requires information about how magnitude and equity relate to priority disease-specific mortality rates and to priority health care interventions and their outcomes.

It was concluded on the basis of the systems approach that poor outputs, outcomes and impacts are normally caused by inadequate inputs and processes and that input and process evaluations should therefore be conducted for specific geographical areas in which output, outcome and impact targets have not been met.

The evaluation process requires valid and reliable data about all these system stages and dimensions if it is to be used to identify whether health care services are on track, where underperformance requires additional support and what progress has been made with regard to the MDGs on child mortality after corrective strategies have been implemented (Kusek & Rist 2004:3).

The present constraints that prevent and hinder an adequate level of child health care can be traced to the incapacity of the HCS in many different areas, one of which is its inability to monitor and evaluate health, morbidity, capacity and mortality problems with the current state of its routine health information system (Saloojee & Bamford 2006:197). The deficiencies of the HCS's health information systems were confirmed by the findings of Loveday et al (2007:4). Because information management system constraints such as shortages of staff, skills and equipment impact negatively on the availability, accessibility and quality (and therefore the use) of information, innovative ways of using available information are required, while priority gaps in the DHIS need to be addressed. The provision of easily accessible, regular and user-friendly DHIS feedback to the managers may enable them to use the information they receive for informed management decisions.

Numerous indicators were identified from international and national literature. The systems-based data extraction framework was used to summarise the potential study indicators in Table 2.1. Because indicators should be kept to a minimum, the study indicators were only selected after extensive reflection and consideration. The methodology that was used in the selection of the final indicators is described in Chapter 3.

Table 2.1 Potential study indicators

System stages, measuring parameters and indicators to monitor lowering of mortality in children under five years of age						
Input indicators Measure **availability, accessibility and equitable distribution** of facilities in terms of numbers and types, staff, interventions to address priority health needs, essential drugs and the accessibility of health care facilities to the population.	**Process indicators** Measure how well services are planned, managed and delivered. They are monitored in terms of the **acceptability** and **utilisation** of health facilities in relation to the population in need of those services.	**Output indicators** Measure coverage by promotive, preventive, diagnostic, curative and rehabilitative interventions. Coverage is only meaningful if it is measured in terms of specific interventions aimed at addressing leading health problems.			**Outcome indicators** Measure effectiveness and efficiency in terms of: * specific interventions implemented * management of personnel and expenditure	**Impact indicators** Measure health status in terms of mortality and life expectancy
		Promotive and preventive	**Screening and early diagnosis**	**Curative and rehabilitative**		
Finance - per capita total expenditure on health (Bryce et al 2006:1069)	Dropout rates between DTP 1 and DTP 3 (WHO 2003b:19)	Birth spacing indicator / Couple year protection rate (WHO 2004:3; Day & Gray 2006:497)	Antenatal care coverage (APP 2006:38)	Delivery in facility rate (Bryce et al 2006:1071)	PHC expenditure per uninsured person (APP 2006:24)	Infant mortality rate (Bryce et al 2006:1069)
Human resources (Bryce et al 2006:1069)	Utilisation rate under five years (APP 2006:25)	Termination of pregnancy rate (Saloojee 2007:102)	HIV test antenatal care rate (Day & Gray 2006:499)	Caesarean section rate (APP 2006:26)	Nurse clinical workload (Day & Gray 2006:496)	Still birth rate (Day & Gray 2006:496)
DTP-Hib 1st dose coverage (WHO 2003b:19)		Neonatal Tetanus protection at birth (Bryce et al 2006 :1067)			Low birth weight rate (WHO 2004:3)	Perinatal mortality rate (Day & Gray 2006:496)
		Prevention of mother to child transmission coverage (Bryce et al 2006:1071)			HIV transmission rate (Saloojee 2007:103)	Neonatal mortality rate (Bryce et al 2006:1069)
		Nevirapine baby coverage (APP 2006:31)			Syphilis prevalence antenatal care (Day & Gray 2006:498)	Under-five mortality rate (Bryce et al 2006:1069)
		Measles immunisation (Bryce et al 2006:1069)			Diarrhoea incidence under five years (APP 2006:42)	Diarrhoea mortality under five years (Bryce et al 2006:1069)
		DTP-Hib 3rd dose coverage (Bryce et al 2006:1070)			Pneumonia incidence under five years (APP 2006:42)	Pneumonia mortality under five years (Bryce et al 2006:1069)
		Vitamin A 6-11 months coverage (Bryce et al 2006:1071)			Malnutrition incidence under five years (APP 2006:42)	Malnutrition mortality under five years (Bryce et al 2006:1069)
		Vitamin A 12-59 months coverage (WHO 2004:3)			Underweight in children under five years (Kekki 2003:4; WHO 2004:3)	
					Not gaining weight under five years (Katzenellenbogen et al 1997:149)	

CHAPTER 3

RESEARCH METHODOLOGY

3.1 INTRODUCTION

Due to the lack of published research in this area, there was no existing methodology that could be adapted for this study. A rapid methodology was developed to:

- Determine if the data and indicators in the DHIS were appropriate for monitoring equity in *U5MR* related PHC.
- Explore how existing DHIS data could be used to help managers to strengthen the HCS to reduce the *U5MR*.
- Develop a performance profile that would enable managers to use evidence-based decision making to make the HCS more successful in dealing with priority *U5MR*-related health problems.

This chapter contains a description of the research design and methodology that was used in this study.

3.2 THE RESEARCH DESIGN

The research design is a master plan that explains the proposed research methods in terms of data collection, enhancement of data quality and data analysis (Brink & Wood 1998:214; Kumar 2005:84; Polit & Beck 2006:509).

This study uses a quantitative, contextual, exploratory and descriptive approach to conduct evaluative health systems research (Brink & Wood 1998:5-7; Kumar 2005:10-12; Polit & Beck 2006:508-509). The study data (reflecting *U5MR*-related health care aspects in the Free State from 2001 to 2006), was already available in the DHIS at the NDoH when the study commenced.

The research methodology is **quantitative** because the variables in the DHIS were pre-formatted in numerical format. The data included variables such as the number of visits made by patients, the number of children who had been vaccinated and the number of deliveries that had been conducted in public health care facilities. The values for the standard system-

generated indicators in the DHIS are presented mostly as percentages, ratios, frequencies and rates (Kumar 2005:12; Polit & Beck 2006:508; DHIS 2007).

This research methodology is also **contextual because** it concerned itself with the quality and performance of public health facilities in one of the nine provinces of South Africa.

The research design was **exploratory** in nature because it explored the relationships between indicator values in order to identify best practices as well as the deficiencies and shortcomings that existed in districts, sub-districts and hospitals within the time period that was investigated. The research also scrutinised a variety of processes and explained them in terms of data validation, data management and use of information in evidence-based management-decisions. A performance profile that makes use of existing DHIS data was developed and refined for the support and convenience of managers as they strive to improve the quality of health care for children under five years of age and the various contexts in which this kind of health care is delivered (Brink & Wood 1998:15; Kumar 2005:10; Polit & Beck 2006:500).

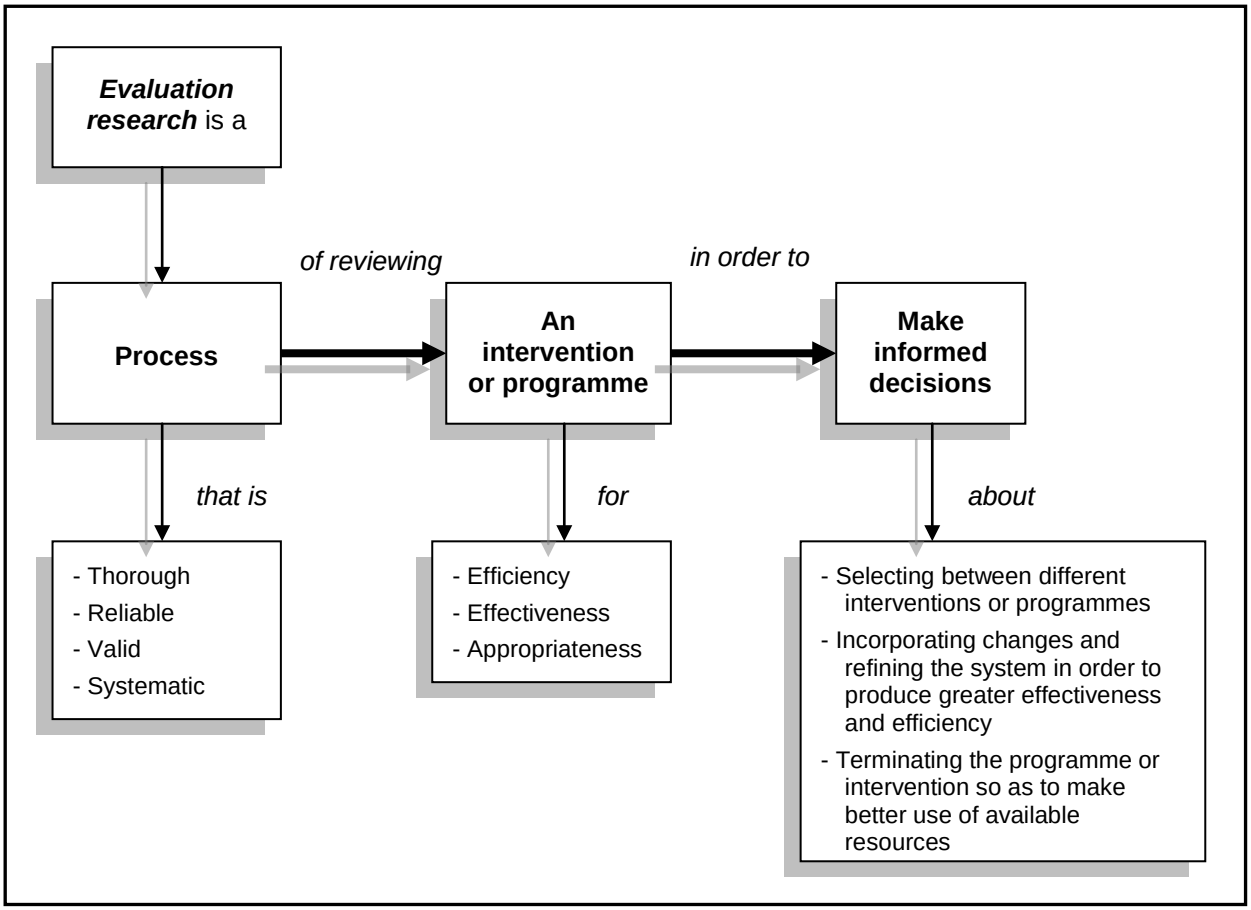
The research methodology is also **descriptive** because it systematically describes the achievements and deficiencies that characterise the high incidence and causes of the *U5MR* as it is reflected in DHIS data. But it also enriches the data with new meaning and significance because it describes how this data can be used to support evidence-based management for reducing the *U5MR*. The study used descriptive statistics to illuminate the findings and examples were adduced to indicate how these findings can be presented to managers in a readily comprehensible way for evidence-based decision-making (Brink & Wood 1998:15; Kumar 2005:10; Polit & Beck 2006:498).

According to Kumar (2005:275) **evaluation research** is a process of reviewing a programme so that managers will be empowered to make informed decisions about improving performance (Figure 3.1). Evaluation research measures the appropriateness, effectiveness and efficiency of interventions. Evaluation research also allows stakeholders to learn from the achievements and mistakes of the past and allows them to improve existing conditions, activities, planning and processes. Evaluation is not only concerned with past problems and their possible causes. It includes recommendations for actions and initiatives that will improve performance and results. Evaluation therefore requires standards for comparison and the envisaged aims of the service that is being evaluated (Katzenellenbogen et al 1997:147).

The purpose of evaluation research is to find out how well programmes, policies, treatments and interventions are being implemented and how well they accomplish the purposes for which they were designed. It also scrutinises the use to which resources are being put, and whether or not such resources are accomplishing their purpose. There are three broad categories of evaluation research:

- **Formative evaluation** of an existing programme or intervention determines whether it has been implemented according to the original plan, whether it is working as it was intended to do, and whether or not the performance of the programme can be improved.
- **Summative evaluation** is conducted on an ongoing or completed programme in order to determine how effective the programme was in meeting its stated objectives.
- **Diagnostic evaluation** assists planners and managers to identify successes, needs, problems and deficiencies within programmes or organisations (Brink & Wood 1998:124-132).

This study is **evaluative** because it measures the usefulness of the DHIS in measuring equity in *U5MR*-related PHC services and how well the DHIS accomplishes its purpose of supporting evidence-based health care management aimed at achieving national and international goals. Indicators and indicator values for measuring the different "stages" (inputs, processes, outputs, outcomes and impacts) of *U5MR*-related health care were evaluated in terms of their appropriateness. The achievements of the Free Sate HCS in terms of *U5MR*-related health care inputs, processes, outputs, outcomes and impacts were also specifically evaluated by means of formative, summative and diagnostic evaluations (Barron et al 1997:2; Brink & Wood 1998:124-125; Katzenellenbogen et al 1997:147; Kumar 2005:274-30; Polit & Beck 2006:499).

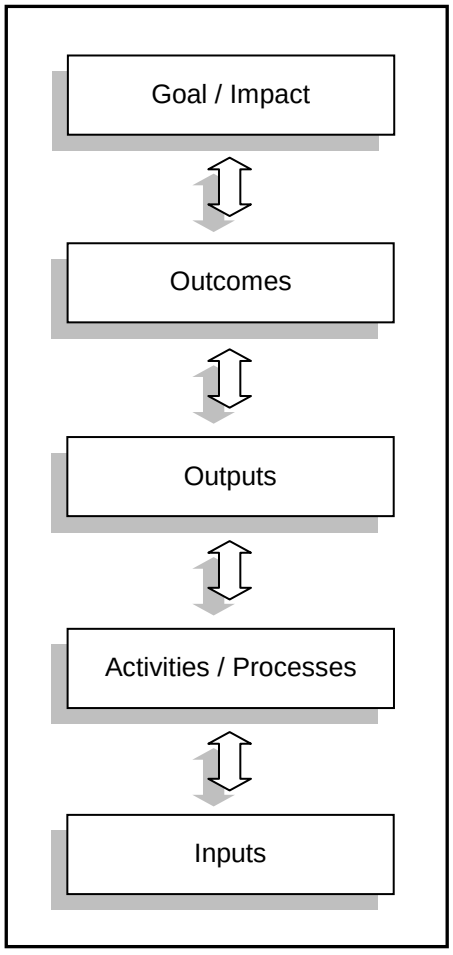


(Kumar 2005:275)

Figure 3.1 The concept of evaluation research

This study is presented as a **health systems research** study because it is applied, problem-based, action orientated, operational research that was undertaken with regard to existing health information and HCS components and activities. It was designed to create simple and practical methods for supporting decision making so that operations at all levels of the HCS could be improved. Although this study was not directly participatory, all the study indicators that have been used were developed by different health care providers, managers and experts throughout the world since the Declaration of Alma-Ata 30 years ago. Similar data in the DHIS was collected by thousands of health care providers in all the public health care facilities in the Free State province (and the other provinces of South Africa) since the DHIS was first launched in 2000 (Barron et al 1997:2,4,6; Katzenellenbogen et al 1997:147,152).

3.3 THE THEORETICAL FRAMEWORK



(Kusek & Rist 2004:18)

Figure 3.2 A results-based application of the systems theory

A results-based application of the systems theory (Figure 3.2), as described by Kusek and Rist (2004:57), was used to determine the appropriateness of the DHIS data for evaluating the Free State HCS in terms of the *U5MR*.

A HCS is a collection of people (clinical and support staff), things (buildings, vehicles, drugs, money and plans) and events (consultations, meetings, procedures and evaluations), all of which are integrated to promote health, prevent illness and assist those in need of health care (Katzenellenbogen et al 1997:148). Several authors equated the HCS, of which the health information system is a sub-system, to an industrial system (Figure 2.1) because of its interdependent inputs, processes, outputs and outcomes (Heavens 1999:14,48; Katzenellenbogen et al 1997:151; WHO 2001a:6, WHO 2003b:12).

Kusek and Rist (2004:57) have remarked that the building of a system is a deductive process because all the inputs, activities and outputs flow from the initial setting of outcome goals (Figure 3.2).

The results-based systems approach emphasises that the successful implementation of a particular health programme will not automatically produce an actual improvement in the quality

of public health. The results of the health programme must be measured to determine the outcomes or differences made in terms of the health status of the population which the programme was designed to serve (Kusek & Rist 2004:16). It is therefore necessary to track each component of a results-based system (the inputs, processes or activities, outputs, outcomes and impacts) in order to monitor and optimise the system's functions (Kusek & Rist 2004:22). Kusek and Rist regard the MDGs as an internationally sponsored initiative that requires a results-based approach because progress in achieving the MDGs require reporting on outcome indicators such as the prevalence of HIV/AIDS and impact indicators such as the *U5MR* (Kekki 2003:4; Kusek & Rist 2004:1,3).

Figure 3.3 illustrates the results-based systems approach as it is applied in this study, and offers examples of potential objectives and indicators with targets or benchmarks (as documented in Annexure 4). In-depth discussions about measuring the different activities of the HCS, and selection of indicators to measure each activity, were documented in sections 2.7 and 3.5.2.

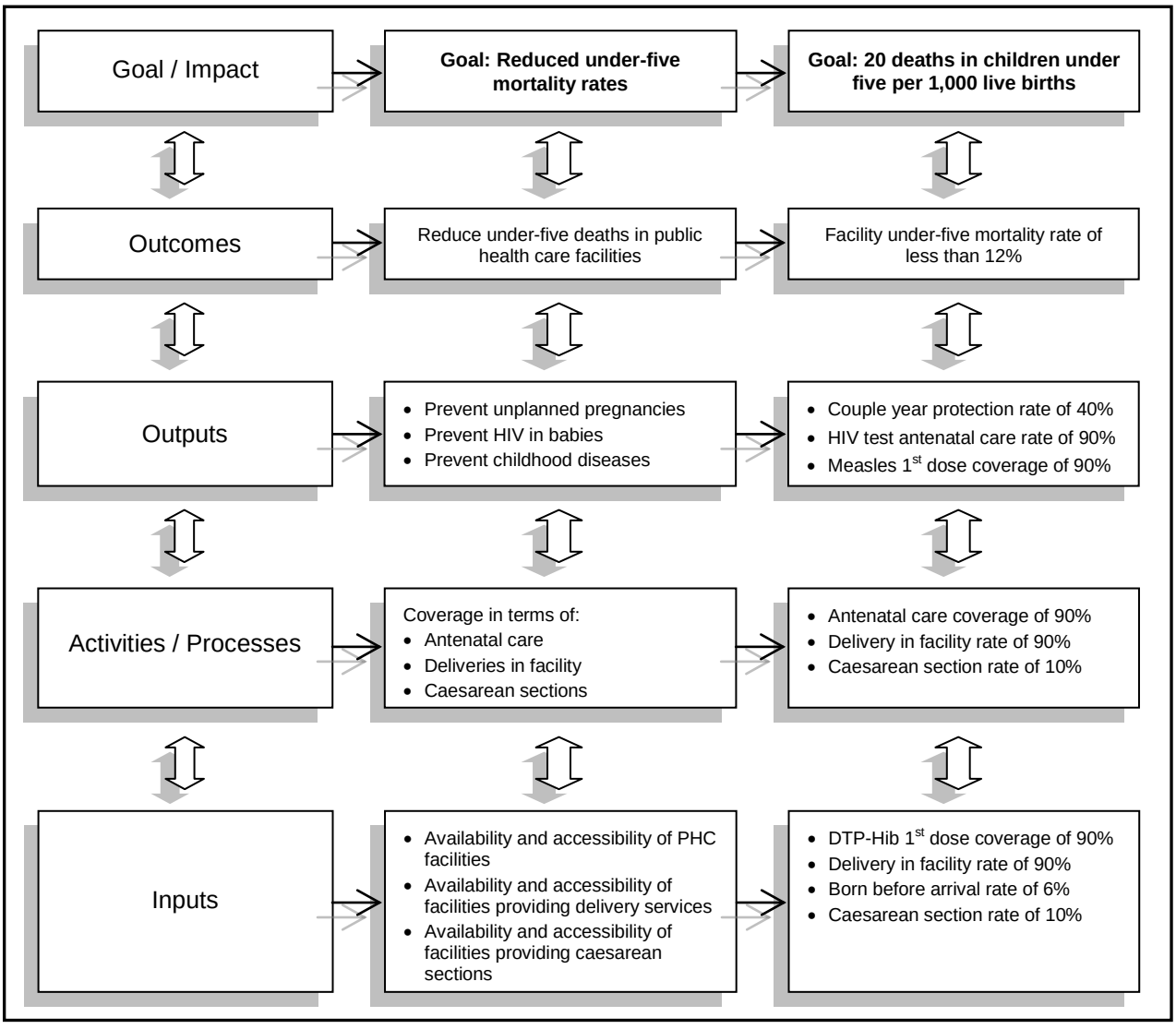


Figure 3.3 Components of a results-based system for reducing the under-five mortality rate

From the point of view of a results-based system, it can be argued that the high *U5MR* in the Free State (and in South Africa as a whole) is caused by inadequate health care processes and/or inputs (WHO 2003b:35-36). In this study a results-based systems approach was followed. This implied the use of selected impact and outcome indicators to identify the best-performing areas and components of a system, as well as the worst-performing areas where additional support and training are needed to achieve targets. By comparing the best practices with the worst performance in the health system, it was possible to define a set of positive and negative polarities in terms of which performance could be judged. Output, process and input indicators were then used in an effort to identify possible reasons for exceptional performance and achievement, as well as for underperformance and failure to achieve the expected outcomes.

3.4 THE STUDY POPULATION AND THE GEOGRAPHICAL AREA

As indicated in Chapter 1 and described in Chapter 2, the systems theory, as applied to health systems research in the conceptual framework provided in Katzenellenbogen et al (1997:151) (Table 3.1), was used for selecting the study population.

Table 3.1 Ways of looking at health care systems

Sector	Level	Unit or service level	Stage	Element
Public Private - for profit - not for profit	Sub-district District Province National International	Carer Mobile Clinic Community health centre (CHC) Hospital Contact Patient Community	Input Process Output Outcome Impact	Effectiveness Equity Efficiency Coverage

(Adapted from Katzenellenbogen et al 1997:151)

The components that were selected for this study were the **public** health care sector at **provincial, district** and **sub-district** levels. This kind of public health care is delivered by means of **mobiles**, **clinics, CHCs** and **hospitals.** These service components and the stages and elements of which they are comprised, are set out in Table 3.1.

The **study population** is comprised of the entire set of subjects that meet the sampling criteria. **Sampling** is a process of selecting a representative number of subjects for a proposed study (also called a sample) from a larger study population. From such a representative group (the study sample) it should be possible to predict outcomes for the entire population (Kumar 2005:164). According to Brink and Wood (1998:292), the ideal sample for descriptive studies is a “total available population” or a sample selected by means of probability sampling. A study in

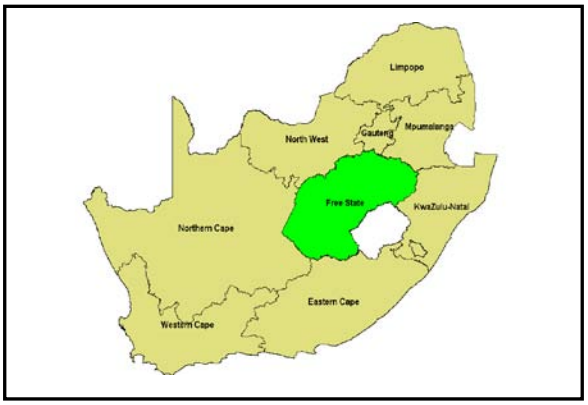
which the *entire* population is studied is referred to as a *population study* or a *census* (WHO 2001b:71-72; Wikipedia [online] 2008). When the purpose of a study is to describe the characteristics of a population by means of a representative sample, external validity is important. But when a total population is used, "external validity is not relevant because no [further] generalization will be made" (Brink & Wood 1998:292). Similarly, "internal validity is not an issue in descriptive designs because no attempts are made to examine causal relationships between variables" (Brink & Wood 1998:293).

Because a study designed to measure equity in *U5MR*-related PHC in all 52 health districts in South Africa would have exceeded the scope and capacity available for this study, the 381 public health facilities in the Free State province (Table 3.2) were selected as a *population study* or *census* because it involved *all* the health facilities of the Free State public HCS.

Table 3.2 Public health care facilities in the five Free State districts

District	Mobile	Clinic	CHC	District Hospital	Regional Hospital	Tertiary Hospital	Total 2006
Fezile Dabi	25	33	4	4	1		**67**
Lejweleputswa	25	45	1	5	1		**77**
Motheo	20	69	2	4	1	1	**97**
T Mofutsanyane	21	66	1	8	2		**98**
Xhariep	21	17	1	3			**43**
Free State total	**112**	**230**	**9**	**24**	**5**	**1**	**381**

The Free State province was selected for the study because data in the Free State DHIS dataset appeared to be complete according to the standards of the National Indicator Data Set as well as in terms of monthly data. In addition to this, the Strategic Management Team in the Free State province expressed interest in the study, and the Head of the Department of Health of the Free State province gave permission for existing Free State province DHIS data to be used.

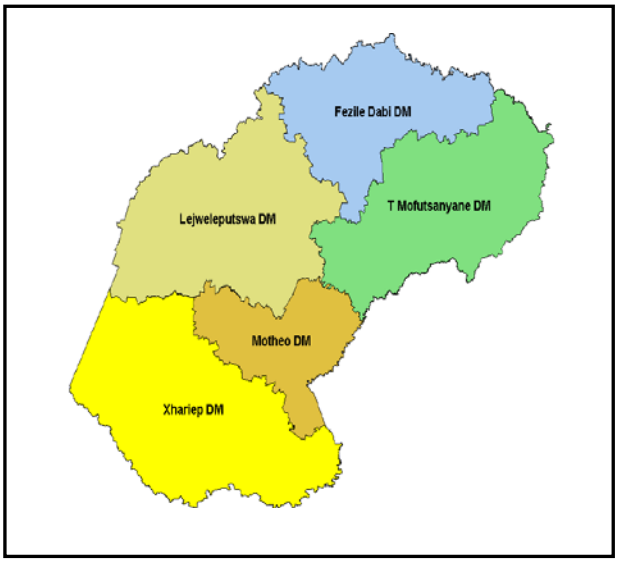


(DHIS 2007)

Figure 3.4 Free State as one of the nine provinces of South Africa

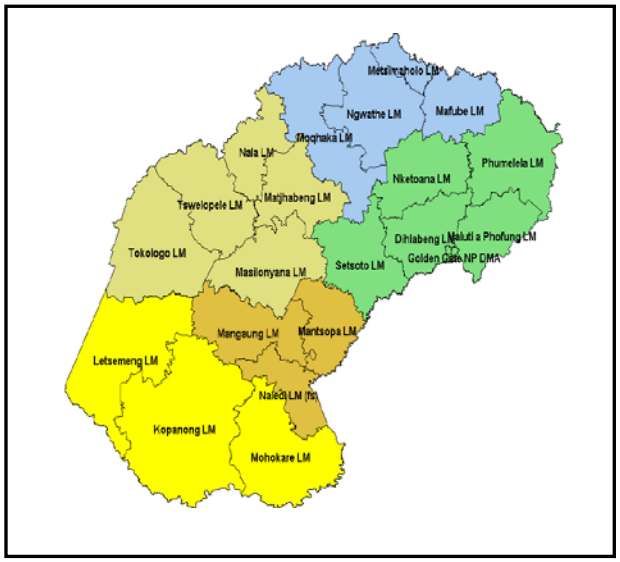
The Free State province is situated in the centre of South Africa and it has common boundaries with the provinces of Gauteng, Mpumalanga, KwaZulu-Natal, Eastern Cape, Northern Cape and North West, as well as with Lesotho, which is coloured white in the map (Figure 3.4). The Free State has a total population of 2,9 million people with an under-five population of 296,800 (StatsSA 2007b:1,8).

There are five district municipalities in the Free State (Figure 3.5), each of which is sub-divided to form 20 local municipalities or sub-districts (Figure 3.6) (Barron et al 2006:118-122; DHIS 2007).



(DHIS 2007)

Figure 3.5 Five districts of the Free State province



(DHIS 2007)

Figure 3.6 Twenty sub-districts of the Free State province

The Free State province is not considered poor by South African standards because all the districts are in the 3rd and 4th highest socio-economic quintiles and an average of 95.3% of households have access to piped water. In spite of an increase in per capita expenditure on PHC from R131 in 2001 to R237 in 2006, the utilisation rate of PHC facilities has remained constant at around 2 visits per person per year over the past 4 years. This is well below the national target of 3.5 visits (Barron et al 2006:116; Barron, Day & Monticelli 2007:140).

By using data from all the public health facilities in the province (Table 3.2), one is able to provide the kind of local evidence that will enable managers to identify the best and worst performing areas, in addition to evidence for planning and monitoring specific corrective measures in practical ways.

3.5 DATA COLLECTION

Because existing data was used for the study, a data extraction framework had to be developed to obtain the required data from the DHIS.

3.5.1 The data extraction framework as research instrument

The kind of data extraction framework that has been used in this study enables a researcher to organise the study and to establish a context in which to examine problems and gather and analyse data (Kumar 2005:22).

The literature review led to the conclusion that the magnitude of equity in health care (intended to reduce child) could only be measured accurately and comprehensively by taking into account all of the system's stages and dimensions, namely **inputs, processes, outputs, outcomes and impact** as well **availability, accessibility, acceptability**, **coverage, effectiveness and efficiency.** The systems theory, as conceptualised and described in Chapters 1 and 2, was used to structure the data extraction framework (Annexure 3).

3.5.1.1 Advantages and disadvantages of the data extraction framework

The data extraction framework was advantageous for this study because it enabled using a structured, principle-based systems approach in all stages of the research. It also helped to cover all possible system stages or dimensions, ensured that all aspects of priority health care that related to *U5MR* had been addressed and provided a method for identifying gaps in the existing DHIS data.

3.5.1.2 Format and use of the data extraction framework

The data extraction framework (Annexure 3) is comprised of sections for all the HCS's stages or dimensions, namely inputs, processes, outputs, outcomes and impacts. The section for outputs was further sub-divided to allow for summaries of the indicators that measure coverage by preventive interventions (immunisation coverage, for example), screening and diagnosis (HIV testing, for example) and curative interventions. This same framework was then used to summarise potential study indicators (Table 2.1) from national and international literature. The framework was also used to make sure that all possible system stages or dimensions and sub-components had been covered for the purpose of supporting the evaluation of *U5MR*-related HCS inputs, processes, outputs, outcomes and impacts. After summarising indicators from the literature, the data extraction framework was re-organised to reflect the results-based systems approach (Figure 3.2). The final study indicators thus collected were summarised in Table 3.5. Although the initial data extraction framework was re-organised to reflect a results-based application of systems theory, the principles identified during the development of the data extraction framework were applied throughout data extraction, analysis and interpretation.

3.5.1.3 Validity and reliability of the research instrument

Valid means based on sound reasoning or well grounded in truth, logic and facts, while "validate" means "confirming that something is true or correct". **Reliable** is defined as "very likely to be correct or trustworthy" (WordNet [online] 2008).

3.5.1.3.1 Validity

Instrument validity refers to the extent to which an instrument accurately measures what it is supposed to measure (Polit & Beck 2006:512; Kumar 2005:153). There are three types of instrument validity, namely face and content validity, concurrent and predictive validity, and construct validity (Kumar 2005:154). Because the DHIS data does not include scales and because no variances were used, it was possible to determine only face and construct validity. **Face validity** requires each question in an instrument to have a logical link with a study objective while **content validity** requires the questions to cover the full range of the phenomena that are being measured (Kumar 2005:154-156). The face and content validity of the data extraction framework was enhanced by the literature review, as well as by subject experts who ensured that all of the data elements and indicators were logically linked to the study objectives. The systems theory, that it has been used for many years by experts and researchers in many related disciplines and the assistance provided by acknowledged experts in this field, served to ensure that the full range of the *U5MR*-related HCS components had been covered. Variables were selected to develop indicators for measuring the inputs, processes, outputs, outcomes and the impacts of under-five health care services. Individual and group discussions were held with health professionals and with monitoring, evaluation and information experts. After that the study supervisors at UNISA, as experts in academic research, provided the final inputs that ensured face and content validity (Heavens 1999:14, 48; Katzenellenbogen et al 1997:151; WHO 2001a:6; WHO 2003b:12).

Because the study was a population study or census without any personal participation on the part of respondents and because no generalisation was intended, a determination of external validity was not relevant. Brink and Wood (1998:292-293) confirm that “internal validity is not an issue in descriptive designs because no attempts are made to examine causal relationships between variables”.

3.5.1.3.2 Reliability

A research instrument is said to be reliable when it is consistent, stable, predictable and accurate (Kumar 2005:156). The reliability of a measuring instrument is an important feature of quantitative data collection, and the less variation an instrument produces from repeated measurements of a specific attribute, the higher is the reliability of the instrument (Polit & Beck 2006:508).

Because the data extraction framework was only used for extracting and organising existing aggregated data, there was no risk of variations from repeated use of the instrument, provided that the same indicators were used and that values were extracted from the DHIS on the basis of the pre-set indicators.

3.5.1.4 Pre-testing the research instrument

It is customary to conduct a pre-test or pilot study to refine a study instrument and procedures (Kumar 2005:10). But since the data extraction framework was only used for organising existing DHIS data and study indicators, no pre-testing of the instrument was required. In spite of this, the prioritisation of indicators and the repeated ”testing” of extraction results were necessary to refine indicators, targets, benchmarks and ranges. The subsequent testing and refinement were based on systems theory principles and stages, literature, peer and expert review and on the data and indicators available in the DHIS.

3.5.2 Study indicators

The potential study indicators were summarised in Table 2.1, but further work was required to select the final study indicators.

3.5.2.1 Selection of study indicators

Although the calculation of indicators is fairly straightforward, the selection of the relevant indicators is a complex and critical process because the choices that are made in the selection affect the accuracy of the information obtained. Indicators also determine the effectiveness or otherwise of the HCS and the health information system in detecting health problems, defining priorities, identifying innovative solutions and allocating resources to improve health outcomes (Stancefield 2005:562).

Because the purpose of this study is support for managers as they attempt to improve the HCS and so reduce the *U5MR*, indicators were selected to guide managers in responding to the following five questions:

- How can progress towards the MDG goal of 20 deaths per 1,000 live births in children under five be measured by means of data available in the DHIS?
- Are current child health policies, programmes and projects achieving the desired results (impacts and outcomes) in terms of child mortality?
- How are managers to judge whether they are presently on the right track in their efforts to reduce the *U5MR* in the health sector?
- What are the obstacles and barriers that are currently inhibiting the reduction of child mortality, and how can they be identified?
- How can the effectiveness and efficiency of corrective strategies or interventions be monitored? (Adapted from Kusek & Rist 2004:3).

The selection of the final indicators used in this study was based on examples of indicators, principles and criteria that had already been documented by several authors (summarised in Chapter 2), as well as on advice obtained from paediatric experts who work in academic and public health care environments. Inputs were also obtained from information and M&E experts by means of direct and indirect communication. The following key considerations were borne in mind during the process of selecting the indicators:

- The indicators should reflect all dimensions of the HCS, namely inputs, processes, outputs, outcomes and impacts for results-based evaluation.
- Over-burdened service providers and managers need a few practice-based indicators (preferably on one page) that are easy to understand because the presentation of too much evidence may obscure clear and concise messages.
- The indicators should correspond to the kind of routine data that is collected by service providers and managers as part of their daily work.
- The indicators that are selected should be congruent with those that have already been in use throughout the world since 1990. They should be such that they retain their relevance until the MDG target date of 2015 (WHO 2004:1), and they should be based on existing DHIS data.
- The selected indicators should be able to measure progress in coping with the present obstacles that are compromising the quality of current child health care.

The international and national indicators that were identified in the literature review were compared with and complemented by the South African indicators that were described in the *Format for Annual Performance Plans of Provincial Health Departments for Financial Years 2007/08 to 2009/10* (APP 2006). Because this study made exclusive use of Free State indicators (that could be measured by means of existing routine information), the resultant in-depth study focused on existing DHIS indicators, together with a few additional indicators that were developed from available DHIS population and service delivery data. These indicators were calculated using the DHIS software and formulas in an Excel format. After that had been done, a DHIS database manager was requested to review the selected indicators, their formulation and their calculation.

Chapter 2 has described how a results-based application of the systems theory was used for this study. In order to conform to a results-based systems approach, the selection of indicators and evaluation was initiated by means of an analysis of impact indicators (mortality rates, for example) and outcome indicators (that measure effectiveness and efficiency). After that, the selection of output/coverage, process and input indicators was guided by their capacity to identify and evaluate inequities. Where more than one indicator was suitable for the same

intervention or monitoring purpose, the one that was considered most relevant and valid was selected.

3.5.2.1.1 Impact indicators

Five proxy impact indicators were selected for this study, and the word “facility” was added in front of each indicator name to distinguish between indicators that had been obtained from other sources (such as population surveys) and those that were based on public health facility data obtained from the DHIS. The *maternal mortality rate* (*MMR)*, for example, is the indicator that is generally used. But for the purposes of this study, the indicator *facility MMR* was used because only DHIS data could be used for calculation.

The five final impact indicators selected for this study were as follows:

1) *Facility MMR* - maternal deaths in public health facilities expressed per 100,000 estimated live births for a specific year in the Free State.
2) *Facility PNMR* – Perinatal deaths in public health facilities expressed per 1,000 estimated live births for a specific year in the Free State.
3) *Facility neonatal mortality rate (NNMR)* – neonatal deaths in public health facilities expressed per 1,000 estimated live births for a specific year in the Free State.
4) *Facility IMR* – children under one year of age who died in public health facilities expressed per 1,000 estimated live births for a specific year in the Free State.
5) *Facility U5MR* – children under five years of age who died in public health facilities expressed per 1,000 estimated live births for a specific year in the Free State.

The variable *estimated live births* was calculated by using the under-one population multiplied by a factor of 1.04 (Day & Gray 2006:385), and *estimated pregnant women* was calculated by using the under-one population multiplied by a factor of 1.15. The extra 0.15 (15%) is a rough estimate to make allowance for late miscarriages (10 to 28 weeks), still births (after 28 weeks gestation) and infant mortality (DHIS 2007).

Since the mortality rates used in this study are based on public health care data in the DHIS in relation to overall (insured and uninsured) population data, these indicators only provide an indication of the results of the health care provided to that 85% of the Free State province’s population who are dependent on public health care facilities (Day & Gray 2007:319). But if one were to take into account the fact that 43.4% of all notified deaths were reported by hospitals (StatsSA 2007a:14), one could at least argue that the principle of using public health facility data (to calculate under-five mortality and morbidity rates) is valid for measuring trends and

progress towards targets by using easily available data. The ultimate value of this approach resides in the fact that it provides a means for measuring, in a standardised way, the amount of progress that the HCS has been making towards reducing the *U5MR* in public health facilities. In the mean time, some of the newly developed proxy indicators may be regarded as "placeholders" that can be replaced when more sensitive or specific indicators can be generated from routinely available data.

3.5.2.1.2 Outcome and output/coverage indicators

Outcomes are measured in terms of effectiveness, efficiency and quality of services (Kusek & Rist 2004:16). Priority health care services and strategies (for which the outcomes and coverage need to be monitored because of their effect on the *U5MR*) were identified from the literature review (section 2.5.2) as being effective for:

- The prevention of unplanned pregnancies.
- The provision of ANC that optimises the health of mothers and babies.
- Describing safe delivery services.
- The prevention of priority illnesses that cause deaths in children under five years of age.
- Identifying care-seeking behaviour and case management (the diagnosis and treatment) of children with these priority illnesses.

The incidence of the main causes of child mortality provides an overall picture of the outcomes of child health care interventions. Section 2.5.2 of the literature review identifies the main causes of death in children under five years of age in the Free State province (and in South Africa as a whole) as complications arising from HIV/AIDS, pneumonia, malnutrition and diarrhoea. The incidence indicators that were initially selected for this study were based on the main causes of child morbidity and mortality. These are:

- The *incidence of HIV* (i.e. the number of HIV positive test results in children under five years of age reported by public health facilities per 1,000 children under five years of age in a specific year).
- The *incidence of pneumonia* (i.e. the number of children under five diagnosed with pneumonia in public health facilities per 1,000 children under five in a specific year).
- The *incidence of severe malnutrition* (i.e. the number of children under five diagnosed with severe malnutrition in public health facilities per 1,000 children under five in a specific year).
- The *incidence of diarrhoea* (i.e. the number of children under five diagnosed with diarrhoea in public health facilities per 1,000 children under five in a specific year).

The indicator values for the selected incidence indicators that were extracted from the DHIS revealed significant variations which may be suggestive of misinterpretations in data collection activities. After discussion of this point with two paediatricians, it was decided to exclude these incidence indicators from the study. After consultation with experts, existing DHIS indicators were selected to reflect the number of under-five deaths in public health facilities as a percentage of the children who had been admitted (or born, in the case of some indicators) as proxy indicators for measuring care seeking-behaviour and case management as described by Bryce et al (2006:1071). A percentage (%) sign was added at the back of each outcome indicator to distinguish between the impact indicators (using population figures [the estimated number of live births]) and the outcome indicators (using the number of children who had been admitted [or born in the case of some indicators] in public health facilities) as denominators. These indicators can also be used to measure the quality and effectiveness of interventions that have been implemented to address priority conditions in specific areas and facilities.

The seven final outcome indicators selected for this study were:

1) The *facility U5MR (%)* – children under five years of age who died in public health facilities expressed as a percentage of those children that were admitted.
2) The *facility LBWR (%)* – live babies born in public health facilities weighing less than 2500g expressed as a percentage of all live births in health facilities.
3) The *facility SBR (%)* – still births in public health facilities expressed as a percentage of all births in health facilities.
4) The *facility NNMR (%)* – neonatal deaths in public health facilities expressed as a percentage of all births in health facilities.
5) The *malnutrition facility case fatality rate (CFR) (%)* – children under five years of age who died of malnutrition in public health facilities expressed as a percentage of those children that were admitted with malnutrition.
6) The *pneumonia facility CFR (%)* – children under five years of age who died of pneumonia in public health facilities expressed as a percentage of those children that were admitted with pneumonia.
7) The *diarrhoea facility CFR (%)* – children under five years of age who died of diarrhoea in public health facilities expressed as a percentage of those children that were admitted with diarrhoea.

The outcome and output/coverage indicators selected for this study were mainly based on the "countdown" indicators discussed by Bryce et al (2006:1067-1068). These indicators (from the 2003 and 2004 Lancet series on child and neonatal survival) were selected by international specialists to measure the results of "proven" interventions. The "countdown" indicators also include 16 of the 19 indicators recommended by international organisations for monitoring progress towards the MDG to reduce the *U5MR*. Because *Countdown to 2015* reports every two years on the progress of strategies being used internationally to increase the rate of child survival throughout the world, South Africa will need this data for reporting until 2015. All "countdown" indicators that were amenable to being measured by means of routine data were included in the study, and proxy or substitute indicators were selected (or, where possible, developed) to account for areas where "countdown" indicators are based on data that can only be obtained by means of surveys.

The ten final output indicators selected for this study (to monitor coverage by interventions that were designed to reduce the *U5MR*) are set out in Table 3.3. The numerators and denominators of these indicators are listed in Annexure 4 and defined in Annexure 5.

Table 3.3 The ten final output/coverage indicators

Strategies	Indicators
Prevention of unplanned pregnancies	1) Couple year protection rate 2) Termination of pregnancy rate
Prevention of HIV in babies	3) Nevirapine pregnant women coverage* 4) Nevirapine newborn coverage* 5) Nevirapine baby coverage* (based on expected number of babies born to HIV positive mothers) 6) HIV test antenatal care rate
Prevention of priority illnesses in children under five	7) Vitamin A 12 to 59 months coverage 8) Measles: 1st dose coverage* 9) Vitamin A 6-11 months coverage* 10) DTP-Hib 3rd dose coverage*

* "Countdown" indicators used by Bryce et al (2006:1071)

After extracting the DHIS data for the selected output indicators (Figure 3.7), the following two indicators were removed from the study indicator list because the Free State province had already met their targets:

- *Vitamin A 6 to 11 months coverage*
- *DTP-Hib 3rd dose coverage*

The targets for both these indicators are 80% (APP 2006:42). Figure 3.7 displays a 2006 *Vitamin A 6 to 11 months coverage* of 104% and a *DTP-Hib 3rd dose coverage* of 99% for 2006.

When using indicators with routine information as numerators and population-based denominators, it should be borne in mind that values may exceed 100%. This can be caused by the cross-boundary movements of patients (to health facilities situated in sub-districts, districts, provinces or even countries other than those in which they live) and/or because of an undercounting of the population in the course of a national census. But in those cases where indicators do exceed 100%, the possible reasons for this need to be identified and documented by province, district or sub-district.

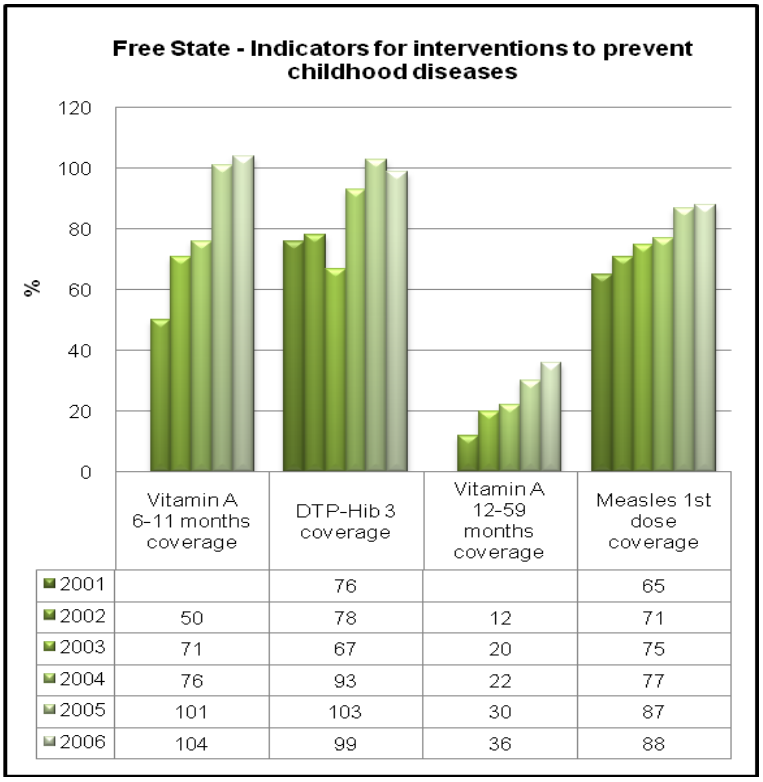


Figure 3.7 Free State province progress for selected output indicators

3.5.2.1.3 Process and input indicators

Process and input indicators measure the availability, accessibility, acceptability and utilisation of health care facilities, services and interventions. Process and input indicators provide managers with an indication of the magnitude of equity in terms of the distribution of health care resources and the extent to which they are used by populations in different geographical areas.

The five final process and input indicators selected for this study are existing DHIS indicators (Table 3.4). These indicators were selected (on the basis of the discussions in Chapter 2) as proxy indicators to measure the availability, accessibility, acceptability and utilisation of PHC, ANC services, delivery services and hospitals in which caesarean sections are performed.

Table 3.4 The five final process and input indicators

Availability, accessibility, acceptability and utilization	Indicator
Hospitals conducting caesarean sections	1) Caesarean section rate
Delivery services (mostly 24 hour services in CHCs and hospitals)	2) Born before arrival rate 3) Delivery in facility rate
PHC facilities and services PHC facilities providing antenatal care services	4) Antenatal care coverage 5) DTP-Hib 1st dose coverage

Equity in the distribution of funding, human resources, drugs and other resources such as equipment, should also be assessed as part of input evaluation. The availability of health care staff and their equity in distribution is both a worldwide priority in health care services and a major problem in South Africa. According to Day and Gray (2006:472), “there is a clear correlation between the availability of health workers and the coverage of health interventions, or put in another way…public health suffers when health workers are scarce”. The DHIS, however, contains no data to measure the inputs represented by finance, human resources and equipment and only limited and incomplete data is available for monitoring the availability of drugs (DHIS 2007). This is a major deficiency for evidence-based HCS management, and it has limited the ability of this study to identify those priority input factors that are responsible for influencing best practices and underperformance.

Table 3.5 sets out the final study indicators summarised in the context of the data extraction framework format after it had been reorganised to reflect the results-based application of systems theory. The definitions of these indicators, together with the definitions of their numerators and denominators, are described in Annexure 5.

Table 3.5 Final study indicators

System stages, measuring parameters and indicators for measuring the under-five mortality rate from a results-based systems perspective (The numerators and denominators for these indicators are listed in Annexure 4 and defined in Annexure 5)				
Impact indicators Measure health status in terms of mortality and life expectancy.	**Outcome indicators** Measure effectiveness and efficiency in terms of: * specific interventions implemented * management of personnel and expenditure.	**Output indicators** **Measure coverage by promotive, preventive, diagnostic, curative and rehabilitative interventions.** Coverage is only meaningful if measured in terms of specific interventions aimed at addressing leading health problems.	**Process indicators** Measure how well services are planned, managed and delivered. They are monitored in terms of the **acceptability** and **utilisation** of health facilities in relation to the population in need of those services.	**Input indicators** Measure **availability, accessibility and equitable distribution** of facilities in terms of numbers and types, staff, interventions to address priority health needs, essential drugs and the accessibility of health care facilities to the population.
Impacts were measured using under-five deaths in public health facilities per 1,000 estimated live births as proxy for under-five mortality rates.	Outcomes were measured in terms of deaths in public health care facilities as a percentage of children born or admitted.	The study focussed mainly on preventive interventions and screening. The selected indicators were grouped to measure the prevention of unplanned pregnancies, the prevention of HIV in babies, and the prevention diseases causing death in children under five.	Input and process indicators were grouped together because the same indicators were used to assess availability, accessibility, acceptability and utilization of health facilities and interventions	
1. Facility maternal mortality rate 2. Facility perinatal mortality rate 3. Facility neonatal mortality rate 4. Facility infant mortality rate 5. Facility under-five mortality rate	1. Facility under-five mortality rate (%) 2. Facility low birth weight rate (%) 3. Facility still birth rate (%) 4. Facility neonatal mortality rate (%) 5. Malnutrition facility case fatality rate (%) 6. Pneumonia facility case fatality rate (%) 7. Diarrhoea facility case fatality rate (%)	**Prevention of unplanned pregnancies:** 1. Couple year protection rate 2. Termination of pregnancy rate **Prevention of HIV in babies:** 3. Nevirapine pregnant women coverage 4. Nevirapine newborn coverage 5. Nevirapine baby coverage 6. HIV test antenatal care rate **Prevention of childhood diseases:** 7. Vitamin A 12-59 months coverage 8. Measles 1st dose coverage	**Availability, accessibility acceptability and utilization of:** **Hospitals providing caesarean section services** 1. Caesarean section rate **Facilities providing delivery services** 2. Born before arrival rate 3. Delivery in facility rate **PHC facilities** 4. Antenatal care coverage 5. DTP-Hib 1st dose coverage	

3.5.2.2 Indicator targets, benchmarks and ranges

The targets for selected indicators (Annexure 4) were obtained from the literature review. In those cases where targets could not be located, benchmarks were developed from the national and/or provincial averages in the DHIS. In order to assist managers to identify achievements and shortcomings values were categorised into four groups, each of which represented the degree of progress that had been made in achieving international and national targets or benchmarks. These were used as a basis for setting arbitrary indicator-specific threshold levels. The thresholds for each indicator were based on a compromise between the need to emphasise successes in particular areas and the need to identify those areas that were in need of support (Bryce et al 2006:1070). The thresholds were initially presented as percentages of the target for each indicator ("60% to 95%", for example), because such an approach guarantees uniformity and can be defended statistically.

In order to facilitate understanding where tables were used to display, analyse and interpret large sets of data, colour codes were used to distinguish between the four groups. The colour coding was performed by applying the Microsoft Excel conditional formatting function to the data after it had been extracted from the DHIS by means of pivot tables.

The colour codes of the different indicator value categories were assigned as follows:

- **Green** to mean "on track"
- **Blue** to mean "progress required"
- **Red** to mean "critical" (i.e. requiring immediate action)
- **Black** to mean "unrealistically high or low values"(these were findings that needed to be explained)

Salojee (2008) recommended an alternative way of setting unique expert-based thresholds for each indicator after considering the specifics (determinants) of each indicator. He also recommended that expert thresholds be updated annually on the basis of DHIS data that reflects whatever progress has been made during the previous year. This suggestion was accepted and expert opinion about how to set benchmarks and thresholds for each of the study indicators was obtained by means of e-mails and telephone conversations.

The study indicator values extracted from the DHIS were colour-coded on the basis of the recommended targets, benchmarks and thresholds. They were then sent to paediatric experts for further review. This further phase of review resulted in assistance in prioritisation, additional refinement of the indicators and advice about how to adapt the ranges of each of the indicators. The inputs thus received were subjected to further discussion in e-mails and telephone

conversations. After that, the ranges were adapted and applied to the data by means of conditional formatting in order to compile a performance profile. This profile was then sent back to the paediatricians for their critique and discussions were continued until agreement was reached. The final targets, benchmarks and ranges for the selected indicators are summarized in Annexure 4.

Tables 3.6 and 3.7 illustrate the practical value of using colour coded indicator values for evidence-based management. Although the information displayed in Table 3.6 is valuable for managers, it requires lengthy assessments and comparisons with indicator definitions and targets**.** Most health care managers do not have the time and/or skills to conduct comparisons of this kind.

Table 3.6 Free State 2006 public health facility mortality rates

District	Delivery in facility rate (B 90)	Facility perinatal mortality rate (B 15)	Facility neonatal mortality rate (B 8)	Facility infant mortality rate (B 15)	Facility under-five mortality rate (B 18)
Fezile Dabi	75	25	9	24	30
Lejweleputswa	94	40	13	46	57
Motheo	78	34	13	17	27
T Mofutsanyane	78	31	16	27	34
Xhariep	66	22	6	25	34
Free State average	**80**	**32**	**13**	**27**	**36**

* B indicates benchmark

The same information is displayed in Table 3.7 after the colour-coded expert threshold values were assigned in terms of the conditional formatting described above.

Table 3.7 Free State 2006 public health facility mortality rates colour-coded

District	Delivery in facility rate (B 90)	Facility perinatal mortality rate (B 15)	Facility neonatal mortality rate (B 8)	Facility infant mortality rate (B 15)	Facility under-five mortality rate (B 18)
Fezile Dabi	75	25	9	24	30
Lejweleputswa	94	40	13	46	57
Motheo	78	34	13	17	27
T Mofutsanyane	78	31	16	27	34
Xhariep	66	22	6	25	34
Free State average	**80**	**32**	**13**	**27**	**36**

* B indicates benchmark

Colour-coded indicator values can increase the effectiveness and efficiency of decisions by helping managers to identify at a glance those areas:

- Where performance has been best -- areas from which lessons can be learned.

- Where limited resources should be allocated in order to validate and improve the quality of data.
- Where there are identified health system shortcomings that need to be addressed.
- Where research is necessary to obtain additional data.

3.5.3 Data collection process

Historic data that had been routinely collected at public health facilities in the Free State province was used in this study and permission to use it was requested and obtained from the Free State head of the Department of Health (Annexures 1 and 2). Once permission to use the data was attained, pivot tables and the data extraction framework was used to extract the required data and indicators (as available at the NDoH in March 2007), from the national DHIS dataset by district, sub-district and hospital.

3.5.4 Data analysis

Data analysis entails the use of various methods to organise, categorise, summarise and interpret data in a way that provides answers to the research questions (Polit & Beck 2006:498). The purpose of analysing quantitative data is to identify descriptive patterns among numerical variables (Polit and Beck 2006:352). The DHIS software was used to analyse data. Even though the DHIS is not a statistical package, it enables analysis because it allows a researcher to organise and categorise raw data, to calculate standardised pre-set indicators and to display the results thus obtained in a meaningful format. One of the features of the DHIS is a powerful report generator which is able to display tables, graphs and maps. DHIS Pivot tables are more suitable when large sets of data are being analysed.

Because the data extraction framework (Annexure 3) as a research instrument was based on the systems theory, it did not need to be tested by means of a pilot study. In spite of this, the selection of the final data elements, indicators, targets, benchmarks and indicator ranges for the study (section 3.5.2) required several rounds of exploration and “testing”.

Kumar (2005:241) is of opinion that although a framework for analysis for quantitative studies evolves continuously during the compilation of a research report, it is desirable to develop it in a broad way before analysing the data. It is his opinion that a frame of analysis should specify:

- The variables that need to be analysed and how they should be analysed.
- The cross-tabulations that need to be compiled.
- The variables that have to be combined in order to construct major concepts.
- The indicators that need to be subjected to specific statistical procedures.

The final study elements (variables) and indicators were grouped to measure *U5MR*-related child health care from a results-based systems perspective (Table 3.5), and the indicator numerators, denominators targets, benchmarks and ranges on which the analysis was based, are displayed in Annexure 4.

The data analysis took place in the following three stages:

3.5.4.1 Data analysis stage 1 – Data quality assessment

While Day and Gray (2006:371) believe that the quality of the DHIS data has improved, there are still causes for concern about the quality of this data. Because of these concerns, DHIS data should still be interpreted with caution and verified wherever necessary. Katzenellenbogen et al (1997:133) emphasise data quality as the main cause for concern when routine data is used for research and Cibulskis (2005:637) asserts that good quality routine data is good when:

- Reporting units and elements are sound.
- It is consistent/within normal ranges.
- It is readily available at all levels.
- It is usable and comparable when the same element and indicator definitions are used.

Kumar (2005:220) describes the first step of data processing as editing or data "cleaning". The reason for this is to minimise (as far as possible) errors, inconsistencies and gaps. Data cleaning may be carried out by means of inference, by recall (when interviews were conducted), or by returning to respondents in order to confirm data that has already been collected/received from them.

The recommendations of Katzenellenbogen et al (1997:133) and Kumar (2005:220) was followed by performing a rapid data quality assessment as the first step of the data analysis process for this study. The rapid data quality assessment was done in order to determine whether the DHIS data was suitable for conducting formative, summative and diagnostic evaluations (from a results-based systems perspective) and in order to illustrate how DHIS pivot tables can be used to assess data quality.

3.5.4.1.1 Suitability of the existing Free State District Health Information System data for formative evaluations

Before the Free State province's DHIS data could be judged to be suitable for the planned formative evaluation, the values for the selected indicators for the years between 2001 and 2006 had to be both consistent and roughly comparable with survey findings. Although routine information cannot be compared directly with non-routine health information obtained from

surveys, the values obtained from the standardised indicators should roughly correlate with the findings of a survey because both approaches are designed to measure the same phenomena. The results of these comparisons are described in Chapter 4 as the first step of each of the formative evaluation findings. While it has already been mentioned that the data in the DHIS is obtained only from public health facilities, these public health facilities serve between 75% and 80% of the total South African population (Gray & Pillay 2006:7) and 85% of the Free State population (Day & Gray 2007:319). It is important to bear these facts in mind when comparing DHIS data to the data obtained from surveys covering the total population.

3.5.4.1.2 Suitability of the existing Free State District Health Information System data for summative and diagnostic evaluations

To be suitable for summative and diagnostic evaluations, the 2006 Free State DHIS data needed to be of high quality in terms of the reporting rate of the facilities, as well as the completeness and consistency of the data over the 12 months of 2006.

The following processes and indicators were used to determine the suitability of the 2006 Free State DHIS data for summative and diagnostic evaluations:

- The indicator *facility reporting rate* was used to assess the completeness of the reporting by facilities on a monthly basis during the whole of 2006.
- A rapid visual inspection was conducted on the relevant raw data by district and by month to identify gaps and major outliers for each district.
- The indicator *delivery in facility rate* was used to illustrate how DHIS pivot tables can be used to assess completeness and the consistency of data at the lower levels of the HCS.
- The following two validation rules (discussed in more detail later) were used as a final measure to assess data quality by health district:
    - The difference between the total number of births reported by public health facilities and the total number of births calculated by the DHIS (as the sum of live births and still births reported by the public health facilities in the Free State).
    - The difference between the number of births and the number of deliveries reported by the public health facilities in the Free State.

Although no indicator have been set up in the DHIS to calculate the facility reporting rate, the DHIS data about public health care facilities is categorised in terms of name, type of facility, province, district and sub-district. The number of DHIS reports that could be expected for the Free State province during 2006 (4,572) was determined by multiplying the 381 public health care facilities (Table 3.2) by 12.

The auto-generated outstanding DHIS report pivot table sheet (Table 3.8) displays and categorises the number of reports that are outstanding in terms of the facility concerned in the month in question. This enables a researcher to calculate the facility reporting rate for all public health care facilities in the Free State province for any particular year. The "outstanding report" pivot table set out in Table 3.8 shows that a total of 125 reports were outstanding for 2006. The fact that 12 reports were outstanding from several facilities may indicate that these facilities were closed during the year but that their closure had not been duly recorded in the DHIS database (as required). Anomalies such as this need to be investigated and verified with the relevant information officers at provincial, district and sub-district levels and corrected in the DHIS at local level.

The percentage of outstanding reports was calculated by using the number of outstanding reports (125) as the numerator and the number of expected reports (4,572) as the denominator. This figure was then subtracted from 100% to obtain the Free State province's public health facility reporting rate of 97% for 2006.

Table 3.8 Free State 2006 outstanding public health facility reports

District	Sub-district	Facility type	Facility name	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	Total 2006
Fezile Dabi	Metsimaholo	Mobile	Sasolburg	1	1	1	1	1	1	1	1	1	1	1	1	**12**
	Moqhaka	Mobile	Kroonstad	1	1	1	1	1	1	1	1	1	1	1	1	**12**
		Mobile	Rammulotsi	1	1	1	1	1	1	1	1	1	1	1	1	**12**
	Ngwathe	Mobile	Heilbron	1	1	1	1	1	1	1	1	1	1			**10**
		Mobile	Tumahole	1		1	1	1	1	1	1	1	1	1	1	**11**
		Mobile	Vredefort	1	1	1	1									**4**
Lejweleputswa	Masilonyana	Mobile	Winburg			1	1	1	1	1	1	1	1			**8**
	Nala	Mobile	Bothaville		1	1	1	1	1	1	1	1	1	1	1	**11**
	Tokologo	Mobile	Boshof	1	1	1	1	1	1	1	1	1	1	1	1	**12**
Motheo	Mangaung	Clinic	A MHUFS			1	1	1	1	1		1	1	1	1	**9**
		Clinic	Fauna Clinic									1			1	**2**
		Mobile	Bloemfontein							1						**1**
	Naledi	Clinic	Dewetsdorp		1											**1**
T Mofutsanyane	Phumelela	Mobile	Vrede												1	**1**
Xhariep	Kopanong	Mobile	Jagersfontein	1	1	1	1	1	1	1	1	1	1	1	1	**12**
	Mohokare	Mobile	Boesmanskop						1	1	1	1	1	1	1	**7**
Free State total				**8**	**9**	**11**	**11**	**10**	**11**	**12**	**10**	**12**	**11**	**9**	**11**	**125**

A rapid visual inspection was conducted on the raw data that had been used for calculating the selected study indicators by month and by health district (Table 3.9) to identify gaps, outliers and validation rule violations. No gaps were identified, and only 17 out of 900 (1.9%) potential outliers (which are highlighted in orange in Table 3.9), were identified. On face value the 2006 district data appeared to be fairly consistent except for the *delivery in facility rate* in Motheo for the months April, May and June.

Table 3.9 Free State 2006 raw data for gap and outlier analysis by health district by month

District	Month	Deliveries	Births	Live births	Still births	Maternal deaths	Inpatient deaths early neonatal	Inpatient deaths late neonatal	Inpatient deaths under one year	Inpatient deaths under five years	Pneumonia under five years admitted	Pneumonia under five years death	Malnutrition under five years admitted	Malnutrition under five years death	Diarrhoea under five years admitted	Diarrhoea under five years death	Difference between births and deliveries (%)	Difference between births reported and sum of live births and still births (%)
Fezile Dabi	Jan	776	785	757	22	3	2	8	23	29	37	4	22	1	39	11	1.1	0.8
	Feb	641	642	642	19	2	4	5	18	22	50	1	10	2	85	11	0.2	-3.0
	Mar	748	749	723	25	2	5	5	25	34	51	1	20	5	70	3	0.1	0.1
	Apr	740	745	707	26	3	0	2	17	27	53	7	34	2	43	2	0.7	1.6
	May	786	788	769	20	1	5	3	23	32	60	4	16	2	83	5	0.3	-0.1
	Jun	726	729	713	19	1	7	2	18	25	75	4	10	1	80	2	0.4	-0.4
	Jul	677	678	660	18	0	5	9	25	32	59	5	14	1	30	1	0.1	0.0
	Aug	805	807	794	13	2	5	3	20	25	46	0	14	1	18	2	0.2	0.0
	Sep	789	793	768	25	3	1	2	27	32	63	2	24	3	33	5	0.5	0.0
	Oct	698	706	684	22	3	4	8	17	21	52	7	4	0	34	1	1.1	0.0
	Nov	681	682	667	15	2	6	5	25	29	73	7	26	3	40	1	0.1	0.0
	Dec	675	708	715	9	1	4	7	29	36	49	9	6	2	25	4	4.7	-2.3
Lejweleputswa	Jan	948	961	917	44	3	9	6	45	60	74	8	40	8	67	7	1.4	0.0
	Feb	922	933	911	22	1	10	3	48	60	53	4	28	5	65	10	1.2	0.0
	Mar	936	943	912	31	1	11	6	58	74	76	3	66	6	107	13	0.7	0.0
	Apr	932	961	927	34	1	11	2	52	68	81	11	48	4	52	4	3.0	0.0
	May	941	976	946	29	4	5	1	57	68	95	8	18	8	69	7	3.6	0.1
	Jun	948	967	947	20	4	15	3	51	63	98	13	20	2	51	1	2.0	0.0
	Jul	932	950	921	29	8	10	2	49	56	77	10	14	0	20	3	1.9	0.0
	Aug	947	984	959	25	6	13	1	29	35	71	5	12	1	37	2	3.8	0.0
	Sep	940	961	928	33	4	5	3	36	39	108	6	32	0	25	0	2.2	0.0
	Oct	908	923	897	26	2	8	2	32	35	92	6	22	0	42	2	1.6	0.0
	Nov	863	871	841	30	4	8	4	30	37	86	10	6	0	60	3	0.9	0.0
	Dec	938	951	930	21	3	13	2	47	58	69	6	18	0	60	6	1.4	0.0
Motheo	Jan	1,312	1,324	1,286	38	2	7	5	32	48	71	8	54	10	61	14	0.9	0.0
	Feb	1,144	1,197	1,142	34	3	11	3	27	40	104	7	84	10	87	7	4.4	1.8
	Mar	1,375	1,392	1,351	41	4	6	5	26	53	171	18	32	3	125	25	1.2	0.0
	Apr	839	1,332	1,297	35	1	10	2	33	55	98	18	38	5	123	18	37	0.0
	May	971	1,302	1,283	19	5	18	2	25	42	183	11	62	13	110	8	25	0.0
	Jun	897	1,410	1,363	48	4	17	1	20	34	179	14	60	7	118	8	36	-0.1
	Jul	1,384	1,397	1,370	30	7	20	6	31	46	151	13	60	5	114	12	0.9	-0.2
	Aug	1,327	1,350	1,312	39	1	18	8	25	31	112	7	46	5	83	6	1.7	-0.1
	Sep	1,369	1,320	1,352	37	3	23	2	21	34	147	12	56	5	80	4	-3.7	-5.2
	Oct	1,339	1,354	1,310	44	2	22	4	22	41	188	16	56	7	98	8	1.1	0.0
	Nov	1,220	1,245	1,207	39	8	20	9	25	39	148	13	42	3	106	7	2.0	-0.1
	Dec	1,363	1,365	1,324	44	5	3	9	22	33	120	15	26	3	84	7	0.1	-0.2
T Mofutsanyane	Jan	1,217	1,228	1,197	31	4	13	13	47	57	85	14	58	5	59	3	0.9	0.0
	Feb	1,057	1,067	1,034	33	1	12	19	47	64	72	20	78	9	93	13	0.9	0.0
	Mar	1,307	1,327	1,296	31	6	12	11	41	57	92	12	118	10	98	14	1.5	0.0
	Apr	1,161	1,173	1,138	35	2	16	18	56	68	80	20	32	2	67	9	1.0	0.0
	May	1,205	1,208	1,169	39	2	8	10	54	64	116	23	40	4	98	13	0.2	0.0
	Jun	1,154	1,159	1,129	30	3	5	5	46	68	104	29	26	4	152	13	0.4	0.0
	Jul	1,176	1,193	1,157	33	1	7	20	28	34	102	12	22	1	60	2	1.4	0.3
	Aug	1,330	1,344	1,310	34	5	12	7	31	38	70	10	28	6	40	4	1.0	0.0
	Sep	1,417	1,427	1,392	35	4	10	8	22	28	45	9	20	8	26	3	0.7	0.0
	Oct	1,210	1,217	1,175	40	5	14	19	30	38	68	13	10	2	30	3	0.6	0.2
	Nov	1,233	1,247	1,204	44	1	14	9	33	41	58	12	34	1	41	5	1.1	-0.1
	Dec	1,189	1,201	1,160	41	4	13	12	56	65	75	8	46	4	109	9	1.0	0.0
Xhariep	Jan	178	178	173	6	0	1	0	4	7	11	2	8	3	19	0	0.0	-0.6
	Feb	151	156	149	7	0	2	0	6	8	14	4	16	4	11	3	3.2	0.0
	Mar	149	151	149	3	0	3	1	12	18	16	2	36	8	40	14	1.3	-0.7
	Apr	161	161	159	2	0	1	0	5	9	8	0	12	1	20	1	0.0	0.0
	May	175	177	175	4	1	3	0	3	4	21	0	8	0	16	1	1.1	-1.1

District	Month	Deliveries	Births	Live births	Still births	Maternal deaths	Inpatient deaths early neonatal	Inpatient deaths late neonatal	Inpatient deaths under one year	Inpatient deaths under five years	Pneumonia under five years admitted	Pneumonia under five years death	Malnutrition under five years admitted	Malnutrition under five years death	Diarrhoea under five years admitted	Diarrhoea under five years death	Difference between births and deliveries (%)	Difference between births reported and sum of live births and still births (%)
	Jun	137	137	135	4	0	0	0	4	6	14	1	8	0	28	0	0.0	-1.5
	Jul	150	149	148	2	0	3	0	3	5	5	4	4	1	8	0	-0.7	-0.7
	Aug	136	139	136	2	0	0	0	0	1	9	0	8	0	7	0	2.2	0.7
	Sep	155	161	159	2	0	0	0	5	5	13	3	6	2	9	0	3.7	0.0
	Oct	121	122	120	2	0	0	0	4	5	18	2	14	0	22	0	0.8	0.0
	Nov	100	101	98	4	0	0	0	12	14	22	3	12	3	21	2	1.0	-1.0
	Dec	148	147	144	4	1	2	0	6	7	9	0	16	3	34	3	-0.7	-0.7
Free State average																	**0.7**	**-0.3**

The indicator *delivery in facility rate* was used to illustrate how the DHIS pivot tables were (and can) be used to conduct basic gap and outlier analysis at different levels of the HCS. Tables 3.10 to 3.14 also illustrate how higher level data masks potential lower level data problems and how using DHIS pivot tables (to drill down to lower level data) can assist with the assessment of data quality and with identifying of areas that are in need of assistance.

Table 3.10 Free State 2006 delivery in facility rate by district

Province	District	Delivery in facility rate
Free State	Fezile Dabi	75
	Lejweleputswa	94
	Motheo	78
	T Mofutsanyane	78
	Xhariep	66
Free State average		**80**

Table 3.10 displays the Free State 2006 *delivery in facility rate* for the health districts or district municipalities. To support gap and outlier analysis by means of visual inspection, Table 3.11 displays the same data for each month of 2006. While monthly data cannot be expected to display the same values, they are normally fairly consistent under normal circumstances. The incidence of diarrhoea, for example, normally rises during the summer while the incidence of pneumonia rises during winter and one may expect to find a correlation between wars and other disasters and an increased incidence of malnutrition.

Table 3.11 Free State 2006 delivery in facility rate by district by month

District	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	Average 2006
Fezile Dabi	80	66	77	76	81	75	70	83	81	72	70	70	**75**
Lejweleputswa	96	93	95	94	95	96	94	96	95	92	87	95	**94**
Motheo	85	75	89	54	63	58	89	86	89	86	79	88	**78**
T Mofutsanyane	78	68	83	74	77	74	75	85	90	77	79	76	**78**
Xhariep	80	68	67	72	78	61	67	61	69	54	45	66	**66**
Free State average	**84**	**74**	**85**	**72**	**77**	**73**	**82**	**86**	**88**	**81**	**77**	**81**	**80**

Although no gaps or major outliers could be identified from the data displayed in Table 3.11, the slightly below average *delivery in facility rate* reported for Motheo for April, May and June illustrate how a visual inspection can be used to assess the quality of data in the DHIS at lower levels in order to identify potential shortcomings.

Table 3.12 displays data on the *delivery in facility rate* in terms of sub-district and month in the Motheo district and thus identifies potential inconsistencies that could have resulted in the lower *delivery in facility rate* in Motheo during April, May and June. The Mangaung *delivery in facility rate* was clearly lower during these three months and thus needs to be validated.

Table 3.12 Motheo 2006 delivery in facility rate by sub-district by month

Sub-district	Jan -06	Feb -06	Mar -06	Apr -06	May -06	Jun -06	Jul-06	Aug -06	Sep -06	Oct-06	Nov -06	Dec -06	Average 2006
Mangaung	93	82	96	58	68	62	98	94	96	94	87	95	**85**
Mantsopa	40	32	62	45	40	48	42	39	51	54	36	60	**46**
Naledi	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Motheo average	**85**	**75**	**89**	**54**	**63**	**58**	**89**	**86**	**89**	**86**	**79**	**88**	**78**

In order to determine whether the inconsistencies that were identified in Table 3.12 were due to data errors, raw data about the number of *deliveries in facility,* for each of the two Motheo sub-districts that provided delivery services in 2006, were extracted from the pivot tables for each month of the year. The orange coloured cells in Table 3.13 reveals variations in the raw Mangaung delivery data for April, May and June. These lower figures have been the cause of the inconsistent *delivery in facility rate* figures that are highlighted in Table 3.12.

Table 3.13 Motheo 2006 deliveries (raw data) by sub-district by month

Sub-district	Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	Total 2006
Mangaung	1,259	1,102	1,293	779	918	834	1,328	1,274	1,302	1,267	1,172	1,284	**13,812**
Mantsopa	53	42	82	60	53	63	55	52	67	72	48	79	**726**
Motheo total	**1,312**	**1,144**	**1,375**	**839**	**971**	**897**	**1,383**	**1,326**	**1,369**	**1,339**	**1,220**	**1,363**	**14,538**

To assess the quality of the reported raw delivery data, pivot tables were again used for “drilling down” to display the number of deliveries reported by each facility for each month of 2006 (Table 3.14).

Table 3.14 Motheo 2006 deliveries (raw data) by facility by month

Sub-district	Facility type	Facility name	Deliveries in health facilities												Total 2006
			Jan-06	Feb-06	Mar-06	Apr-06	May-06	Jun-06	Jul-06	Aug-06	Sep-06	Oct-06	Nov-06	Dec-06	
Mangaung	Clinic	Dr Pedro Memorial	35	39	32	5	2	5	49	42	41	34	40	36	**360**
		Gaongalelwe	28		29	2	0	2	29	33	38	26	22	30	**239**
		Itumeleng	41	21	48	2	3	2	39	28	29	22	33	29	**297**
		Mafane	30	53	50	1	4	3	43	48	51	28	23	34	**368**
		Maletsatsi Mabaso	51	57	48	5	3	3	47	64	68	64	37	57	**504**
		MUCPP	129	106	83	14	130	8	144	133	130	115	104	139	**1,235**
		Pule Sefatsa	29	42	37	2	1	3	33	52	48	38	33	30	**348**
		W Mandela	34	36	30	1	2	0	34	46	32	29	33	36	**313**
	CHC	Heidedal	94	63	84	1	0	2	103	46	86	86	107	123	**795**
	District Hospital	Botshabelo	131	116	138	127	130	120	129	121	141	114	94	125	**1,486**
		Dr JS Moroka	89	73	91	69	78	85	84	77	77	84	79	80	**966**
		National	198	172	215	185	197	189	213	201	207	188	144	125	**2,234**
	Tertiary Hospital	Universitas (C)	33	37	45	53	50	49	45	44	47	50	60	30	**543**
	Regional Hospital	Pelonomi	337	287	363	312	318	363	336	339	307	389	363	410	**4,124**
Mantsopa	District Hospital	Mantsopa	53	42	82	60	53	63	55	52	67	72	48	79	**726**
Motheo total			**1,312**	**1,144**	**1,375**	**839**	**971**	**897**	**1,383**	**1,326**	**1,369**	**1,339**	**1,220**	**1,363**	**14,538**

Table 3.14 displays the data for each of the facilities that provided delivery services in Motheo for each sub-district and each month of 2006. Although the number of deliveries reported by hospitals was consistent for each month, inconsistencies for clinics and the CHC (displayed in the orange coloured sections) provide the reason for the variations in the Motheo *delivery in facility rates* for the months April, May and June 2006. The number of deliveries reported by these facilities was much lower for the months under investigation and has to be followed up with facility managers urgently. Using pivot tables to drill down suspect data enable data and other managers at all levels of the HCS to identify and follow up gaps, outliers and inconsistencies right down to the facility level (which is the level of data collection) in their quest for optimising DHIS data quality. Pivot tables also enable the de-selection of values that are clearly incorrect (Kumar 2005:220).

The following two **validation rules** were developed to facilitate the assessment of data quality by the comparison of data element values that are related to each other:

- **Validation Rule 1:** The reported data values for *births* and *deliveries* should be nearly the same - the *number of deliveries* (mothers) cannot be more than the *number of births* (babies) because each baby is born from a mother. The *number of births* may be slightly higher than the *number of deliveries* because some mothers deliver twins or triplets. Any such difference, however, is expected to be less than 2%.
- **Validation Rule 2:** The reported data values for the *total number of births* and the sum of the reported *live births* and *still births* (as calculated by computer) should be equal.

Values for the two validation rules are displayed according to district and month in the last two columns to the right of Table 3.9. The average Free State difference between *births* and *deliveries* was 0,7%, with monthly district values ranging from 0% to 37%. The average Free State difference between *total births* reported by facilities and the value calculated electronically (by summarising *live births* and *still births*) was -0,3% with monthly district values ranging from 0% to 5.2%. While the effect of the validation rule violations can be minimised by means of inference (Kumar 2005:220) or the de-selection of the outliers, the researcher decided (as mentioned above) not to “clean” the data - these outliers are capable of identifying those shortcomings that need to be attended to as part of strengthening the routine health information system as a sub-system of the HCS.

Although several different processes can be used to validate data, the assessment of facility reporting rates and the performance of gap and outlier analysis (by making use of pivot tables, as already described), is probably one of the simplest, most effective and efficient ways of assessing the quality of the DHIS data. While several processes can also be used to obtain additional information, the “drilling down” by means of pivot tables often identifies the sub-districts and/or facilities from which the problems derive, as well as possible HCS deficiencies in terms of inputs, processes, outputs, outcomes and impacts. In those cases where the available data is of no help in identifying potential constraints, rapid surveys or other research methods may have to be used to collect additional data. The areas and study populations for further investigation can, however, normally be narrowed down by using the DHIS data.

Because this study reports on many indicators, the method described above was not used to validate data for each of the study indicators. The data that was used in the study had already been scrutinised for any major errors and, although no data values were changed, the data for a few indicators was suppressed where obvious errors (such as missing numerators or denominators or major outliers clearly caused by typing errors) were identified. Although such measures were implemented to calculate representative averages for district and sub-district

levels, it was not possible to verify whether each outlier was caused by data errors or by real changes or incidences in the Free State health care environment.

The other factors that influenced the decision not to conduct an in-depth data quality assessment on each data element as part of the study (after the rapid review of the DHIS data quality had been undertaken) are briefly described below.

- Health care professionals have been collecting and using these variables, definitions and indicators to manage and interpret data over a period of several years in South African, therefore it is not unreasonable to assume that they understand the meaning and significance of the data collection instruments, the data elements and the indicators (SA 2002:5; Shaw 2005:632).
- The improvement of the quality of DHIS data (as outlined in the National Health Information System of South Africa [NHIS/SA] Data Flow Policy and which was discussed in Chapter 1) is one of the functions and responsibilities of information officers at different levels of the HCS. As a result of such activities, the data that is collated at provincial and national levels should theoretically be valid and reliable.
- The validity and reliability of the DHIS data is further enhanced by the fact the data used in the system is obtained mainly from standardised international and national public health data elements and indicators, refined over several years of use in the system.
- Another factor that contributes to the validity and reliability of the DHIS data is the fact that data for all public health facilities are included in the database.
- The professional experience and observations of the researcher have familiarised her with the special efforts that have been made since 2004 by the NDoH (working in conjunction with the Health Information Systems Program and Health Systems Trust) to update and validate all the reporting units and all the data contained in the DHIS. Officials responsible for this initiative have been active in monitoring the data flow, completeness and consistency on a quarterly basis between August 2005 and March 2007. They provided regular feedback about achievements, problems and deficiencies to national managers, provinces and districts for comment. As part of this initiative, health programme managers have been asked to clarify the reasons for any problems that were identified in health programme data, while health information managers have been consulted to provide explanations for problems that have arisen with regard to the flow and quality of data in specific areas.
- Those health care professionals, service and programme managers who are responsible for ensuring that health care services are delivered effectively and efficiently, are equally responsible for the effective management of all health care sub-systems, including the health information system. It is therefore their responsibility to ensure that information in

the DHIS reflects the correct measurements of health care inputs, processes, outputs, outcomes and impact. Any erroneous data reported in this study (or by means of other feedback mechanisms) can be used to identify those places where the health information system needs to be strengthened so that it can be relied upon to deliver effective M&E data.

The quality of the DHIS data from the Free State province was found acceptable for this study on the basis of the facts discussed above.

3.5.4.2 Data analysis stage 2 – Formative, summative and diagnostic evaluations

The purpose of stage 2 of the data analysis process was to describe and demonstrate how existing DHIS data can be used to support managers in using the results of previous interventions for evidence-based decision making aimed at reducing child mortality.

A results-based systems approach was used and findings, together with examples of how such findings can be used to support managers in evidence-based decision-making, were displayed and described in terms of:

- Raw data and indicators available in the DHIS.
- Formative evaluation (using selected impact, outcome, output, process and input indicators) for the years 2001 to 2006.
- Summative evaluation for 2006 (comparing selected impact, outcome, output, process and input indicators) with the targets and benchmarks in Annexure 4.
- Diagnostic evaluation for 2006 (using selected impact, outcome, output, process and input indicators), together with threshold levels (Annexure 4), that were developed for this study on the advice of experts. Data were colour-code for identifying the best and worst performing areas as well as inequities in distribution of HCS impacts, outcomes, outputs, processes and inputs.
- How the available evidence may be used to strengthen the HCS so that it will be more effective in reducing the *U5MR*.

3.5.4.2.1 Formative evaluation of under-five mortality rate-related health care system impacts, outcomes, outputs, processes and inputs

The purpose of formative evaluation in this study was to support managers in assessing whether child health policies, strategies, services and interventions were implemented as planned, whether they were working as planned and whether improvement was necessary (Brink & Wood 1998:132).

Formative evaluations were conducted in the following way:

- Relevant raw DHIS data was extracted (Table 3.15), and this was used to assess the appropriateness of the available data to conduct formative assessments for the period 2001 to 2006.
- Available pre-calculated DHIS indicators were extracted (Table 3.16) to illustrate the progress that had been made in terms of each of the indicators for the period 2001 to 2006.
- Where needed, existing raw DHIS data was used to develop additional indicators such as, for example, the facility *U5MR* that was discussed in section 3.5.2.1.1.

Table 3.15 Examples of raw data extracted from the District Health Information System

Year	Raw Free State DHIS data					
	Still births	Live births under 2500g	Early neonatal deaths	Late neonatal deaths	Inpatient deaths under one year	Inpatient deaths under five years
2001	1,577	452	288			
2002	1,605	465	335			
2003	1,617	654	470			
2004	1,655	668	524			
2005	1,609	535	488	200	628	853
2006	1,493	552	492	302	1,664	2,203

Table 3.16 Examples of indicators calculated from the District Health Information System data

Year	Free State Public health facility mortality rates per 1,000 estimated live births			
	Facility perinatal mortality rate	Facility neonatal mortality rate	Facility infant mortality rate	Facility under-five mortality rate
2001	29	4		
2002	30	5		
2003	33	7		
2004	35	8		
2005	34	11		
2006	32	13	27	36

Wherever raw DHIS data was available for the six years under consideration and wherever it appeared to be consistent, it was accepted that such data could be used to calculate indicators for formative evaluation. Examples of raw data that were found to be appropriate for formative evaluation are *still births* and *live births under 2500g* (Table 3.15). Examples of raw data in the same table that were considered to be unsuitable for conducting formative evaluations are *inpatient deaths under one year* and *inpatient deaths under five years*. Data for both these elements were only available for 2005 and 2006 and the major differences between the 2005 and 2006 data create an impression that the 2005 data was incomplete. Some indicators that were calculated by using the raw data in Table 3.15 are displayed in Table 3.16 and the indicator *facility PNMR* is an example of an indicator that could be used for formative evaluation because it displayed consistent values since 2001.

Similar principles can be used to conduct formative evaluations on any other relevant DHIS indicators to measure progress over specific periods of time in districts, sub-districts and/or facilities. Indicators on immunisation coverage, for example, can be used to conduct a formative evaluation over time to assess whether immunization policies, strategies, services and interventions have been implemented according to plan and whether they are as effective as they were intended to be.

3.5.4.2.2 Summative evaluation of under-five mortality rate-related health care system impacts, outcomes, outputs, processes and inputs

The purpose of summative evaluations is to assess the success of an ongoing or completed programme in terms of its stated objectives (Brink & Wood 1998:132; Wikipedia [online] 2008). In this study summative evaluations were conducted by comparing the DHIS values for the selected indicators against the set targets or benchmarks to indicate the degree of progress the Free State had made towards achieving the stated national objectives by the end of 2006 (Figure 3.8). In those cases where targets could not be identified benchmarks (that were based on the national or provincial average and/or expert opinion for each of the respective indicators, [as described in section 3.5.2.2 and displayed in Annexure 4]), were used. Existing DHIS indicators were also compared with published non-DHIS data to determine to which extent the DHIS data correlates with data obtained from national surveys (Figure 3.9).

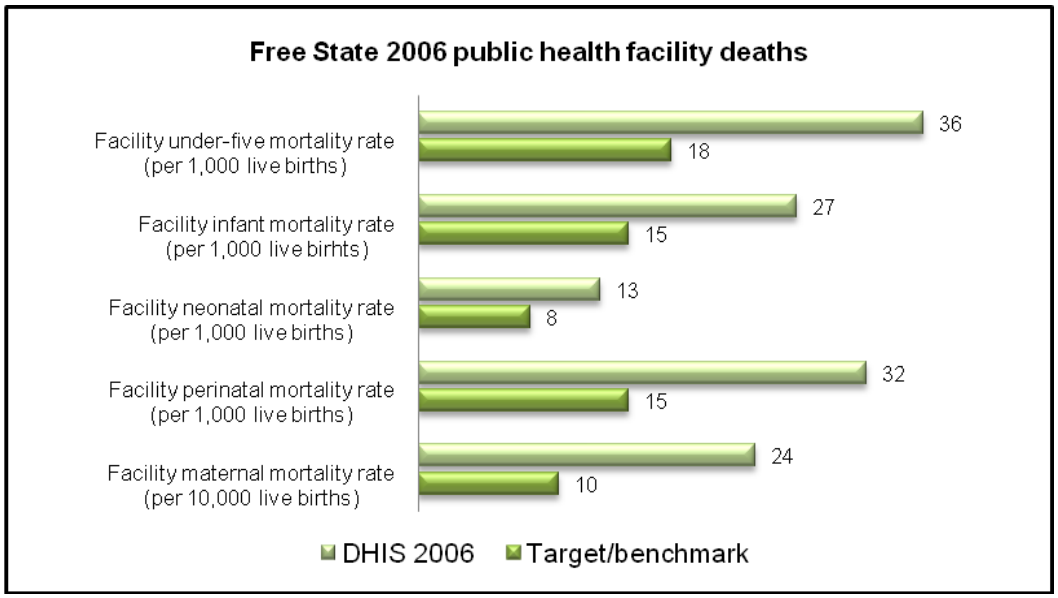


Figure 3.8 Free State 2006 public health facility deaths in relation to targets or benchmarks

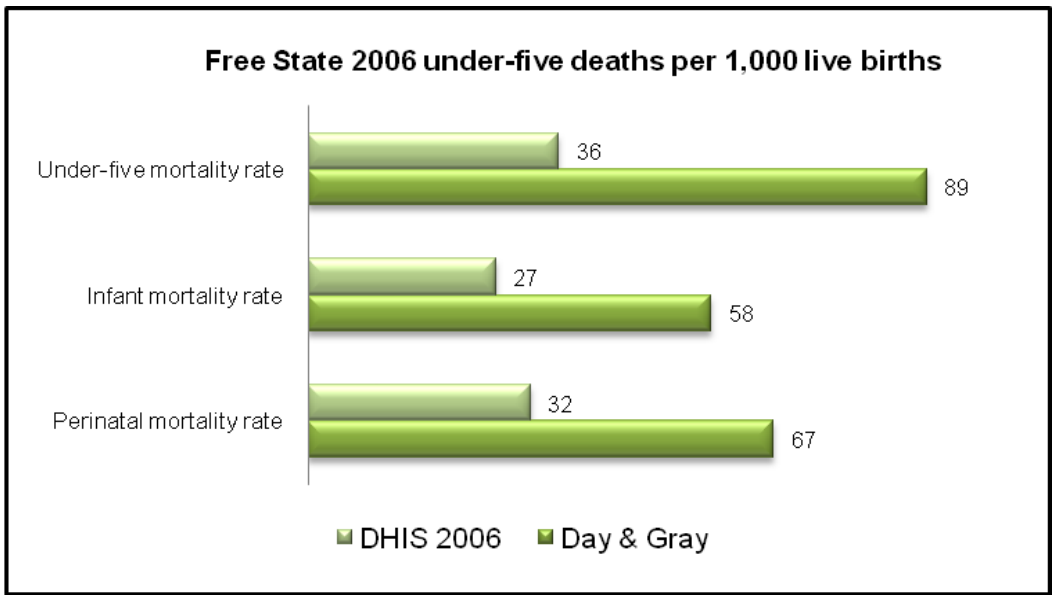


Figure 3.9 Free State 2006 deaths per 1,000 estimated live births in comparison with the published source Day and Gray (2007:269-270)

3.5.4.2.3 Diagnostic evaluation of under-five mortality rate-related health care system impacts, outcomes, outputs, processes and inputs

The purpose of diagnostic evaluations is to identify weaknesses that result in underachievement (Wikipedia [online] 2008) as well as best performances. Diagnostic evaluations that are performed on lower level/service delivery level data are important because the analysis of health service data often reveals that acceptable indicator values from aggregated data at higher levels mask shortcomings at lower levels.

The categories, thresholds and colour-coding principles (described in section 3.5.2.2 and which are displayed in Annexure 4) were applied to district, sub-district and (where applicable) hospital level indicators, to "diagnose" and prioritise specific areas where specific interventions were needed. For the purpose of this study, a particular emphasis was placed on providing examples that would enable managers to understand how to address critical *U5MR*-related HCS shortcomings (indicated in red) in terms of impact, outcome, output, process and input targets. But similar principles can be applied for identifying and addressing any additional shortcomings.

Table 3.17 provides an example of diagnostic evaluations that were conducted by using DHIS indicators. Displaying the number of critical (red) and on track (green) indicator values for each district horizontally, identifies the best and worst performing districts at a glance for the convenience of busy managers. Examples of the best performing areas in Table 3.17 are Fezile Dabi, Lejweleputswa and Motheo, with two on track values each. An example of the worst performing area in Table 3.17 is Xhariep with three critical values. Displaying the total number of red and green values vertically help managers to identify the best and poorest performing health

care interventions. The *caesarean section rate* (with three on track values in Table 3.17) appears to be the most successful intervention, while critical shortcomings are identified in terms of *delivery in facility rate* with four critical values. (More in-depth discussions of diagnostic evaluations and findings are contained in Chapter 4.)

Table 3.17 Examples of how colour-coded District Health Information System indicators are used in diagnostic evaluation

Free State Districts (5)	Inputs and processes (%) (availability, accessibility, acceptability & utilization)					Number on track values	Number critical values
	Caesarean section rate (B 10)	Born before arrival rate (B 6)	Delivery in facility rate (B 90)	Antenatal care coverage (B 90)	DTP-Hib 1st dose coverage (T 90)		
Fezile Dabi	16	8	75	83	95	2	2
Lejweleputswa	16	11	94	119	125	2	1
Motheo	24	6	78	94	95	2	1
T Mofutsanyane	15	11	78	91	101	1	2
Xhariep	0.3	18	66	95	108	1	3
Free State	**18**	**9**	**80**	**96**	**103**	**2**	**1**
Critical values	**1**	**3**	**4**	**1**	**0**	**8**	**9**
On track values	**3**	**1**	**1**	**1**	**2**	**32%**	**36%**

* B indicates benchmark and T indicates target

The diagnostic data analysis and interpretation of findings were done using the results-based systems approach (Figure 3.2) in order to identify those geographical areas where limited resources should be concentrated on specific activities and interventions.

The impact indicators (indicating the final "results" of child health care) were summarised and colour-coded for the Free State province with its five districts.

- Based on available evidence, the poorest performing district in terms of impact was selected to:
  - Demonstrate how evidence about outcomes, outputs, processes and inputs can be used to identify and address potential reasons for impact shortcomings in districts.
  - Demonstrate how the DHIS pivot tables can be used to "drill down" to sub-district level in order to identify the poorest performing sub-district in terms of impact indicators.
- The poorest performing sub-district in terms of impact was then selected to:

  - Demonstrate how existing evidence about outcomes, outputs, inputs and processes can be used to identify and address shortcomings in sub-districts.
  - Demonstrate how the DHIS pivot tables can be used to drill down to facility level in order to identify the poorest performing facilities (which are hospitals for the purposes of this study) in terms of impact indicators.
- Although it was not within the scope of this project, the poorest performing hospital can also be selected to:
  - Demonstrate how existing evidence can be used to identify and address potential data, facility and HCS-related shortcomings in health facilities.

These diagnostic evaluation principles were used to achieve the third study objective. A Free State province performance profile, consisting of three pages containing indicator values, together with a fourth page of raw data to provide the "context" in which the results should be interpreted, was compiled (Tables 5.1 to 5.4).

Any attempt to address the information needs of different manages at the various levels of the HCS requires a lot of data. While the sheer quantity of this data may appear to be overwhelming, a manager needs only to select that data that is relevant to his or her respective needs.

The data analysis and interpretation described above is by no means all inclusive - it only provides examples of evidence-based management from a results-based perspective by using existing DHIS data. These examples are meant to stimulate discussions about the methodology that has been used, the current strengths and shortcomings of the DHIS, the targets and thresholds that had been selected and potential deficiencies in the HCS and policy. This approach should help managers in the Free State province to identify priority areas in which interventions and additional support are required.

3.6 ETHICAL CONSIDERATIONS

The customary ethical principles that guide this kind of research were strictly adhered to. These included obtaining permission from the relevant authorities, managing resources honestly, duly acknowledging those who provided guidance and assistance, the accurate reporting of results, a consideration of the consequences of the research for society at large, and adherence to principles of scientific accuracy, honesty and rigour (Polit & Beck 2006:100,499).

No human subjects were directly involved in this study because the DHIS contains data that has been collected only from health facilities. It was therefore not possible during the course of the

study to violate any of the ethical codes or standards that regulate research with living human respondents and subjects.

Those experts who contributed to the selection of indicators and who were involved in peer review were informed about the purpose and objectives of the study and all of them have been duly acknowledged and credited.

3.7 SUMMARY

Chapter 3 contains an explanation of the research steps and processes that were followed between the planning of the study and the analysis and interpretation of its results. This kind of approach ensures that the various stages of the study are subjected to the highest standards of logical thinking and scientific rigour and it therefore contributes to the completeness and integration of the study. The systems theory was described and a results-based application of systems theory was used as the theoretical framework for the study. The study population and geographical area was described and the data extraction framework was explained. Methods used for selecting the study indicators as well as for developing targets, benchmarks and ranges for colour-coding of data were discussed and described, together with the methods that were used for extracting, organising and analysing existing routine Free State province data in the DHIS from a results-based systems perspective.

The contextual and quantitative approach of the research was described in this chapter. This approach enabled the researcher to explore, describe and explain formative, summative and diagnostic evaluations by using selected indicators to identify the achievements and shortcomings in *U5MR*-related HCS impacts, outcomes, outputs, processes and inputs.

Chapter 4 contains the results of the study which are presented by means of descriptive statistics.

CHAPTER 4

DATA ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION

Data analysis is the process of categorising, ordering, manipulating and summarising data so that it can be displayed in a meaningful way that will provide answers to the research questions. Quantitative data is analysed so that one will be in a position to identify descriptive patterns and causal relations among numerical variables and distribution patterns of attributes for one or more variables (Polit & Beck 2006:495).

From the point of view of systems theory, one could argue that the MDG for the *U5MR* is not being met in South Africa because health care inputs and processes are inadequate. One might make the additional point that health interventions are not being implemented in an effective way in whatever facilities, sub-districts, districts and provinces the mortality rate or incidence of specific priority conditions (such as malnutrition) is inequitably distributed, higher than the target or higher than the average for the specific geographical area or facility under consideration (WHO 2003b:35-36).

This chapter shows how an analysis of the Free State data and findings confirmed that the DHIS data could be used to evaluate child health care from a results-based systems perspective. The results obtained from the formative, summative and diagnostic evaluations that were conducted also enabled the researcher to provide examples of how it was possible to use such data for evidence-based health care management.

All the data assembled in this section was obtained from the DHIS data set that had been submitted to the NDoH by the Free State provincial health information office by the end of March 2007. Any data that was obtained from sources other than the DHIS has been referenced by means of standard procedures.

It should be kept in mind that a database such as the DHIS is dynamic and subject to constant changes and fluctuations. The data that is presented in this study will be different from data that is obtained from the NDoH, the Free State province or districts, sub-districts and hospitals for different points in time. This happens because additional data is constantly being imported and because particular features of the data may have been validated since the original data for this study was extracted from the DHIS.

4.2 DATA ANALYSIS

Data analysis was conducted in three separate stages in order to determine the appropriateness of the Free State DHIS data for evaluations, to identify the distribution patterns of selected indicator values, and to integrate priority information into a quarterly performance profile. The findings and procedures of this study provide examples of how data and information can be periodically formatted in simple and practical ways that will assist busy managers at different levels of the Free State HCS to use the evidence provided by the data to implement results-based management.

While the methodology that was used for data analysis was described in Chapter 3, the findings of the study, together with conclusions, are described below.

4.2.1 Data analysis stage 1 – Exploration of the appropriateness of the Free State District Health Information System data

The purpose of stage 1 of the data analysis process was to reach conclusions about whether the available Free State DHIS data was suitable for conducting formative, summative and diagnostic evaluations on *U5MR*-related child health care from a results-based systems perspective.

Chapter 3 described the methods that were used to demonstrate the completeness and consistency of annual data for the years between 2001 and 2006. Such a procedure is an indispensable prelude to carrying out formative evaluations (namely formative impact, outcome, output, process and input evaluations), and is necessary for improving the clarity and certifying the practical value of the results that are obtained from the study.

The findings of the rapid data quality assessment for the 2006 Free State DHIS data (which are described in section 3.5.4.1) included:

- A public health facility reporting rate of 97%.
- No gaps in the raw data for each of the five health districts during the 12 months of 2006.
- Only 17 potential outliers out of the 900 data elements (representing a rate of 1.9%).
- An average Free State difference of 0.7% between reported births and reported deliveries, and district values that ranged from 0% to 37% (the benchmark is 2%).
- A difference of -0.3% between the total number of births reported by health facilities and total number of births calculated electronically as the sum of live births and still births (the benchmark is 0%).

The indicator “facility reporting rate” provides an indication of data completeness in terms of the proportion of facilities that actually reported from among those that were required to report. A total of 4,584 reports were expected from the 382 public health care facilities (Table 3.2) in the Free State province for the twelve months of 2006. Table 3.8 shows that 125 reports were outstanding for 2006 – 113 from mobiles and 12 from clinics, resulting in a facility reporting rate of 97%. It is expected that the Free State facility reporting rate would be higher than 97% because there were 12 outstanding reports for 2006 from several of the mobiles (Table 3.8). This usually means that the facilities in question had been closed and were therefore not providing services for the year concerned, but that the information officers had omitted to enter their closing dates into the DHIS.

Although the facility reporting rate provides a good indication of completeness in terms of facility data submission, it does not indicate whether all facilities did in fact report on all the required data elements and how consistent the reported data was. The methodology used to conduct a gap and outlier analysis on raw DHIS data was described in Chapter 3. A total of 900 elements (15 elements for each of the five districts over a period of 12 months) were visually scanned. Table 3.9 shows that potential outliers (coloured orange) were identified for only 17 of the 900 data values (a rate of 1.9%).

The results obtained from the two validation rules (described in section 3.5.4.1) indicate the existence of minor data quality problems that need to be followed up at the level of service delivery. Values for these two validation rules are displayed according to district and month in the last two columns to the right of Table 3.9.

- The average Free State province difference between “total births in facilities” reported by public health care facilities and the value calculated electronically (by adding together live births and still births), was -0.3%, with a mode of 0%.
- As mentioned before, the average Free State difference between births and deliveries was 0.7% with monthly district values ranging from 0% to 37%, where it should not have exceeded 2%.

Motheo district reported outliers for *delivery in facility rate* for the months April to June 2006. Further investigation (Tables 3.11 to 3.14) revealed the reasons for the for the Motheo outliers which resulted in differences of 37%, 25% and 36% between births and deliveries for these three months. When the researcher used the pivot tables for drilling down, she was able to establish that the three outliers exerted an insignificant effect on the provincial indicator value for *delivery in facility rate*. When the researcher unselected the indicators for the three months with inconsistent data, the Free State *delivery in facility rate* was 79% for the year 2006 whereas it would have been 80% if these 3 values had not been unselected. For the Motheo district, however, the difference was 7% (85% when unselected and 78% when not unselected) and for

the Mangaung sub-district in which the outliers originated, the difference was 8% (93% when unselected and 85% when not unselected).

The researcher noted in Chapter 3 that a decision was made not to change any of the existing data in the system for study purposes. By identifying potential DHIS data problems for rectification at the point of origin (after which exports can be used to update these data throughout the DHIS), the routine health information system, as sub-system of the HCS, can be strengthened to support managers in making evidence-based decisions. It should be borne in mind that those managers who are responsible for effective health service delivery at the different levels of the HCS are also equally responsible for M&E and effective health information management. If, in the course of their duties, they find that the information that they have obtained from the routine health information system does not reflect the actual situation, such managers are responsible for addressing whatever problems may emerge and, more particularly, for ensuring that the data concerned is validated without delay.

It was decided on the basis of the findings that emerged from the general rapid data quality assessment (section 3.5.4.1), from the data validation procedures required by the NHIS/SA data flow policy (SA 2003:1-4) and from the data validation support provided at provincial and national levels (section 3.5.4.1), to accept that the quality of data in the Free State DHIS was in general of a standard that would justify its use in this study.

4.2.2 Data analysis stage 2 – Evaluation of under-five mortality rate-related health care in the Free State

The information needs of health care providers, service, programme and information managers at each level of the HCS are different. During the analysis and interpretation of the data, the researcher provided a comprehensive overview of several aspects related to the *U5MR*, first for the Free State province as a whole and then for each health district, so that the researcher would be in a position to meet the informational needs of the provincial managers.

Pivot tables were used to drill down even further so that the data could be displayed in terms of the sub-districts in each of the districts, and so that the researcher would be in a position to provide a few practical examples of how district and sub-district managers could use DHIS data from a results-based perspective. Where applicable, data from hospitals was used to illustrate how data, service delivery, management and health system-related shortcomings in facilities could be identified. This data was also used to demonstrate how managers could use data as a first step in the process of identifying and implementing possible corrective strategies and activities.

Any attempt to meet the varying needs of managers at different levels of the HCS requires a vast amount of data. Even though such huge quantities of data may be daunting, it is possible in most cases for each manager to select only those portions of the data that are relevant to his/her respective needs. To enable results-based management that makes use of available evidence, all data should be interpreted within the relevant provincial HCS context. Although the analysis and interpretation in this study used an array of indicators as examples, some raw data and all study indicators were included in the performance profiles for further exploration and use.

The purpose of stage 2 of the data analysis was to identify ways in which existing Free State DHIS data could be used to help managers to strengthen the operations of the HCS so that it would be effective in reducing the *U5MR*. Stage 2 of the data analysis and interpretation was undertaken in conformity with the results-based application of the systems approach, and started by determining the extent to which impact and outcome targets had been met. After that an assessment was made of outputs, processes and inputs in an attempt to identify the potential reasons for successes and failures. The resultant findings, together with examples of how such findings could be used to support managers to make decisions based on evidence, were displayed and described in terms of:

- The raw data and indicators available in the DHIS.
- The formative evaluation of impacts, outcomes, outputs, processes and inputs by using data from between 2001 and 2006.
- The summative evaluation of impacts, outcomes, outputs, processes and inputs for 2006 displayed against national targets or benchmarks that had been developed with the support of child health experts.
- The diagnostic evaluation of impacts, outcomes, outputs, processes and inputs for 2006 by using threshold levels developed for this study with the support of experts. These were intended to identify:
    - The best performing areas (which could be used as models for learning).
    - The poorest performing areas (which needed additional support and encouragement).
    - Inequities in the distribution of HCS impacts, outcomes, outputs, processes and inputs (which needed to be investigated further).
- How available evidence could be used to strengthen the HCS for reducing the *U5MR*.

Evaluation of this kind may be defined as a systematic way of examining all available evidence in order to determine whether programmes, policies and interventions have been effectively implemented. Evaluation also determines how well they functioned during their lifespan,

whether they achieved the goals that were set for them and, if they have not produced the expected results, what the obstructions and problems might be. In other words, evaluation uses results, performance and first-hand investigation to find out whether the programme in question has made any difference, and to learn from past failures and deficiencies how future activities and planning can be improved (Brink & Wood 1998:124, 126; Katzenellenbogen et al 1997:147).

The researcher accordingly conducted formative, summative and diagnostic evaluations on each of the stages of the system with the intention of determining whether *U5MR*-related child health policies, programmes and services had been successfully implemented in the Free State province.

A **formative evaluation** provides feedback while a programme is still operative. This kind of evaluation gives the first indications of whether a programme is being implemented according to plan, whether it is working as it is supposed to work, what (if any) difference has been made by the programme, and whether or not it should be modified or improved (Brink & Wood 1998:132). The purpose of a formative evaluation is thus to maximise the probability that a programme will be successful while it is operative, rather than waiting until the final results become available for summative evaluations of its performance and usefulness. The purpose of the formative evaluations carried out in this study was to provide managers with evidence that would allow them to assess whether their child health policies, strategies, services and interventions between 2001 and 2006 could be described as successful and whether they were being successful in reducing the *U5MR* in the Free State province over these six years.

Summative evaluations are conducted after a specified period of operation or after the programme itself has been completed. Their purpose is to assess the success or otherwise of the programme and to determine whether the programme's stated objectives have been met (Brink & Wood 1998:132; Wikipedia [online] 2008). The researcher conducted summative evaluations during the course of this study and used clearly stated targets or benchmarks (Annexure 4) to measure the progress that the Free State province had made towards achieving the national targets or benchmarks at the end of 2006.

Diagnostic evaluations are conducted to identify the specific weaknesses, problems or deficiencies that seem to be causing underachievement (Wikipedia [online] 2008). Diagnostic evaluations were conducted on lower level data (namely district, sub-district and hospital data) in order to narrow down the list of geographical areas, facilities, activities and interventions on which the Department of Health's limited resources should be concentrated. Because this process necessitated the simultaneous display of vast amounts of data so that all the stages of the system could be covered at a glance, the researcher used the system of colour-coding for

diagnostic evaluation in terms of the targets or benchmarks. The details of how colour coding was used to highlight indicator values have already been described in section 3.5.2.2 and section 3.5.4.2.3. There it was explained that critical indicator values (red) are indicative of those areas where the biggest possible reductions of the *U5MR* could be made. The green-coloured values identified the best performing areas and activities which could serve as examples of best practice for other managers. Wherever green and red are used together, they serve to identify the best and least successful health programmes and/or interventions that should have the effect of reducing the *U5MR*. Blue values are used to indicate areas, programmes and interventions where yet more progress is required to achieve targets. Black-coloured values indicate unrealistic or improbable values such as, for example, rates of immunisation that exceed 100% and that need to be validated and explained.

4.2.2.1 Impact evaluation

Chapters 1, 2 and 3 described how the impact of a HCS is measured mainly in terms of life expectancy and the rates of mortality that are being generated by the main prevailing health problems and conditions. This form of measurement uses indicators such as the *IMR* and the *U5MR* (Katzenellenbogen 1997:16, 20; WHO 2001a:6; WHO 2003b:12).

Five proxy impact indicators, namely the *facility MMR*, the *facility PNMR*, the *facility NNMR*, the *facility IMR* and the *facility U5MR* (section 3.5.2.1.1) were selected to enable comparison to be made with survey and other research values. These proxy indicators also allows for routine information to be compared and aligned with international goals and indicators in the most effective and efficient way in the current circumstances.

4.2.2.1.1 Formative impact evaluation

The formative impact evaluation that was undertaken in this study was intended to measure the differences in the *U5MR* in the Free State between 2001 and 2006. The first step of the formative evaluation was to determine whether the Free State DHIS data was suitable for conducting a formative impact evaluation. This was done by assessing the availability and consistency of data over these years and by comparing DHIS indicator values with survey findings, where available.

It became evident that, although the Free State province DHIS did not contain any of the selected proxy population based impact indicators, the numerator and denominator data for these indicators was available in the database. The numerator and denominator values were therefore extracted from the DHIS for calculating the selected impact indicators.

Table 4.1 Raw data from 2001 to 2006 used for calculating impact and outcome indicators in the District Health Information System

Year	Demographic data		Raw data												
	Population under one year	Live births estimated	Live births under 2500g	Still births	Maternal deaths	Early neonatal deaths	Late neonatal deaths	Inpatient deaths under one year	Inpatient deaths under five years	Diarrhoea under five years with dehydration admitted	Diarrhoea under five years with dehydration deaths	Pneumonia under five years admitted	Pneumonia under five years deaths	Malnutrition under five years admitted	Malnutrition under five years deaths
2001	62,888	65,404	452	1,577		288									
2002	61,361	63,815	465	1,605		335									
2003	60,381	62,796	654	1,617		470									
2004	59,899	62,295	668	1,655		524									
2005	59,731	62,120	535	1,609	101	488	200	628	853	1,186	116	1,997	184	984	73
2006	59,428	61,805	552	1,493	149	492	302	1,664	2,203	3,532	345	4,447	496	1,800	214

Table 4.1 displays the raw Free State public health facility data that were used for calculating impact and outcome indicators in the DHIS. Data for three elements had been collected since 2001, and the remainder of the data had been collected since mid-2005. Table 4.1 also displays the population data contained in the DHIS. This population data is based on the annually updated StatsSA mid-year population estimates for each year since 2001.

The public health facility death data and the population data displayed in Table 4.1 enabled the researcher to calculate the selected proxy population-based impact indicators per 1,000 estimated live births (Table 4.2). As has already been described in Chapter 3, the estimated number of live births was calculated by using the under-one population factorised by 1.04 (Day & Gray 2006:385). The outcome indicators displayed in Table 4.2 were calculated as percentage of children born or admitted in the Free State public health facilities.

Table 4.2 Free State 2001 to 2006 formative impact and outcome evaluation

Year	Impact indicators					Outcome indicators						
	Public health facility deaths per 1,000 estimated live births					Public health facility deaths as % of live births or children admitted for specific conditions in public health care facilities						
	Facility maternal mortality rate	Facility perinatal mortality rate	Facility neonatal mortality rate	Facility infant mortality rate	Facility under-five mortality rate	Facility under-five mortality rate (%)	Facility low birth weight rate (%)	Facility still birth rate (%)	Facility neonatal mortality rate (%)	Malnutrition case fatality rate (%)	Pneumonia facility case fatality rate (%)	Diarrhoea facility case fatality rate (%)
2001		29	4					3.5	0.6			
2002		30	5					3.5	0.7			
2003		33	7					3.4	1.0			
2004		35	8					3.2	1.0			
2005		34	11					3.0	1.3			
2006	2.41	32	13	27	36	16	13	2.8	1.5	24	11	10

While the *MMR* is usually displayed per 100,000 live births, the *facility MMR* was also displayed per 1,000 estimated live births to enable its inclusion in Table 4.2 in the same context for which it is used in the display of other public health facility impact indicators. The *facility MMR* of 2.41 deaths per 1,000 live births in Table 4.2 is therefore equal to 241 maternal deaths per 100,000 live births.

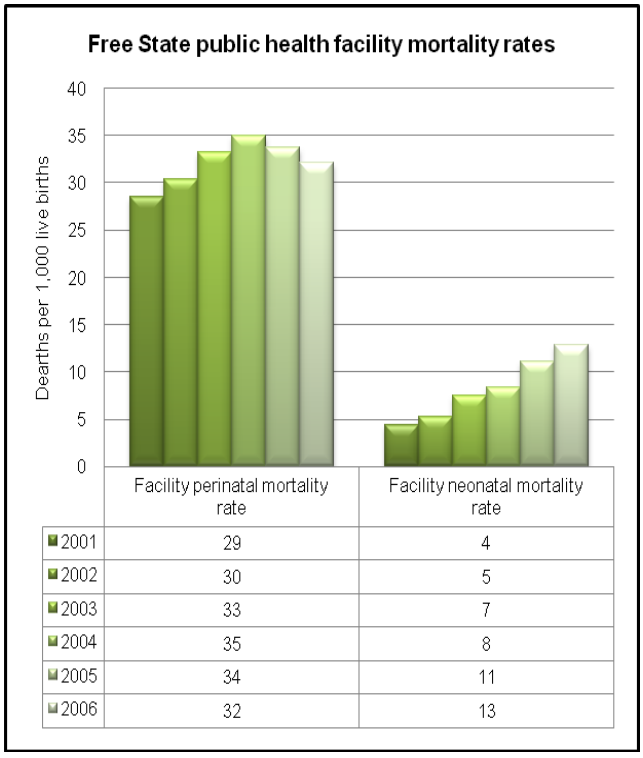
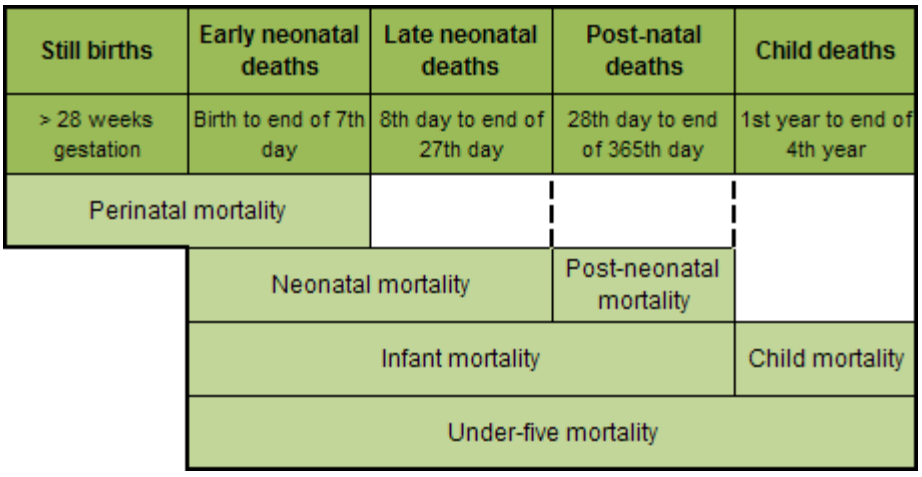


Figure 4.1 Free State 2001 to 2006 formative impact evaluation

Figure 4.1 displays the fairly stable *facility PNMR* listed in Table 4.2 in a graph. The *facility PNMR* increased the from 29 in 2001 to 35 in 2004, after which it decreased to 34 and 32 in 2005 and 2006 respectively. However, the *facility NNMR* of 4 deaths per 1,000 estimated live births for 2001 doubled to 8 deaths per 1,000 estimated live births in 2004 and became nearly triple the 2001 value by 2006. While the doubling of the rate between 2001 and 2004 is a cause for concern, the sharp rise in 2005 should be interpreted within the context of late neonatal death data that was collected from 2005 onwards. Figure 4.2 explains the overlapping measures of death in children under five years of age.



(Adapted from Day & Gray 2006:348)

Figure 4.2 Measures of death in children under five years of age

Since only early neonatal death data was reported before 2005 (Table 4.1 and Figure 4.2), the *facility NNMR* for 2001 to 2004 was based only on deaths that occurred before the seventh day after birth. From 2005 onwards, the *facility NNMR* was based on both early and late neonatal deaths (Figure 4.2), in other words deaths that occurred within the first 28 days after birth (Day & Gray 2007:335; DHIS 2007). The raw data in Table 4.1 shows that the early neonatal deaths in fact did start a downward trend since 2005.

This is an example of how important it is for managers to have access to all available data, the skills to interrogate these data and sufficient knowledge about the HCS context to interpret information for evidence-based decision-making.

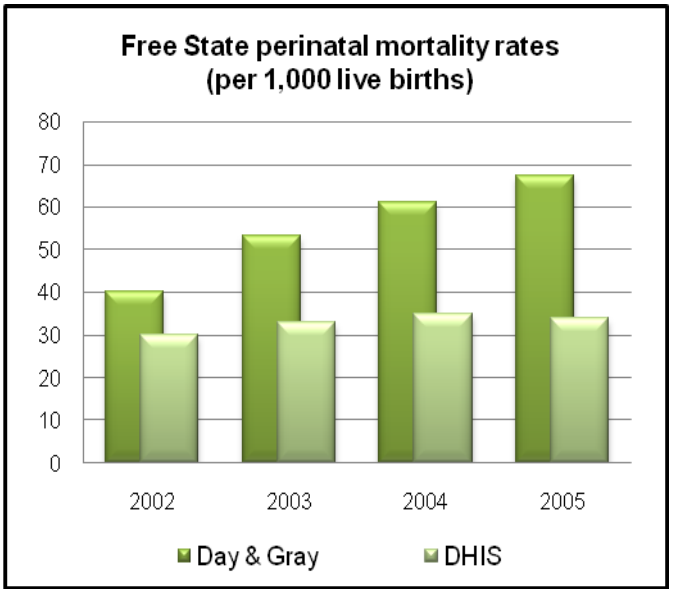


Figure 4.3 Free State 2002 to 2005 perinatal mortality rates in comparison with the published sources Day and Gray (2006:386) and Day and Gray (2007:267)

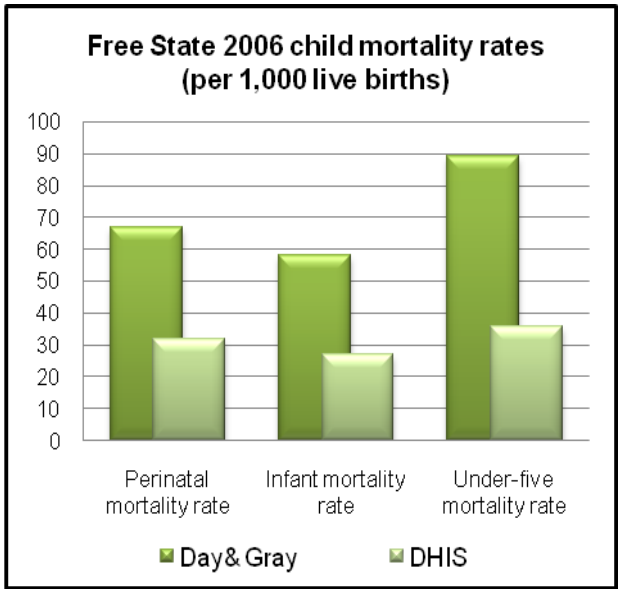


Figure 4.4 Free State 2006 impact evaluation indicator values in comparison with the published source Day and Gray (2007:269-270)

When comparing the Free State province *facility PNMRs* in the DHIS for the years 2002 to 2005 with those documented by Day and Gray (2006:386) and Day and Gray (2007:267), the differences ranged from 50% to 74% (Figure 4.3). When comparing the 2006 Free State province *facility IMR* and *facility U5MR* in the DHIS with results published by Day and Gray (2007:269-270), the differences ranged from 40% to 48% of the published values (Figure 4.4).

When one takes into consideration the fact that the DHIS contains only public health care facility data, that 43% of the number of 2005 deaths were reported by hospitals (StatsSA 2007a:14), and that public health care facilities serve approximately 85% of the total Free State population (Day & Gray 2007:319), one could make a case for asserting that the proxy DHIS population-based *U5MR*s could be of value in evidence-based decision-making designed to reduce the *U5MR* in the Free State. Because the DHIS data is collected in a standardised way in all public

health facilities every month, the trends that emerge from this data can also indicate to managers whether public health facility interventions that provide preventive and curative *U5MR*-related services are being successful or not.

Although *MMR* indicator values could not be obtained from the literature for the years after 2003, the 241 Free State public health *facility MMR* per 100,000 estimated live births reported in the DHIS for 2006, are not surprising when one compares them to the 234 maternal deaths per 100,000 live births that were reported by Day and Gray (2006:398) for the Free State in 2003.

While two of the five selected impact indicators appeared, at face value, to be appropriate for conducting a formative *U5MR* impact evaluation for the years 2001 to 2006, further investigation revealed that only the *facility PNMR* was suitable for this purpose because only the *facility NNMR* could only be accepted as valid for 2006. When the DHIS impact indicator values were compared with those obtained from other sources, the DHIS values were approximately 50% of the published values since 2004. Because the public health sector is responsible for approximately 85% of the Free State population (Day & Gray 2007:319) and because StatsSA (2007a:14) reported that 43% of deaths were notified by hospitals, it was accepted that, although the DHIS contains only public health facility data, this data can be of value to assist managers as they strive to strengthen the Free State HCS and so reduce the *U5MR*.

4.2.2.1.2 Summative impact evaluation

By making use of national targets or benchmarks that had been developed with the support of experts, the researcher conducted a summative impact evaluation of *U5MR*-related services in the Free State in order to determine whether the objectives for child health care services were being met. When interpreting the findings of the summative evaluation, it should be borne in mind that the DHIS contains data for public health facilities only, and that national targets were devised for the whole South African population, which means that they had included deaths that had occurred in private health facilities as well as in public health facilities and outside health facilities.

The indicator values of the 2006 summative evaluations, conducted in terms of the targets or benchmarks summarised in Annexure 4, are displayed in Figure 4.5. The Free State *facility MMR* of 24.1 maternal deaths per 10,000 estimated live births (or 241 maternal deaths per 100,000 estimated live births) during 2006 represented more than double the South African target of 100 maternal deaths per 100,000 live births (or 10 maternal deaths per 10,000 live births).

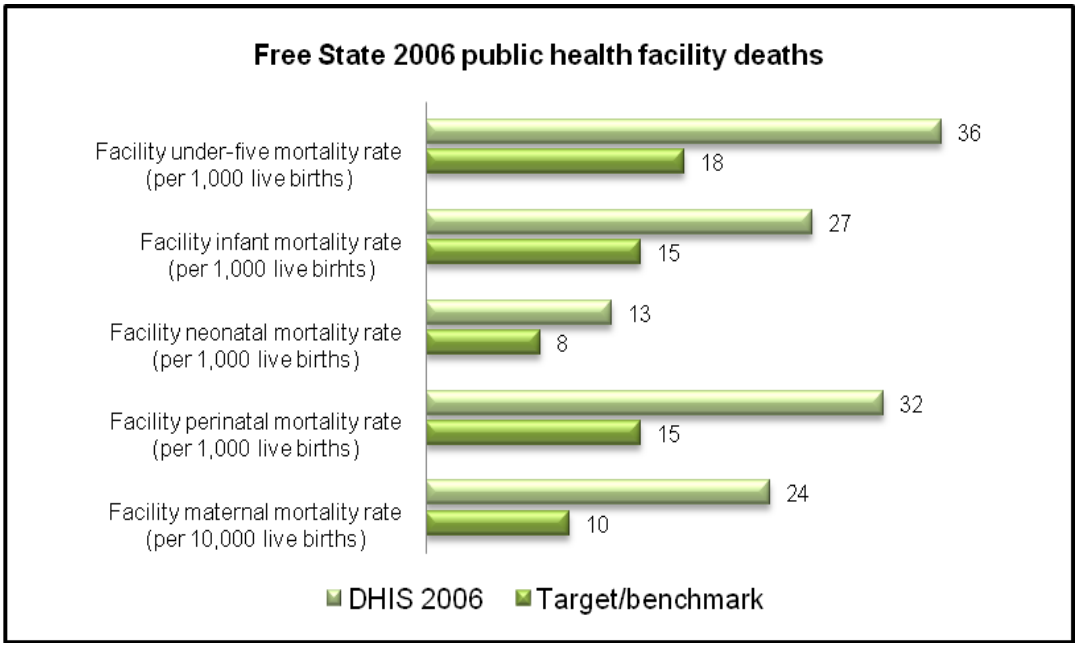


Figure 4.5 Free State 2006 impact evaluation indicator values in relation to targets or benchmarks (copy of Figure 3.8)

The DHIS *facility U5MR* of 36 deaths per 1,000 estimated live births in 2006 was nearly double the MDG of 20 deaths per 1,000 live births by 2015. The DHIS values for the Free State *facility PNMR* of 32 perinatal deaths per 1,000 estimated live births in 2006 (Figure 4.5) was in line with the *Fifth Perinatal Care Survey of South Africa* that reported a Free State *PNMR* of 33 deaths per 1,000 live births. The 2006 DHIS *facility NNMR* was 13 deaths per 1,000 estimated live births, while the *Fifth Perinatal Care Survey of South Africa* reported an early *NNMR* of 11.9 deaths per 1,000 live births (Pattinson 2007:114). The correlation between the Free State province DHIS data and the data reported by *Fifth Perinatal Care Survey of South Africa* confirms that that DHIS data is useful to guide managers and service providers in evidence-based decision-making in periods between official population surveys and/or publication of other studies.

Comparisons with published sources led to the conclusion that Free State DHIS impact indicator values (for public health care facilities only), were approximately 50% of the published values for the province. When one compares these public health indicators with national targets (for all facility and non facility deaths) or benchmarks, one sees that the DHIS indicator values for 2006 were nearly double the targets or benchmarks. This is a clear indication that, unless drastic measures are implemented to reduce the *U5MR* in the Free State, the province will not be able to meet the MDG of 20 deaths per 1,000 live births in 2015.

4.2.2.2 Outcome evaluation

Outcomes of the HCS are measured in terms of effectiveness and efficiency. *Effectiveness* measures success in producing a given result and *efficiency* measures success in monetary terms (Katzenellenbogen et al 1997:149). In other words, outcome evaluations measure whether management interventions have been effective in providing the best possible quality of health care at an optimal cost (Heavens 1999:45, 47).

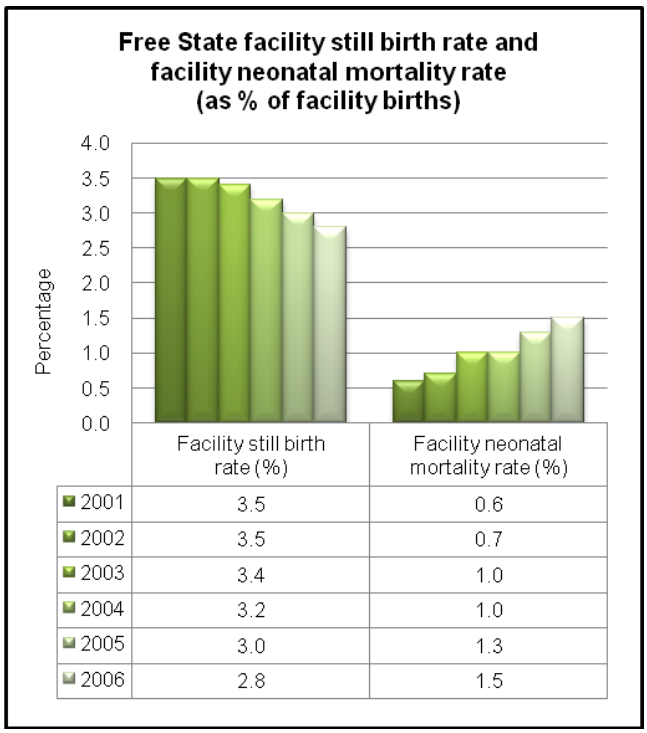
The seven outcome indicators that were selected for the study were the *facility U5MR (%), facility LBWR (%), facility SBR (%), facility NNMR (%)* and the three facility CFR indicators, namely the *diarrhoea facility CFR (%)*, *malnutrition facility CFR (%)* and *pneumonia facility CFR (%)*. These outcome indicators were calculated as percentages of children born or admitted in the Free State public health facilities (refer to Annexure 4 & 5 for numerators and denominators) and provide an indication of case management for the priority diseases that cause death in children under five years of age. Although the death data for this study was obtained mostly from hospitals, these indicators also provide an indication of the outcomes of the preventive, diagnostic and curative child health care interventions that were provided from the community to the tertiary hospital level in specific geographical areas.

4.2.2.2.1 Formative outcome evaluations

The purpose of the formative outcome evaluations was to measure the effectiveness of under-five health care services in the Free State province between 2001 and 2006. When the researcher examined the DHIS in order to determine whether the Free State data was suitable for conducting the planned formative outcome evaluations, she discovered that the DHIS contained standard indicators for measuring the *facility U5MR (%)*, *facility LBWR (%)* and *facility NNMR (%).* In addition to these indicators (even though they had been differently named) the DHIS also contained indicators for measuring the facility CFR for diarrhoea, malnutrition and pneumonia as percentage of cases admitted in public health care facilities.

The raw data displayed in Table 4.1 sets out an example of the data that was used in the DHIS as numerators and denominators to auto-calculate the seven selected outcome indicators that are displayed in Table 4.2 and the two outcome indicators that are displayed in Figure 4.6.

While the *facility SBR (%)* (Figure 4.6) decreased gradually from 3.5% in 2001 to 2.8% in 2006, the *facility NNMR (%)* more than doubled from 0.6% in 2001 to 1.5% in 2006. But again it should be taken into consideration that late neonatal death data was only collected in the Free State since the middle of 2005. Because the remaining five selected outcome indicators had values for 2006 alone, they were unsuitable for use in formative evaluation.



Although two outcome indicators were suitable at face value for formative evaluation, the *facility NNMR (%)* was found to be valid only since 2006. The *facility SBR (%)* was therefore the only suitable indicator for formative outcome evaluation of *U5MR*-related health care in the Free State. No non-DHIS data sources could be located for purposes of comparison.

Figure 4.6 Free State 2001 to 2006 formative outcome evaluation

Although the *facility PNMR (%)* (Figure 4.1) and the *facility SBR (%)* (Figure 4.6) showed a downward trend (indicating the *U5MR*-related health care may be improving), it is crucial for the province not only to improve health care, but also to meet the national and international *U5MR*-related targets.

4.2.2.2.2 Summative outcome evaluations

The researcher conducted summative outcome evaluations in terms of the national targets or benchmarks (obtained from literature or developed with the assistance of experts and displayed in Annexure 4), to determine the effectiveness of *U5MR*-related health care in the Free State province during 2006 and progress to national and international goals.

Figure 4.7 displays the 2006 DHIS values for the seven outcome indicators in terms of the targets or benchmarks that are summarised in Annexure 4. All the Free State outcome indicator values exceeded the targets or benchmarks by far, indicating that drastic measures need to be implemented to reduce the *U5MR*. One should also take into consideration that in the Free State province and throughout South Africa, the prevalence of *LBWR*, and all the most likely causes of death in children, are increased by the incidence of HIV, which is drastically underreported (section 2.5.2). This emphasises the need of managers for valid and reliable routine health information to measure equity in health care outcomes among health districts, sub-districts and facilities to identify what type of support is needed and areas where interventions are needed most.

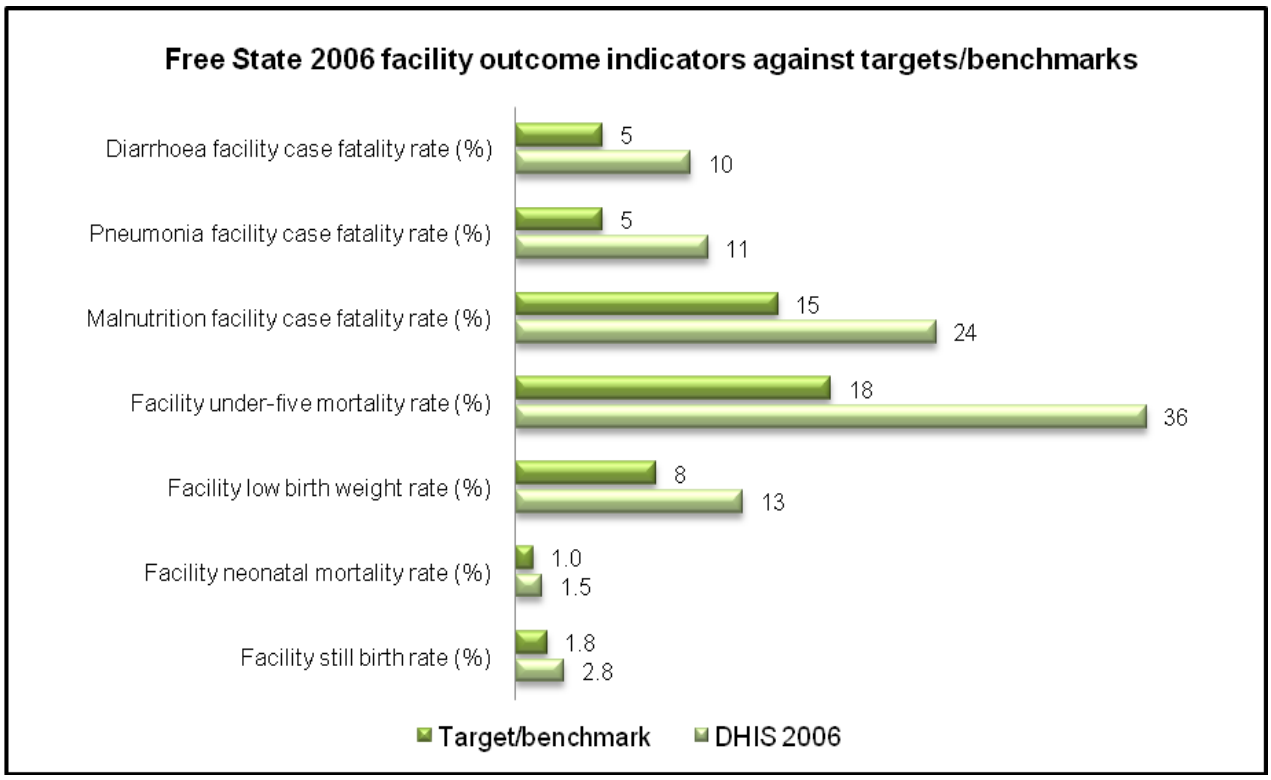


Figure 4.7 Free State 2006 outcome evaluation indicator values in relation to targets or benchmarks

4.2.2.2.3 Diagnostic impact and outcome evaluation

Because impact and outcome indicators constitute the results of the HCS, they were grouped together for diagnostic outcome evaluations.

Chapter 3 provides an explanation of the methodology that was followed to select indicators and threshold levels, as well as the methods used for identifying the best and poorest performing areas and services/interventions/indicators. Annexure 4 contains all the indicator targets, benchmarks and range values that were used for diagnostic evaluations in this study.

Table 4.3 displays the colour-coded 2006 values for the 12 selected public health care facility impact and outcome indicators in the five Free State districts, resulting in a total of 60 district indicator values to be evaluated. Although the provincial indicator values are also displayed in the yellow cells in Table 4.3 to provide a complete picture, the researcher did not include them in the analysis because the purpose of this part of the analysis was to describe the performance of the five districts.

To evaluate the performance of each of the five districts in terms of the 12 selected indicators, the number of on track (green-coloured) values and the number of critical (red-coloured) values were counted horizontally and displayed in the two grey columns to the right of Table 4.3.

In order to evaluate which of the 12 selected services or interventions (represented by each of the 12 indicators) were performing well and those for which support was needed, the number of on track and critical values were counted vertically and displayed in the two grey rows at the bottom of Table 4.3).

Table 4.3 Free State 2006 diagnostic impact and outcome evaluation by district

Free State Districts (5)	Target population		Results of under-five mortality rate-related health care														
			Impact as public health facility deaths per * estimated live births					Outcomes as % of live births or children admitted for specific conditions in public health care facilities									
			*100,000	*1,000													
	Population under five years	Live births estimated	Facility maternal mortality rate (T 100)	Facility perinatal mortality rate (B 15)	Facility neonatal mortality rate (B 8)	Facility infant mortality rate (B 15)	Facility under -five mortality rate (B 18)	Facility under-five mortality rate (%) (B 12)	Facility low birth weight rate (%) (B 8)	Facility still birth rate (%) (B 1.8)	Facility neonatal mortality rate (%) (B 1)	Malnutrition case fatality rate (%) (B 15)	Pneumonia case fatality rate (%) (B 5)	Diarrhoea case fatality rate (%) B 5)	Number of on track values	Number of critical values
Fezile Dabi	53,043	11,316	203	25	9	24	30	15	15	2.6	1.2	23	8	8	0	7
Lejweleputswa	68,110	11,538	355	40	13	46	57	23	14	3.0	1.3	21	9	9	0	10
Motheo	80,716	18,070	249	34	13	17	27	10	12	2.8	1.4	25	9	10	1	8
T Mofutsanyane	83,585	18,276	208	31	16	27	34	20	13	2.9	1.9	22	19	10	0	12
Xhariep	13,081	2,605	77	22	6	25	34	15	15	2.4	0.9	34	13	10	2	6
Free State	**298,535**	**61,805**	**241**	**32**	**13**	**27**	**36**	**16**	**13**	**2.8**	**1.5**	**24**	**11**	**10**	0	10
Critical values			4	3	3	4	5	2	4	4	4	5	2	3	3	43
On track values			1	0	1	0	0	1	0	0	0	0	0	0	5%	72%

* B indicates benchmark and T indicates target

The public health facility indicator values displayed in Table 4.3 make the following facts clear:

- The Free State as a province was not on track with any of the 12 indicators selected for measuring the results of *U5MR*-related health care, and 10/12 (83%) of the indicator values for the province had critical values.
- The 2006 values for the 12 selected impact and outcome indicators were inequitably distributed between the five districts.
- The on track values for each of the five districts ranged from 0/12 (zero out of 12) (0%) to 2/12 (20%), and the critical values ranged from 6/12 (50%) to 12/12 (100%).
- Although the *U5MR* MDG target for South Africa is 20 deaths per 1,000 live births, the Free State 2006 *facility U5MR* was 36 per 1,000 estimated live births, with district values ranging from between 30 and 57 deaths per 1,000 estimated live births.
- While the *MMR* target is 100 deaths per 100,000 live births, the Free State 2006 *facility MMR* was 241 deaths per 100,000 live births, with district values ranging from between 77 and 355 maternal deaths per 100,000 live births.

- The number of on track district values for each indicator ranged from 0/5 (0%) to 1/5 (20%), and the number of critical district values ranged from 2/5 (40%) to 5/5 (100%).
- While Xhariep appeared to be the best-performing district with two on track and six critical values, further investigation showed that the *facility MMR* and the *facility U5MR* in Xhariep were probably low because the hospitals in Xhariep are small. This necessitates the transfer of sick mothers and children to regional hospitals in other districts where some of them die. Therefore the only real on track indicator in Table 4.3 was the *facility U5MR (%)* in Motheo, where 10% of children admitted in public health facilities died during 2006.
- T Mofutsanyane was the poorest performing district with 0 on track and 12 critical values.
- Only 3/60 (5%) of the 60 district indicator values were on track, and 43/60 (72%) of the values were critical.

Table 4.4 displays the colour-coded 2006 values for the 12 selected public health care facility impact and outcome indicators in the 20 Free State sub-districts, which resulted in the evaluation of 240 sub-district indicator values. Although the district and provincial indicator values are displayed in Table 4.4 in the yellow cells for the sake of completeness, they were not included in the analysis because the purpose of this part of the analysis was to assess and describe the performance of the 20 sub-districts.

In order to evaluate the performance of the 20 sub-districts in terms of the 12 selected indicators, the researcher counted the number of on track (green-coloured) values and the number of critical (red-coloured) values horizontally and displayed them in the two grey columns to the right of Table 4.4.

In order to evaluate which of the 12 selected services or interventions (represented by each of the 12 indicators) were performing well and those for which support was needed, the researcher counted the number of on track and critical values vertically and displayed them in the two grey rows at the bottom of Table 4.4.

Three sub-districts, namely Tokologo, Naledi and Letsemeng, reported values of 0 for most of the 12 selected indicators. Further investigations (Table 4.11) showed that the first two of these sub-districts did not have any facilities for providing delivery or other 24-hour services during 2006 and that Letsemeng (with one CHC) also did not offer such services to their local community. This is discussed in more depth under input evaluation.

Table 4.4 Free State 2006 diagnostic impact and outcome evaluation by sub-district

Free State Sub-districts (20)	Target population		Results of under-five mortality rate-related health care													Number of on track values	Number of critical values
			Impact as public health facility deaths per * estimated live births					Outcomes as % of live births or children admitted for specific conditions in public health care facilities									
			*100,000	*1,000													
	Population under five years	Live births estimated	Facility maternal mortality rate (T 100)	Facility perinatal mortality rate (B 15)	Facility neonatal mortality rate (B 8)	Facility infant mortality rate (B 15)	Facility under -five mortality rate (B 18)	Facility under-five mortality rate (%) (B 12)	Facility low birth weight rate (%) (B 8)	Facility still birth rate (%) (B 1.8)	Facility neonatal mortality rate (%) (B 1)	Malnutrition case fatality rate (%) (B 15)	Pneumonia case fatality rate (%) (B 5)	Diarrhoea case fatality rate (%) B 5)		
Mafube	7,516	1,604	62	20	6	12	20	25	14	2.2	0.9	38	9	10		2	3
Metsimaholo	12,885	2,749	146	28	6	17	24	15	14	2.6	0.7	7	10	19		2	4
Moqhaka	18,526	3,952	354	31	17	44	52	14	15	3.4	2.0	40	5	7		1	9
Ngwathe	14,116	3,012	133	16	5	9	13	19	12	1.7	0.7	8	16	4		5	3
Fezile Dabi	**53,043**	**11,316**	**203**	**25**	**9**	**24**	**30**	**15**	**15**	**2.6**	**1.2**	**23**	**8**	**8**		**0**	**7**
Masilonyana	6,625	1,122	0	4	2	23	29	23	20	1.3	0.5	0	8	43		2	5
Matjhabeng	39,832	6,748	548	63	21	66	79	25	14	3.5	1.6	20	8	8		0	10
Nala	10,849	1,838	54	12	3	20	26	19	15	1.4	0.5	8	11	6		6	4
Tokologo	3,898	660	0	0	0	0	0	0	0	0	0	0	0	0		0	0
Tswelopele	6,906	1,170	256	9	1	25	36	17	9	1.3	0.1	59	12	15		2	7
Lejweleputswa	**68,110**	**11,538**	**355**	**40**	**13**	**46**	**57**	**23**	**14**	**3.0**	**1.3**	**21**	**9**	**9**		**0**	**10**
Mangaung	70,596	15,805	272	38	13	19	30	10	13	2.9	1.4	26	9	10		1	9
Mantsopa	6,912	1,546	129	15	12	9	17	18	8	1.1	2.6	11	5	16		6	4
Naledi	3,208	719	0	0	0	0	0	0	0	0	0	0	0	0		0	0
Motheo	**80,716**	**18,070**	**249**	**34**	**13**	**17**	**27**	**10**	**12**	**2.8**	**1.4**	**25**	**9**	**10**		**1**	**8**
Dihlabeng	14,734	3,222	372	52	25	45	56	26	14	3.7	3.0	18	17	13		0	11
Maluti a Phofung	41,265	9,023	211	31	20	24	30	17	12	3.0	2.2	31	27	12		0	11
Nketoana	7,140	1,561	64	24	5	15	16	11	12	2.7	0.7	7	3	8		6	2
Phumelela	6,480	1,416	71	9	1	13	16	23	13	2.7	0.2	33	14	0		2	5
Setsoto	13,966	3,053	164	21	7	28	40	25	14	1.8	0.8	18	11	9		1	6
T Mofutsanyane	**83,585**	**18,276**	**208**	**31**	**16**	**27**	**34**	**20**	**13**	**2.9**	**1.9**	**22**	**19**	**10**		**0**	**12**
Kopanong	5,116	1,019	0	23	5	20	34	20	12	2.5	0.7	18	14	13		0	5
Letsemeng	4,610	918	0	5	0	0	0	0	0	3.3	0	0	0	0		0	1
Mohokare	3,355	668	300	43	16	66	81	13	15	2.1	1.2	40	13	9		0	9
Xhariep	**13,081**	**2,605**	**77**	**22**	**6**	**25**	**34**	**15**	**15**	**2.4**	**0.9**	**34**	**13**	**10**		**2**	**6**
Free State	**298,535**	**61,805**	**241**	**32**	**13**	**27**	**36**	**16**	**13**	**2.8**	**1.5**	**24**	**11**	**10**		**0**	**10**
Critical values			**8**	**7**	**7**	**8**	**11**	**12**	**13**	**10**	**7**	**8**	**9**	**8**		**36**	**108**
On track values			**4**	**3**	**4**	**2**	**4**	**2**	**2**	**4**	**2**	**4**	**3**	**2**		**15%**	**45%**

* B indicates benchmark and T indicates target

The following conclusions were drawn from the public health facility indicator values displayed in Table 4.4:

- There were huge inequities between the 20 sub-districts for the 2006 values of the 12 selected impact and outcome indicators.
- On track values for each of the sub-districts ranged from 0/12 (zero out of 12) to 6/12 (50%), and the critical values ranged from 1/12 (8%) to 11/12 (92%).
- The sub-district *facility U5MR* values ranged from 0 deaths per 1,000 estimated live births to 81 deaths per 1,000 estimated live births (which is four times the MDG goal of 20 deaths per 1,000 live births). Only 4/20 (20%) sub-districts met the performance expectations in terms of the *facility U5MR* while 11/20 (55%) reported critical values.
- While the *MMR* target is 100 maternal deaths per 100,000 live births, the Free State *facility MMR* in the sub-districts ranged from 0 to 548 deaths per 100,000 estimated live births in 2006, with only 4/20 (20%) sub-districts performing as expected and 8/20 (40%) having critical values.
- The number of on track values for each of the 12 indicators in the 20 districts ranged from 2/20 (10%) to 4/20 (20%) and the number of critical values ranged from 7/20 (35%) to 13/20 (65%).
- The sub-districts with the highest number of on track values were Mantsopa, Nala and Nketoana. Each of them had six on track values, while the sub-districts with the highest number of critical values were Dihlabeng and Maluti a Phofung with 11/20 (92%) critical values each. Once again these results must be interpreted within the entire health care context. The low mortality rates in Tokologo, Naledi and Letsemeng, for example, do not reflect good quality of care - because there are no hospitals in these sub-districts, their very sick patients are probably transferred to other districts where some of them die.
- While only 36 (15%) of the 240 sub-district indicator values were on track during 2006, 108 (45%) reflected critical values.

The results of the formative, summative and diagnostic evaluations that were conducted on the selected impact and outcome indicators show that drastic intervention is required in the Free State if the *MMR* and the *U5MR* are to be reduced.

But how can this data be used to help managers to strengthen and improve the performance of the HCS?

One may argue from a systems theory point of view that in those cases where impact and outcome targets were not met, the inputs, processes and outputs (that relate to these targets) need to be evaluated so that the deficiencies and causes of such underperformance can be identified and be addressed (WHO 2003b:35-36).

4.2.2.3 Output/coverage evaluation

The outputs of a HCS are measured in terms of the quantity of services that are provided or as the proportion of the population have been reached by specific interventions in relation to the total number of those who actually needed the services in specific geographical areas (WHO 2003b:12). High coverage rates indicate successful service delivery while low coverage rates indicate the existence of underperformance that needs to be investigated and corrected.

Seven output/coverage indicators were selected to assess whether Free State populations in need were being reached by services that were designed to prevent unplanned pregnancies, HIV in children and a variety of childhood diseases. These indicators are the *couple year protection rate (CYPR)*, *TOP rate*, *HIV test ANC rate*, *nevirapine pregnant women coverage*, *nevirapine baby coverage*, *vitamin A 12-59 months coverage* and the *measles 1st dose coverage*. The numerators and denominators for these indicators can be viewed in Annexure 4 and Annexure 5.

4.2.2.3.1 Formative output/coverage evaluation

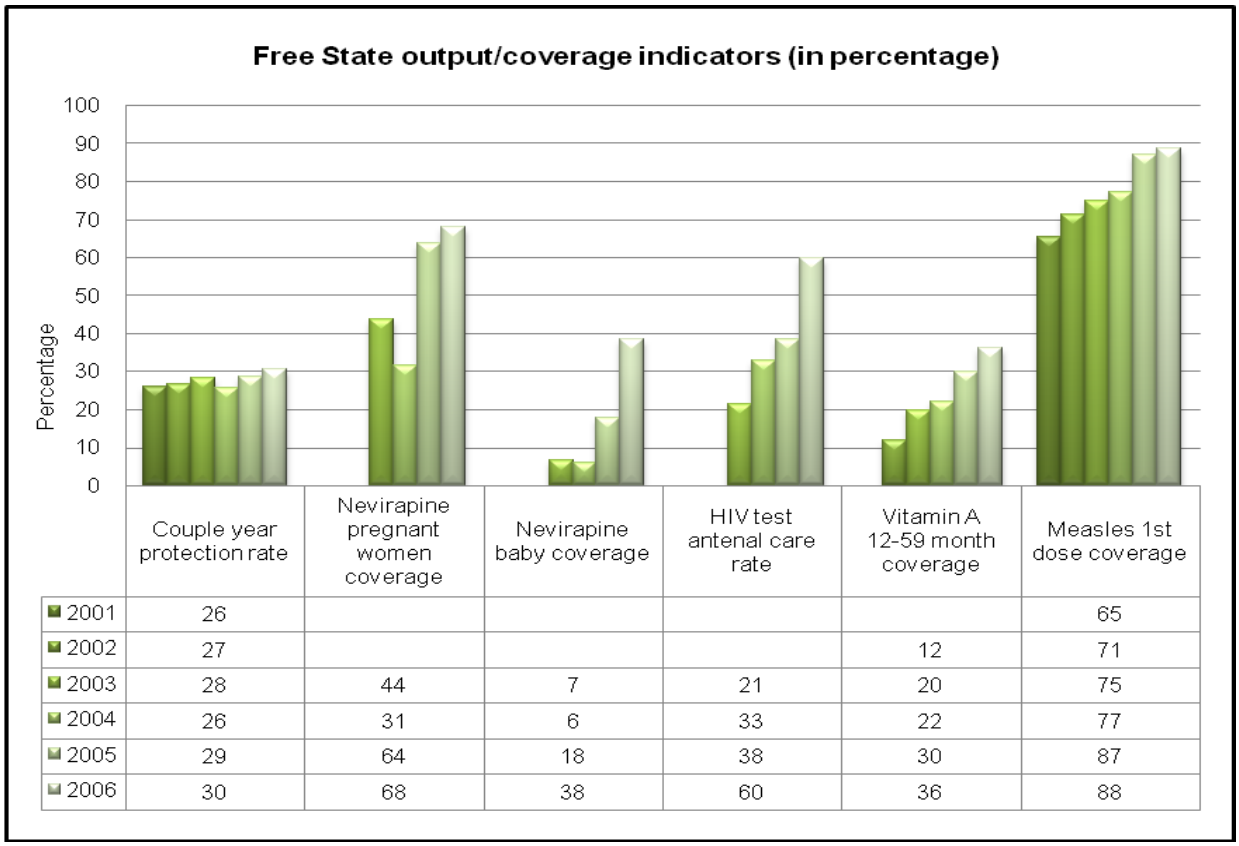
Once again, the first step of the formative output evaluation was to determine whether the Free State DHIS data was suitable for conducting evaluations for the years between 2001 and 2006. Table 4.5 displays the raw Free State data that was available in the DHIS for auto-calculating of the selected output/coverage indicator values. The DHIS contained data for five of the 14 data elements since 2001, for one more since 2002, for four more since 2003 and for four new elements since 2005.

Table 4.5 Raw data from 2001 to 2006 used for calculating output/coverage indicators in the District Health Information System

Year	Prevent unplanned pregnancies								Prevent HIV in babies				Prevent childhood diseases	
	Oral pill cycle	Norethisterone enanthate injection	Medroxyprogesterone injection	Sterilisation - female	Sterilisation – male	Termination of Pregnancy performed	Female condoms distributed	Male condoms distributed	Nevirapine dose to woman at antenatal or labour	Nevirapine dose to baby born to woman with HIV	Antenatal clients HIV tested - new	Antenatal clients HIV positive – new	Vitamin A supplement to 12-59 months child	Measles 1st dose under 1 year
2001	370,677	223,365	387,025					8,893,268						41,100
2002	392,064	229,493	403,788					8,898,644					43,515	43,707
2003	440,950	222,837	404,458					13,149,834	1,483	600	11,851	3,405	95,819	45,128
2004	402,079	205,265	382,532					10,427,598	1,678	791	19,373	5,304	105,685	46,249
2005	392,480	207,822	404,755	980	16	3,949	778	12,705,748	4,037	2,402	24,473	6,328	143,259	51,995
2006	356,526	205,808	397,331	2,082	63	9,449	7,634	14,741,832	6,709	5,235	38,940	9,865	172,522	52,585

The raw data in Table 4.5 indicates the number of people who were reached or covered by each selected preventive intervention. The data shows an improvement in performance and/or data management for some of the interventions. These include, for example, male condoms distributed, ANC clients tested for HIV and nevirapine administered to women and babies. In spite of this, some of the interventions showed little if any performance improvement, for example, the number of women who received either oral or intramuscular methods to prevent unplanned or unwanted pregnancies.

The DHIS contained standard auto-calculated indicator values for all seven of the selected output/coverage indicators. Figure 4.8 displays six of these indicators. The DHIS values for the *CYPR* and *measles 1st dose coverage* had been available in the DHIS since 2001 and they appear to be consistent. The *TOP rate* (not displayed in Figure 4.8) was only available for 2006 while the *vitamin A 12-59 months coverage* had been available since 2002. The three HIV-related indicators, namely the *HIV test ANC rate*, the *nevirapine pregnant women coverage* and the *nevirapine baby coverage,* had been available in the DHIS since 2003. The researcher was able to use the *CYPR* and *measles 1st dose coverage* for formative output evaluations over the six years and, although data was not available for all six years, the *vitamin A 12-59 months coverage* and the three HIV-related indicators were accepted as suitable for formative evaluation.



	Couple year protection rate	Nevirapine pregnant women coverage	Nevirapine baby coverage	HIV test antenal care rate	Vitamin A 12-59 month coverage	Measles 1st dose coverage
2001	26					65
2002	27				12	71
2003	28	44	7	21	20	75
2004	26	31	6	33	22	77
2005	29	64	18	38	30	87
2006	30	68	38	60	36	88

Figure 4.8 Free State 2001 to 2006 formative output/coverage evaluation

Figure 4.8 also shows that the proportion of women who were supported with interventions to prevent pregnancies (measured as the *CYPR*) improved slightly from 26% in 2001 to 30% in 2006. The *South African Demographic and Health Survey* (SA 1998:51) shows that 68% of sexually active women in the Free State used modern contraceptive methods in 1998. Although many women obtain contraceptive services from private health facilities, these large differences between the survey and DHIS indicator values warrants further investigation.

Because the Free State only started reporting on TOPs in the DHIS in 2005 (Table 4.5), the *TOP rate* could not be used for formative evaluation. In spite of this the 9,449 TOPs reported for 2006 in the DHIS seem to align well with the 8,890 TOPs reported in Day and Gray (2007:15) for 2005.

The DHIS *HIV test ANC rate* increased from 21% in 2003 to 60% in 2006 (Figure 4.8) while the *nevirapine pregnant women coverage* increased from 44% in 2003 to 68% in 2006. The *nevirapine baby coverage* (for babies born to mothers estimated to be HIV positive based on the annual *National HIV and Syphilis Survey for South Africa*), increased from 7% in 2003 to 38% in 2006.

Although HIV prevalence is not one of the selected study indicators, it was interesting to note (Figures 4.9 and 4.10) that the DHIS data on *HIV prevalence in pregnant women* was consistent and that it compared well with the findings of the annual national antenatal survey. The DHIS showed a slight decrease in *HIV prevalence in pregnant women* (from 29% in 2003 to 25%) in 2006, and, according to the 2006 *National HIV and Syphilis Survey for South Africa*, the HIV prevalence for ANC clinic attendants was 29.5, 30.3 and 31 in 2004, 2005 and 2006 respectively (SA 2007b:7).

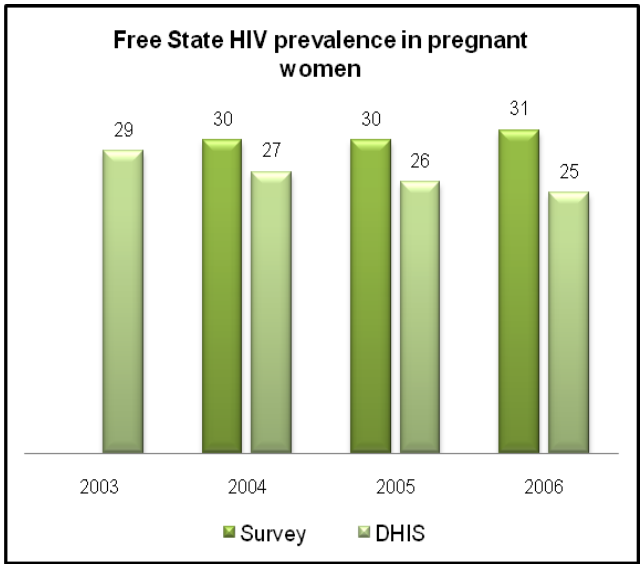


Figure 4.9 Free State 2003 to 2006 HIV prevalence in pregnant women in comparison with the published source SA (2007b:7)

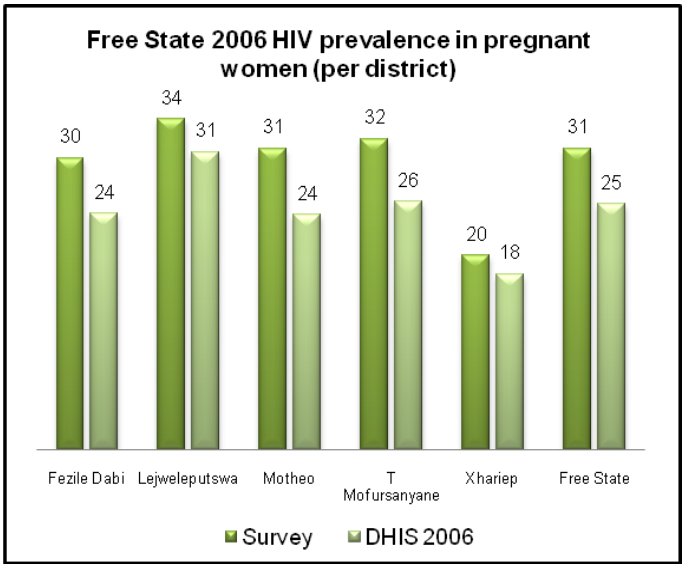


Figure 4.10 Free State 2006 HIV prevalence in pregnant women by district in comparison with the published source SA (2007b:23)

The *HIV prevalence in pregnant women* in the five districts ranged from 19.7% in Xhariep (the DHIS value was 18.1%) to 34.1% in Lejweleputswa (the DHIS value was 30.6%), while the Free State provincial average was 31.1% (the DHIS value was 25.3%). The difference between the survey data and the data in the DHIS ranged from 1.6% to 6.7%, with an average of 5.8% (SA 2007b:23). Again it should be emphasised that the DHIS contains only public health facility data while the *National HIV and Syphilis Survey for South Africa* covers the total South African population.

The Free State has been doing well with *measles 1st dose coverage*. This coverage improved from 65% in 2001 to 88% in 2006. No recent non-DHIS sources could be located for comparison in this regard.

Formative evaluation to the conclusion that Free State performance had improved since 2001 in terms of output or coverage by interventions aimed at preventing or reducing deaths in children under five years of age. But the question remains: were all people in need of preventive services reached?

4.2.2.3.2 Summative output/coverage evaluation

Summative output evaluations were conducted in terms of the national targets or benchmarks to determine to what extent the Free State target populations had been covered by interventions aimed at preventing deaths in children under five years of age.

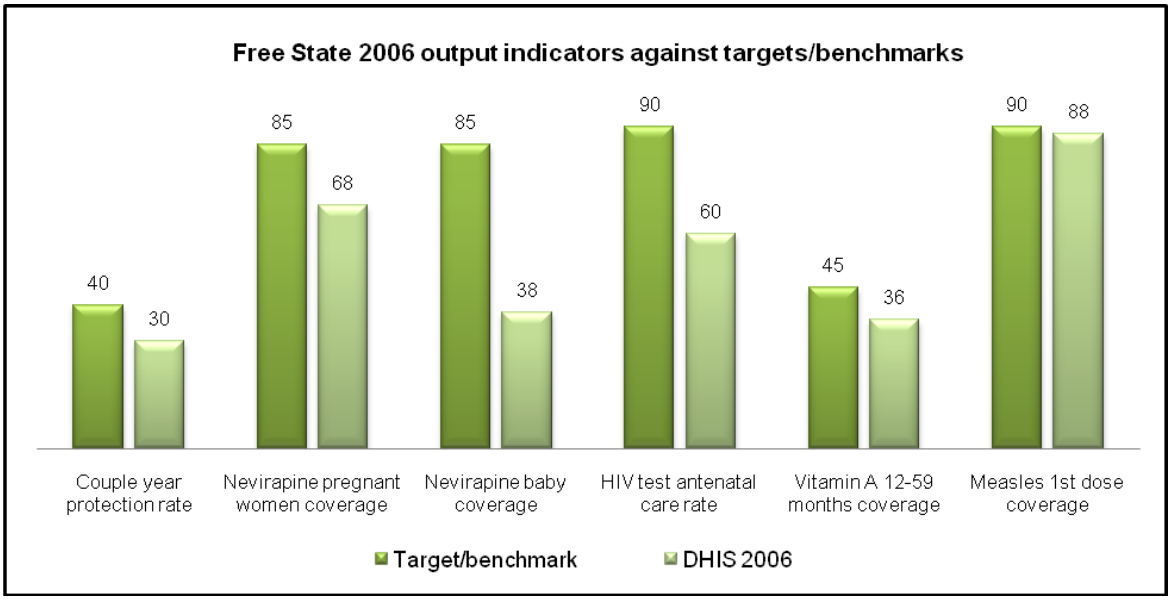


Figure 4.11 Free State 2006 output/coverage evaluation indicator values in relation to targets or benchmarks

The prevention of unplanned pregnancies amongst HIV-infected women is one of the most effective ways of reducing perinatal HIV transmission, which is one of the main causes of still births and deaths in children under five. Ramkisoon, Coutsoudis, Coovadia, Mtembu, Hlazo and Smit (2006:318) stated that "contraception programs were found to prevent 28.6% more HIV positive births than the use of nevirapine for PMTCT". Figure 4.11 shows that the Free State reported a *CYPR* of 30% in 2006 while the benchmark was 40%. This leaves a lot of room for improvement. The *Choice on Termination of Pregnancy Act* (as amended) gives pregnant women the opportunity to prevent having unplanned children by means of safe and legal TOPs that are provided free of charge at public health facilities (Ramkisoon et al 2006:320). Table 4.6 reflects a *TOP rate* of 1% in terms of a benchmark of 2% in public health facilities during 2006. One may take this underperformance, as well as the evidence of Ramkisoon et al (2006:320) which stated that only 55% of the South African facilities authorised to provide TOP services were doing so in 2004/05, to demonstrate that the Free State may benefit from an in-depth assessment of their TOP services.

The Free State also underperformed in terms of the targets for the three HIV prevention indicators. The *nevirapine pregnant women coverage* was nearly 20% below the target of 85%, the *nevirapine baby coverage* was nearly 50% below the target of 85% and the *HIV test ANC rate* was 30% below the target of 90% (Figure 4.11). These figures are unacceptably low if one considers the magnitude of the HIV/AIDS pandemic in South Africa and in the Free State especially, where an estimated 51% of all deaths was attributed to HIV infection during 2006 (Day & Gray 2006:430). Because HIV positive women are more likely to develop anaemia, hypertension, syphilis, premature delivery, in utero growth retardation, tuberculosis, still births and miscarriages (Ramkisoon et al 2006:321), HIV testing during pregnancy is of crucial importance to mothers and babies.

Vitamin A deficiency has been associated with increased mother to child transmission of HIV in pregnant women and with increased mortality in HIV infected children (Hendricks, Eley & Bourne 2006:206). While the Free State DHIS reported a 36% *vitamin A 12-59 month coverage* (the target is 45%), the Free State *measles 1st dose coverage* of 88% in 2006 was very close to the target of 90% (Figure 4.11).

Although the Free State coverage by preventive interventions improved since 2001, its performance in terms of targets/benchmarks is still sub-optimal. Drastic interventions are required to achieve targets/benchmarks for especially prevention of unplanned pregnancies and HIV in children.

4.2.2.3.3 Diagnostic output/coverage evaluation

The researcher conducted diagnostic output evaluations (in terms of the targets and benchmarks displayed in Annexure 4) in order to identify those districts, programmes and services that were in need of support.

Table 4.6 Free State 2006 diagnostic output/coverage evaluation by district

Free State Districts (5)	Target population		Output/coverage indicators (%)							Number on track values	Number critical values
			Prevent unplanned pregnancies		Prevent HIV in babies			Prevent childhood diseases			
	Population under five years	Live births estimated	Couple year protection rate (B 40)	Termination of pregnancy rate (B 2)	Nevirapine pregnant women coverage (B 85)	Nevirapine baby coverage (B 85)	HIV test antenatal care rate (T 90)	Vitamin A 12-59 months coverage (T 45)	Measles 1st dose coverage (T 90)		
Fezile Dabi	53,043	11,316	35	1.9	68	38	77	41	85	2	3
Lejweleputswa	68,110	11,538	27	1.0	56	27	44	34	107	0	5
Motheo	80,716	18,070	29	1.0	67	47	65	34	81	0	6
T Mofutsanyane	83,585	18,276	32	0.7	78	38	55	36	85	0	4
Xhariep	13,081	2,605	31	0.0	73	50	71	40	96	1	3
Free State	**298,535**	**61,805**	**30**	**1.0**	**68**	**38**	**60**	**36**	**89**	0	3
Critical values			2	2	3	5	4	2	3	3	21
On track values			1	1	0	0	0	0	1	9%	60%

* B indicates benchmark and T indicates target

Table 4.6 displays the colour-coded 2006 DHIS values for the seven selected public health facility output/coverage indicators in the five Free State districts, which resulted in the evaluation of 35 district indicator values. Although the provincial indicator values are included in the yellow coloured cells in Table 4.6 to provide a complete picture, they were not included in the analysis because the purpose of this part of the analysis was to describe the performance of the five districts.

In order to evaluate the performance of each of the five districts in terms of the seven selected indicators, the number of on track (green-coloured) values and the number of critical (red-coloured) values were counted horizontally and displayed in the two grey columns to the right of Table 4.6.

In order to evaluate which of the seven selected services or interventions (represented by each of the seven indicators) were performing well and those for which additional support was needed, the number of on track and critical values were counted vertically and displayed in the two grey rows at the bottom of Table 4.6.

The following conclusions were drawn from the public health facility indicators in Table 4.6:

- The 2006 values for the seven selected output/coverage indicators were inequitably distributed between the five districts.
- The number on track values for each of the five districts ranged from 0/7 (zero out of seven or 0%) to 2/7 (two out of seven or 29%) and the critical values ranged from 3/7 (43%) to 6/7 (86%).
- The Free State as a province was not on track with any of the seven indicators that were selected for measuring the outputs/coverage by interventions/services designed to reduce the *U5MR*. In addition to this, 3/7 (43%) of the indicators for the province showed critical values.
- The number on track district values for each indicator ranged from 0/5 (0%) to 1/5 (20%) while the number of critical district values ranged from 2/5 (40%) to 5/5 (100%).
- Each of the five districts reported a critical value for the indicator *nevirapine baby coverage*. The district values ranged from 27% to 50%, with a provincial average of 38%, while the target is 85%.
- Fezile Dabi showed the highest number of on track values namely 2/7(29%), and Motheo showed critical values of 6/7 (86%).
- Only 3/35 (9%) of the 35 district indicator values were on track, and 21/35 (60%) of the values were critical.

The best and poorest performing districts (in terms of the selected output/coverage indicators) are displayed in Table 4.6. To identify best practices and shortcomings at service delivery levels, the DHIS pivot tables were used to drill down to display the same indicators for each sub-district.

Table 4.7 displays the colour-coded 2006 Free State DHIS values for the seven selected public health care facility output/coverage indicators in the 20 Free State sub-districts. This resulted in the evaluation of 140 sub-district indicator values. Although the district and provincial indicator values are displayed in the yellow cells in Table 4.7 to provide a complete provincial picture, these were not included in the analysis because the purpose of this analysis was to assess and describe the performance of the 20 sub-districts.

In order to evaluate the performance of the 20 sub-districts in terms of the seven selected indicators, the researcher counted the number of on track (green-coloured) values and the number of critical (red -coloured) values horizontally and displayed them in the two grey columns to the right of Table 4.7.

Table 4.7 Free State 2006 diagnostic output/coverage evaluation by sub-district

Free State Sub-districts (20)	Target population		Output/coverage indicators (%)							Number on track values	Number critical values
			Prevent unplanned pregnancies		Prevent HIV in babies			Prevent childhood diseases			
	Population under five years	Live births estimated	Couple year protection rate (B 40)	Termination of pregnancy rate (B 2)	Nevirapine pregnant women coverage (B 85)	Nevirapine baby coverage (B 85)	HIV test antenatal care rate (T 90)	Vitamin A 12-59 months coverage (T 45)	Measles 1st dose coverage (T 90)		
Mafube	7,516	1,604	36	0.1	77	43	77	35	79	1	4
Metsimaholo	12,885	2,749	31	7.6	78	34	64	42	90	0	2
Moqhaka	18,526	3,952	38	0	61	54	111	40	78	1	4
Ngwathe	14,116	3,012	34	0.1	68	14	48	44	93	1	4
Fezile Dabi	**53,043**	**11,316**	**35**	**1.9**	**68**	**38**	**77**	**41**	**85**	**2**	**3**
Masilonyana	6,625	1,122	26	0	46	19	46	30	121	0	6
Matjhabeng	39,832	6,748	29	1.7	60	30	47	32	109	0	5
Nala	10,849	1,838	21	0	67	17	22	34	107	0	6
Tokologo	3,898	660	29	0	24	54	45	37	102	0	5
Tswelopele	6,906	1,170	25	0	38	8	57	44	87	1	5
Lejweleputswa	**68,110**	**11,538**	**27**	**1.0**	**56**	**27**	**44**	**34**	**107**	**0**	**5**
Mangaung	70,596	15,805	29	1.1	70	46	66	34	82	0	5
Mantsopa	6,912	1,546	25	0	37	63	61	42	75	0	6
Naledi	3,208	719	31	0	26	189	45	31	75	0	5
Motheo	**80,716**	**18,070**	**29**	**1.0**	**67**	**47**	**65**	**34**	**81**	**0**	**6**
Dihlabeng	14,734	3,222	34	0.2	66	40	73	35	86	0	4
Maluti a Phofung	41,265	9,023	33	1.4	88	38	48	43	91	1	2
Nketoana	7,140	1,561	33	0	89	56	77	29	75	1	4
Phumelela	6,480	1,416	31	0	43	20	64	28	65	0	6
Setsoto	13,966	3,053	26	0	69	28	47	24	80	0	7
T Mofutsanyane	**83,585**	**18,276**	**32**	**0.7**	**78**	**38**	**55**	**36**	**85**	**0**	**4**
Kopanong	5,116	1,019	33	0.1	69	42	59	43	104	0	4
Letsemeng	4,610	918	26	0	74	74	78	33	75	0	4
Mohokare	3,355	668	36	0	74	51	80	45	112	2	2
Xhariep	**13,081**	**2,605**	**31**	**0**	**73**	**50**	**71**	**40**	**96**	**1**	**3**
Free State	**298,535**	**61,805**	**30**	**1.0**	**68**	**38**	**60**	**36**	**89**	**0**	**3**
Critical values			**9**	**16**	**13**	**18**	**15**	**10**	**9**	**8**	**90**
On track values			**3**	**0**	**2**	**0**	**0**	**3**	**0**	**6%**	**64%**

* B indicates benchmark and T indicates target

In order to evaluate which of the seven selected services or interventions (represented by each of the seven indicators respectively) were performing well and those for which support was needed, the researcher counted the number of on track and critical values vertically and displayed them in the two grey rows at the bottom of Table 4.7.

The following conclusions were reached on the basis of the Free State public health care facility indicator values displayed in Table 4.7:

- There were huge inequities in 2006 among the 20 sub-district values for the seven selected output/coverage indicators.
- The number of on track values for each of the sub-districts ranged from 0/7 (zero out of 7) (0%) to 2/7 (29%), and the critical values ranged from 2/7 (29%) to 7/7 (100%).
- The number of on track values for each of the indicators ranged from 0/20 (0%) to 3/20 (15%), and the critical values for these indicators ranged from 9/20 (45%) to 18/20 (90%).
- The sub-district values for *nevirapine baby coverage* had 18/20 (90%) critical values and the reported values ranged from 8% to 189% (this value needs to be validated from facility level upwards), while the target was 85%.
- The sub-district with the highest number of on track values was Mohokare with 2/7 (29%) of the indicator values on track and the sub-district with the highest number of critical values was Sesotho with 7/7 (100%) critical values.
- Only 8 (6%) of the 140 sub-district values were on track during 2006, and 90/140 (64%) of the sub-districts reported critical values.

The findings from the output evaluations emphasised that Free State managers need to intervene urgently to prevent unplanned pregnancies, the infection of children with HIV and childhood diseases in general.

4.2.2.4 Process and input evaluation

Processes are the activities, interactions or interventions that constitute the inputs which are applied to meet specific needs and to achieve specific results. The purpose of process evaluations is to determine how well health care services are being accepted and used by communities in specific geographical areas (Katzenellenbogen et al 1997:149; WHO 2001a:6; WHO 2003b:12). The researcher conducted process evaluations to measure the acceptability and utilisation of health care facilities for specific priority *U5MR*-related services and interventions.

Priority inputs into the HCS include finance, human resources and health care facilities. The purpose of input evaluations is to determine whether health care resources are available, accessible and equitably distributed in those geographical areas where they are needed (Heavens 1999:14, 48; Katzenellenbogen et al 1997:149; WHO 2001a:6; WHO 2003b:12). Because the DHIS does not contain financial and human resource data, the focus of the input evaluation was directed towards those health care facilities that provide specific priority *U5MR*-

related services and interventions. Input evaluations were conducted to measure the availability and accessibility of facilities that provided ANC, those where deliveries were conducted, hospitals where caesarean sections were performed and the *born before arrival (BBA) rate* (which provides an indication of the accessibility and availability of transport for women in labour).

Because coverage and/or utilisation of the same interventions were used as proxies to measure the availability, accessibility, acceptability and the utilisation of facilities and services, the process and input evaluations were conducted and described simultaneously.

4.2.2.4.1 Formative process and input evaluation

The researcher conducted formative process and input evaluations to measure the progress of the Free State province in terms of availability, accessibility, acceptability and the utilisation of *U5MR*-related services from 2001 to 2006.

In order to determine whether the DHIS data was suitable for formative process and input evaluations of *U5MR*-related health care services during these years, the researcher reviewed the relevant available raw data (Table 4.8) and the values of selected indicators (Table 4.9). Because she was unable to locate any direct or specific data about the availability and accessibility of facilities that provide ANC, delivery and caesarean section services, the researcher was unable compare the DHIS values of the selected proxy indicators with other sources.

Table 4.8 Raw data from 2001 to 2006 used for calculating process and input indicators in the District Health Information System

Year	ANC 1st visits	Caesarean sections	Deliveries in facility	DTP-Hib 1st doses
2001	55,497	6,033	44,296	46,851
2002	55,695	6,969	44,785	44,461
2003	55,286	7,125	46,384	48,349
2004	58,971	8,126	50,379	52,616
2005	63,735	7,966	52,388	59,526
2006	65,309	8,917	50,854	58,902

Table 4.8 displays the raw data for ANC 1st visits, caesarean sections, deliveries conducted in public health care facilities and DTP-Hib 1st doses administered. This data has been available in the DHIS since 2001and appeared to be consistent.

Indicator values for *caesarean section rate*, *delivery in facility rate, ANC coverage* and *DTP-Hib 1st dose coverage* were available in the DHIS (Table 4.9) and appeared to be consistent for the years 2001 to 2006.

Table 4.9 Free State 2001 to 2006 formative process and input evaluation

Year	Caesarean section rate	Born before arrival rate	Delivery in facility rate	Antenatal care coverage	DTP-Hib 1st dose coverage
2001	14		66	77	83
2002	16		68	79	84
2003	15		72	80	72
2004	16		79	86	98
2005	15	4	82	93	106
2006	18	9	80	96	103

The Free State province *ANC coverage* increased from 77% in 2001 to 96% in 2006 (Table 4.9). These indicator values compared well with the 91% *ANC coverage* published in Day and Gray (2006:492).

The *delivery in facility rate* increased from 66% in 2001 to 82% in 2005, with a slightly lower value of 80% in 2006 and the *caesarean section rate* also increased from 14% in 2001 to 18% in 2006. While births assisted by trained health personnel increased from 88% in 1998 to 91.9% in 2003 (Day & Gray 2006:492), the DHIS value for *delivery in facility rate* 72% in 2003.

The *DTP-Hib 1st dose coverage* also increased from 83% in 2001 to 103% in 2006, with a lower value of 72% (which has to be validated) in 2003 (Table 4.9).

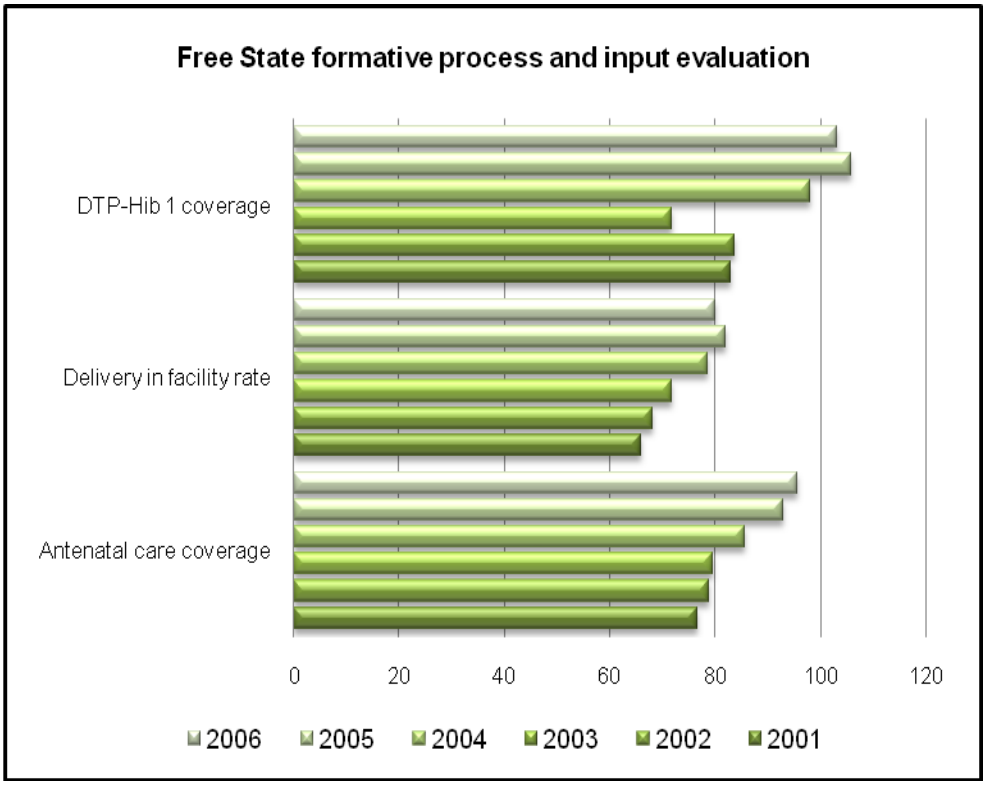


Figure 4.12 Free State 2001 to 2006 formative process and input evaluation

Using the DHIS values from Table 4.9, Figure 4.12 shows a gradual improvement in the *ANC coverage*, the *DTP-Hib 1st dose coverage* and the *delivery in facility rate*. This is indicative of a gradual improvement of services (or of an improvement in routine data management) in the Free State since 2001.

Four of the five indicators selected for process and input evaluations had DHIS values that dated from 2001 and were therefore accepted as suitable for formative evaluation. The *BBA rate* was only available for 2006 and could therefore not be used for formative evaluation. Formative evaluations indicated that availability, accessibility, acceptability and utilization of facilities and services by pregnant women increased from 2001 to 2006. But how was the Free State province performing in terms of national targets and benchmarks by the end of this period?

4.2.2.4.2 Summative process and input evaluation

Summative 2006 process and input evaluations were conducted in terms of targets or benchmarks in order to determine whether PHC facilities, ANC and delivery services and hospitals performing caesarean sections were available, accessible, acceptable and utilised by women in the Free State.

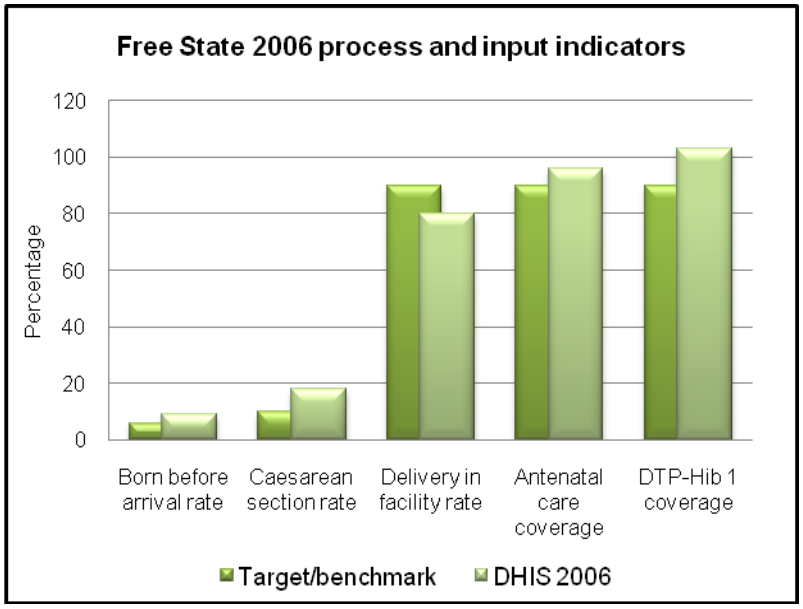


Figure 4.13 Free State 2006 process and input evaluation in relation to targets or benchmarks

Figure 4.13 shows that the Free State exceeded the targets of 90% for both *ANC coverage* and *DTP-Hib 1st dose coverage*. From this data it was inferred that PHC facilities were available, accessible and acceptable to Free State women during 2006.

In spite of the increase from 66% in 2001 to 80% in 2006 (Table 4.9 and Figure 4.13), the Free State did not achieve the target of 90% for *delivery in facility rate* by 2006. This may indicate that the public health facilities that were providing delivery services in the Free State were insufficiently available, accessible and acceptable to women in labour during 2006. The 2006 *BBA rate* (9%) cannot be used for formative input evaluation, but it contributes to the impression that delivery facilities were not available and/or accessible. Although the situation could have improved, the high Free

State *facility MMR*, *facility SBR* and *facility NNMR* (Figures 4.5, 4.6 and 4.7) warrant an assessment of all potential contributory factors including the availability of transport.

4.2.2.4.3 Diagnostic process and input evaluation

Table 4.10 and Table 3.2 show that the Free State had 112 mobile clinics, 230 clinics, 9 CHCs, 24 district hospitals, 5 regional hospitals and 1 tertiary hospital in 2006. The questions are whether these facilities were adequate and sufficient for the requirements of local health care consumers, and whether or not they were equitably distributed so that they met the needs of all the communities in the Free State.

Diagnostic process and input evaluations were conducted to determine the degree of equity in availability, accessibility and acceptability, as well as in the utilisation of health care facilities and specific *U5MR*-related services in the five districts and 20 sub-districts of the Free State.

Table 4.10 Free State 2006 diagnostic process and input evaluation by district

Free State Districts (5)	Demographic data				Health care facilities					Inputs and processes (%) (available, accessible, acceptable & use)					Number on track values	Number critical values
	Total population	Population under five years	Population under one year	Live births estimated	Mobiles	Clinics	Community Health Centres	District hospitals	Hospital beds	Caesarean section rate (B 10)	Born before arrival rate (B 6)	Delivery in facility rate (B 90)	Antenatal care coverage (B 90)	DTP-Hib 1st dose coverage (T 90)		
Fezile Dabi	514,568	53,043	10,881	11,316	25	33	4	4+*1	536	16	8	75	83	95	2	2
Lejweleputswa	759,748	68,110	11,094	11,538	25	45	1	5+*1	735	16	11	94	119	125	2	1
Motheo	786,001	80,716	17,375	18,070	20	69	2	4+*2	1,825	24	6	78	94	95	2	1
T Mofutsanyane	765,464	83,585	17,573	18,276	21	66	1	8+*2	862	15	11	78	91	101	1	2
Xhariep	132,934	13,081	2,505	2,605	21	17	1	3	80	0.3	18	66	95	108	1	3
Free State	**2,958,715**	**298,535**	**59,428**	**61,805**	**112**	**230**	**9**	**24+*6**	**4,038**	**18**	**9**	**80**	**96**	**103**	**2**	**1**
Critical values										**1**	**3**	**4**	**1**	**0**	**8**	**9**
On track values										**3**	**1**	**1**	**1**	**2**	**32%**	**36%**

* indicates regional or tertiary hospital

-- B indicates benchmark and T indicates target

Table 4.10 displays the population figures, the number of health care facilities and the colour-coded 2006 values for the five selected public health care facility process and input indicators in the five Free State districts. Taken together, this data enables the evaluation of 25 district indicator values. Although the provincial values are displayed in the yellow cells to provide a comprehensive overview, these values were not included in the analysis because the purpose of this part of the analysis was to assess and describe the performance of the five districts.

As was the case with the previous diagnostic evaluations, the number of on track (green – coloured) values and the number of critical (red -coloured) values were counted horizontally and

displayed in the two grey columns to the right of Table 4.10. This enabled an evaluation of the performance of the five districts in terms of the five selected indicators.

To evaluate which of the five selected services or interventions (represented by each of the five indicators) were performing well and those for which support and remediation were needed, the researcher counted the number of on track and critical values vertically and displayed them in the two grey rows at the bottom of Table 4.10.

The public health facility indicator values that are displayed in Table 4.10 enable the following conclusions to be drawn:

- Although there were inequities between the five districts for the five selected process and input indicators during 2006, they appeared to be less than those reflected by the impact, outcome and output indicators.
- While on track values for the five districts ranged from 1 out of 5 (1/5) (20%) to 2/5 (40%), the critical values ranged from 1/5 (20%) to 3/5 (60%).
- The number of on track values for each indicator ranged from 1/5 (20%) to 3/5 (60%) and the critical values for each indicator ranged from 0/5 (0%) to 4/5 (80%).
- The Free State province was on track for 2/ 5 (40%) process and input indicators and in fact exceeded the target for *DTP-Hib 1st dose coverage* by 13% (This was the only selected study indicator with 0 critical values at the district level).
- *Delivery in facility rate* is a MDG indicator for which the South African benchmark is 90%. The *delivery in facility rate* for the Free State as a province was 80% during 2006, with values ranging from 66% in Xhariep to 94% in Lejweleputshwa.
- The *BBA rate* had 3/5 (60%) critical values, with a provincial average of 9% and district values that ranged from 6% to 18%.
- The low *delivery in facility rate* (66%) and the high *BBA rate* (18%) in Xhariep provides a clear indication that the needs of the Xhariep community were not met in terms of the approximately 2,600 deliveries (Table 4.10) that should have been conducted in the district.
- Eight of the 25 (32%) district indicator values were on track and 9/25 (36%) of the process and input indicator values were critical.

One may infer from the 2006 Free State province *DTP-Hib 1st dose coverage* that ranged from 95% to 125% as well as from the *ANC coverage* that ranged from 83% to 119% in the five districts, that PHC services in the Free State were fairly available, accessible, acceptable and utilised. In spite of this, only one district met the target for the *delivery in facility rate*. While Xhariep reported critical values for the *delivery in facility rate*, the *caesarean section rate* and the *BBA rate*, 3/5 (60%) of the districts reported critical values for the *BBA rate*.

Although the Free State as a province showed a critical value for only one of the five selected process and input indicators, these facilities and services did not seem to be equitably distributed among the populations of the different districts and further assessment was necessary.

Table 4.11 Free State 2006 diagnostic process and input evaluation by sub-district

Free State Sub-districts (20)	Demographic data				Health care facilities					Inputs and processes (%) (available, accessible, acceptable & use)					Number on track values	Number critical values
	Total population	Population under five years	Population under one year	Live births estimated	Mobiles	Clinics	Community Health Centres	District hospitals	Hospital beds	Caesarean section rate (B 10)	Born before arrival rate (B 6)	Delivery in facility rate (B 90)	Antenatal care coverage (B 90)	DTP-Hib 1st dose coverage (T 90)		
Mafube	64,395	7,516	1,542	1,604	5	8		1	29	14	9	66	64	82	1	3
Metsimaholo	129,541	12,885	2,643	2,749	4	7	1	1	82	22	7	83	87	106	0	0
Moqhaka	187,541	18,526	3,800	3,952	9	8	2	* 1	340	17	7	81	83	83	1	2
Ngwathe	133,091	14,116	2,896	3,012	7	10	1	2	85	9	12	65	88	108	1	2
Fezile Dabi	**514,568**	**53,043**	**10,881**	**11,316**	**25**	**33**	**4**	**4+*1**	**536**	**16**	**8**	**75**	**83**	**95**	**2**	**2**
Masilonyana	74,787	6,625	1,079	1,122	5	9		1	55	17	7	34	149	162	1	1
Matjhabeng	470,424	39,832	6,488	6,748	7	25	1	2+*1	613	18	10	128	122	127	1	0
Nala	114,384	10,849	1,767	1,838	6	4		1	38	8	11	59	116	121	0	2
Tokologo	37,865	3,898	635	660	3	4				0	7	2	97	95	2	2
Tswelopele	62,288	6,906	1,125	1,170	4	3		1	29	0	23	62	87	104	0	3
Lejweleputswa	**759,748**	**68,110**	**11,094**	**11,538**	**25**	**45**	**1**	**5+*1**	**735**	**16**	**11**	**94**	**119**	**125**	**2**	**1**
Mangaung	696,431	70,596	15,197	15,805	12	57	2	3+*2	1,637	25	6	85	97	95	3	0
Mantsopa	59,878	6,912	1,487	1,546	6	9		1	44	3	13	46	76	89	0	4
Naledi	29,692	3,208	691	719	2	3				0	67	0	81	101	0	4
Motheo	**786,001**	**80,716**	**17,375**	**18,070**	**20**	**69**	**2**	**4+*2**	**1,825**	**24**	**6**	**78**	**94**	**95**	**2**	**1**
Dihlabeng	136,773	14,734	3,098	3,222	4	9		1+*1	220	28	9	79	81	108	0	2
Maluti a Phofung	379,218	41,265	8,676	9,023	7	32		2+*1	442	13	10	86	99	106	2	0
Nketoana	65,391	7,140	1,501	1,561	3	6		1	45	15	15	72	93	91	1	2
Phumelela	53,980	6,480	1,362	1,416	2	7		1	27	0	18	31	58	81	0	5
Setsoto	130,102	13,966	2,936	3,053	5	12	1	3	128	10	14	78	90	94	1	2
T Mofutsanyane	**765,464**	**83,585**	**17,573**	**18,276**	**21**	**66**	**1**	**8+*2**	**862**	**15**	**11**	**78**	**91**	**101**	**1**	**2**
Kopanong	55,030	5,116	980	1,019	9	9		1	32	1	22	67	104	111	0	3
Letsemeng	42,221	4,610	883	918	6	4	1			0	20	15	69	83	0	5
Mohokare	35,683	3,355	642	668	6	4		2	48	0	14	133	115	137	0	2
Xhariep	**132,934**	**13,081**	**2,505**	**2,605**	**21**	**17**	**1**	**3**	**80**	**0.3**	**18**	**66**	**95**	**108**	**1**	**3**
Free State	**2,958,715**	**298,535**	**59,428**	**61,805**	**112**	**230**	**9**	**24+*6**	**4,038**	**18**	**9**	**80**	**96**	**103**	**2**	**1**
Critical values										**8**	**11**	**14**	**7**	**4**	**14**	**44**
On track values										**8**	**1**	**0**	**3**	**2**	**14%**	**44%**

* indicates regional or tertiary hospital

-- B indicates benchmark and T indicates target

Table 4.11 displays colour coded values for the five public health care facility process and input indicators in the 20 sub-districts of the Free State. These values enabled a total of 100 sub-district indicator values to be evaluated. Demographic data on the total population, the under-one and under-five population and the estimated live births are also displayed, together with the number of public health care facilities (distinguished according to type) in each sub-district.

In order to evaluate the performance of each of the 20 sub-districts in terms of the selected indicators, the researcher once again counted the number on track values and the number of critical values horizontally and displayed them in the two grey columns to the right of Table 4.11.

In order to evaluate which of the five selected services or interventions (represented by each of the five indicators) were performing well and those for which support and remediation were needed, the researcher counted the number of on track and critical values vertically and displayed them in the two grey rows at the bottom of Table 4.11.

The researcher was subsequently able to draw the following conclusions and make the following inferences on the basis of the public health facility indicator values that are displayed in Table 4.11:

- The 2006 values for the five selected process and input indicators were inequitably distributed among the 20 sub-districts.
- The on track values for each of the 20 sub-districts ranged from 0/5 (0%) to 3/5 (60%), the critical values ranged from 0/5 (0%) in four sub-districts to 5/5 (100%) in two sub-districts.
- While the number of on track values for each indicator ranged from 0/20 (0%) to 8/20 (40%), the critical values ranged from 4/20 (20%) to 14/20 (70%). The indicator that reflected the poorest performance was *the delivery in facility rate* with 14/20 (70%) critical values. To deliver in a facility is one of the most basic services South African women have a right to. It is also a MDG indicator because deliveries conducted by skilled health care staff is one of the most effective means of preventing deaths in mothers and babies.
- The *BBA rate* is a cause for concern because only one sub-district reported an on track value. The *BBA rate* ranged from 6% to 67% in the sub-districts, with a provincial average of 9%.
- The sub-district with the highest number of on track values was Mangaung. The two sub-districts with 100% critical values were Phumelela and Letsemeng.
- Only 14% of the 100 sub-district indicator values were on track and 44% reflected critical values.

- Three sub-districts (Tokologo in Lejweleputswa, Naledi in Motheo and Letsemeng in Xhariep) did not have any hospitals in 2006 (Table 4.11). Two of these sub-districts (Tokologo and Naledi) did not have CHCs either. While sub-districts without hospitals are not an unusual feature of the South African rural HCS, 24-hour emergency and delivery services are a fundamental and necessary part of basic public health care. Such emergency and delivery services should, by definition, be accessible and equitably distributed, and should be within five km or two hours travel time for 90% of the population (SA 2006b:4, 7). The absence of 24-hour delivery services in these two sub-districts enabled only 14 (2%) of the 660 estimated deliveries to take place in health care facilities in Tokologo, while the same deficiency enabled only 2 (0.3%) of the estimated 719 deliveries in Naledi to take place in health care facilities. Because there was no hospital at Letsemeng and only one CHC, only 152 (15%) of the expected 918 deliveries took place in health care facilities in this sub-district. The fact that three of the sub-districts had no hospitals and could therefore not offer 24-hour delivery services should be taken into consideration when *U5MR*-related data such as *facility mortality rates* and *caesarean section rates* are interpreted because data such as this is obtained mainly from hospitals.

The diagnostic evaluation of the sub-district data clearly showed that *U5MR*-related health care facilities and services were not equitably distributed in the Free State during 2006. While 14/20 (70%) of the sub-districts seem to have experienced critical shortcomings in delivery services, critical *BBA rates* were identified for 11/20 (55%) of them in 2006. The diagnostic evaluation, together with facility data obtained from the DHIS, clearly indicated that some of the most critical input shortcomings that managers in the Free State have to address are a lack of facilities that provide delivery services and/or a lack of transport to get women in labour to health facilities in time.

4.2.2.5 Using the District Health Information System data for evidence-based management decisions

The researcher used the input and process indicators from the poorest performing district in the Free State to illustrate how the DHIS data may be used to improve the performance of the HCS to meet the needs of communities where the biggest possible impact can be made in the shortest possible period of time.

Xhariep reported a *delivery in facility rate* of 66%, a *BBA rate* of 18% and a *caesarean section rate* of 0.3% for 2006. Although the most important effect of underperformance in terms of delivery services in Xhariep is reflected in the small percentage of deliveries that take place in

health care facilities, inadequate facilities also have a negative effect on neighbouring districts and on the mortality rates of the whole Free State as a province.

There is an urgent need for provincial managers and the district management team of Xhariep to find effective, efficient and sustainable ways of strengthening the HCS to meet the needs of the Xhariep population for delivery services and caesarean sections. The following questions can guide managers in making evidence-based decisions aimed at meeting the needs of the Xhariep population and to reduce the strain that Xhariep's lack of facilities place on other districts.

- Where are the root causes of underperformance in this particular district?
- Where should the district management team start to address shortcomings?
- If one considers the lack of resources, what urgent measures can the district management team take to make delivery and caesarean section services available and to reduce the *BBA rate* as quickly as possible?
- How will the district management team know whether the measures they implement are producing the envisaged results?

Local managers are in the best possible position to interpret their data and to decide which plans and measures will be most effective and efficient. Some examples of how existing data could be used for these purposes are set out below.

Table 4.12 Xhariep 2006 process and input evaluation

Sub-district	Demographic data				Health care facilities					Inputs and processes (%) (available, accessible, acceptable & use)				
	Total population	Population under five years	Population under one year	Live births estimated	Mobiles	Clinics	Community Health Centres	District hospitals	Hospital beds	Caesarean section rate (B 10)	Born before arrival rate (B 6)	Delivery in facility rate (B 90)	Antenatal care coverage (B 90)	DTP-Hib 1st dose coverage (T 90)
Kopanong	55,030	5,116	980	1,019	9	9		1	32	1	22	67	104	111
Letsemeng	42,221	4,610	883	918	6	4	1			0	20	15	69	83
Mohokare	35,683	3,355	642	668	6	4		2	48	0	14	133	115	137
Xhariep	**132,934**	**13,081**	**2,505**	**2,605**	**21**	**17**	**1**	**3**	**80**	**0.3**	**18**	**66**	**95**	**108**

* B indicates benchmark and T indicates target

The 2006 DHIS data (Table 4.12) revealed that, although Kopanong had a *delivery in facility rate* of 67% and the highest *BBA rate* (22%) in Xhariep, the *DTP-Hib 1st dose coverage* of 111% and an *ANC coverage* of 104% indicated an adequate number of PHC facilities in the sub-district. In Kopanong the low *delivery in facility rate* and the high *BBA rate* emphasise the need for additional 24-hour delivery services. The extremely low *caesarean section rate* of 1% further

indicates that hospital services are insufficient to support complicated pregnancies and deliveries.

Although Letsemeng was the sub-district with the lowest *delivery in facility rate* (15%), it also revealed critical values for *DTP-Hib 1st dose coverage* (83%) and *ANC coverage* (69%), in addition to a *BBA rate* of 20% and no caesarean sections performed during 2006. This indicates that Letsemeng, with its six mobiles, four clinics, one CHC and no district hospital, had insufficient PHC and delivery facilities to meet the needs of the population of 42,221 in 2006.

Mohokare, with its six mobiles, four clinics and two district hospitals, was the best performing sub-district in Xhariep during 2006 in terms of meeting the PHC and delivery service needs of their community. The Mohokare *ANC coverage* was 115%, the *DTP-Hib 1st dose coverage* was 137% and the *delivery in facility rate was 133%.* It is worth noting, however, that in spite of having two district hospitals, no caesarean sections were performed in Mohokare during 2006 (Table 4.12).

It was described earlier in this text that population-based indicator values that exceed 100% may reflect incorrect data reported by facilities, incorrect StatsSA under-five population estimates and/or the cross-boundary influx of patients from neighbouring districts or even from the Eastern Cape, the Northern Cape or Lesotho.

From the above examples it can be inferred that the facilities that provide 24-hour delivery services are inadequate in Kopanong and even more so in Letsemeng.

DHIS data can also be useful for drawing the attention of health care managers to facilities where improvement of delivery services may be most effective and efficient.

Table 4.13 Xhariep 2006 deliveries in facility

Sub-district	Facility	Deliveries 2006
Kopanong	Diamond Hospital	664
	Lephoi Clinic	15
	Mamello	4
	N Mandela Clinic	8
	Phekolong Clinic	4
	Phillippolis	2
	Sehularo Tau	5
Letsemeng	Bophelong CHC	110
	Ethembeni	11
	Jacobsdal Clinic	21
	Luckhoff	2
	Oppermansgr Clinic	1
Mohokare	Embekweni Hospital	527
	Stoffel Coetzee Hospital	386
Xariep total		**1760**

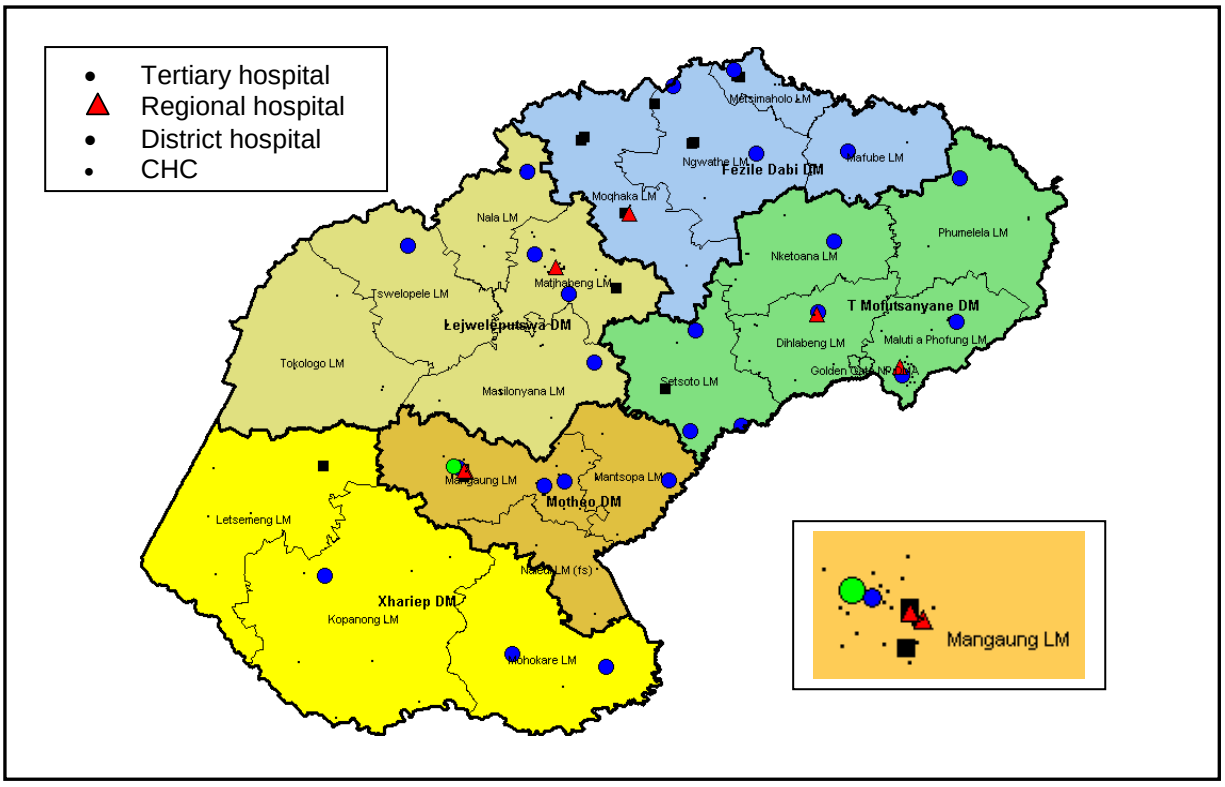
Table 4.13 shows the number of deliveries that were conducted at public health care facilities in the different sub-districts of Xhariep during 2006. This data can help managers to identify the places where the most urgent need for 24-hour facilities (that provide non-hospital delivery services) exists. In Kopanong, for example, the Lephoi clinic conducted the highest number of deliveries (15). This is followed by N. Mandela clinic, which conducted eight deliveries, while the Bophelong CHC in Letsemang which conducted 110 deliveries, followed by the Jacobsdal clinic which conducted 21 deliveries. The need for 24-hour delivery services is probably the highest in these areas and provision of delivery services in these facilities should contribute towards meeting the needs of these particular communities.

Although DHIS data (Table 4.12) indicates that Xhariep had three hospitals in 2006, the *caesarean section rate* for this district was a critical 0.3%. By making use of the DHIS pivot tables to drill down to facility level, it was found that only six caesarean sections were conducted in one of the hospitals (Diamond hospital) in 2006 (Table 4.14). Because the DHIS contains no financial and human resource data, it was impossible to elucidate the reasons why this hospital and others were not conducting caesarean sections. The DHIS data about the number of hospital beds in each of these hospitals as well as the data about the number of caesarean sections performed in 2006 (Table 4.14) indicate that none of the Xhariep hospitals met the requirements of the *National Department of Health's Facility Definitions* (SA 2006a:10) for being classified as a hospital.

Table 4.14 Xhariep 2006 hospital beds, deliveries and caesarean sections

Sub-district	Hospital	Hospital beds	Deliveries 2006	Caesarean sections 2006
Kopanong	Diamond hospital (Jagersfontein)	32	664	6
Mohokare	Embekweni hospital (Zastron)	25	527	0
	Stoffel Coetzee hospital (Smithfield)	23	386	0
Xhariep Total		**80**	**1577**	**6**

Although local management teams are usually aware of the location of health facilities, the basic GIS functionality of the DHIS permits managers to take the location of facilities into consideration when they make evidence-based decisions. Xhariep district with its three sub-districts is coloured yellow in Figure 4.12. Since Diamond district hospital in Kopanong is close to the Letsemeng boundary, this hospital most probably provides delivery and other services for many Letsemeng patients. Although the 133% *delivery in facility rate* in Mohokare (Table 4.12) may indicate some cross-boundary patients from Kopanong and Naledi (in the Motheo district), both the Embekweni and Stoffel Coetzee district hospitals are close to the Eastern Cape and Lesotho boundaries and so may attract patients from those areas as well.



(DHIS 2007)

Figure 4.14 Free State province map of the districts, sub-districts and public health facilities providing delivery services

The information that is extracted from the DHIS, together with maps that indicate where facilities are situated, can assist managers to make evidence-based decisions about meeting the needs of communities in the most effective and efficient way. A management team might, for example, argue that the two hospitals in Mokohare should be re-classified as CHCs and that Diamond hospital in Kopanong should be upgraded to conduct more caesarean sections since it was the only hospital that reported caesarean sections during 2006. Since Diamond hospital also conducted the highest number of deliveries in 2006, it would logically be the hospital in which the highest number of caesarean sections would be needed. The six caesarean sections that were reported by Diamond hospital in 2006 suggest that it possessed a fully functional theatre that might well be revived.

Although final decisions cannot be taken on the basis of DHIS data alone, data from the DHIS can help managers to identify deficiencies and shortcomings, the potential causes of underperformance and possible measures for addressing such shortcomings and deficiencies. Such data therefore also provides a starting point for further investigations and remedial action.

Explanations of how to conduct formative, summative and diagnostic evaluations in terms of impacts, outcomes, outputs, processes and inputs into the HCS are useful to health care managers because they provide examples of how DHIS data may be used to identify systemic needs and deficiencies. Before they can make informed decisions, managers need to be in possession of comprehensive periodic overviews of HCS achievements (in terms of impacts, outcomes, outputs, processes and inputs) so that they will be able to identify priority needs, draw up plans of action for addressing shortcomings and measure whether corrective strategies are successful.

4.3 SUMMARY

This chapter used tables, graphs and maps to present data that had been extracted from the DHIS. The purpose of this study was to determine whether the DHIS data could be used to conduct formative, summative and diagnostic evaluations on *U5MR*-related health care in the Free State and to explain how existing data could be used to support evidence-based decision-making from a results-based systems perspective.

Selected indicators were used to present the data about the impacts, outcomes, outputs, processes and inputs related to the *U5MR*. Pivot tables were used to drill down to district, sub-district and hospital levels to identify specific best practices, areas that were underperforming and shortcomings that might be contributing to the high *U5MR*. Thresholds based on national targets or benchmarks (developed with the support of experts) were used to colour-code indicators for clear diagnostic evaluations of progress towards achieving targets or benchmarks and for identifying inequities in districts, sub-districts and hospitals.

These investigations have confirmed that the DHIS contains a wealth of data and information that can be interpreted and used in numerous ways by service providers and managers (at different levels of the HCS) to support evidence-based management for reducing the *U5MR* in the Free State. Provincial managers can use DHIS data to identify the best and poorest performing districts while district and hospital management teams can identify the best and poorest performing sub-districts and hospitals, as well as the least successful health care programmes, services and interventions. Where insufficient data is available to support and inform decisions directly, the DHIS data can be used to identify those places, variables and initiatives for which additional data should be obtained.

While outputs in general seem to have improved, limited improvement in some impact and outcome indicator values was identified between 2001 and 2006. While increased coverage may well be indicative of improvement in health services and/or data management, it should be

noted that optimal data quality and optimal health service delivery are equally important for successful evidence-based health management.

The quality of DHIS data was found to be acceptable for the purposes of this study. During formative evaluation an attempt was made to compare DHIS data with survey findings that were obtained from literature. Although it is accepted that routine and survey data cannot be directly compared, the DHIS data was generally found to be in line with survey findings when taking into consideration that the DHIS only contains data about public health facilities.

It has been found that DHIS data can help managers to pursue evidence-based management to strengthen the HCS and so to reduce the *U5MR* and the incidence of HIV in children – especially because this data is available for the lower levels of the HCS. Such data enables managers to justify their decisions about where to allocate resources for increasing the coverage by specific interventions and it also enables them to monitor the progress after corrective strategies have been implemented.

The results of the formative, summative and diagnostic evaluations clearly indicated that the Free State was not on track in terms of the *U5MR* in 2006 and that several other outputs and processes were also not on track. One of the most frequently cited reasons for the poor performance of any system is a lack of resources and evidence has shown that there were critical shortages in Free State delivery services, especially in the Xhariep district. The fact that the DHIS does not contain human resource and financial data is a major limitation of the routine health information system because it does not permit measuring the influence of human resources and finance on utilisation, outputs and outcomes of the health care services that are provided.

The synthesis of findings, discussions, conclusions, limitations and recommendations are discussed in Chapter 5.

CHAPTER 5

SYNTHESIS OF FINDINGS, DISCUSSION, CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The previous chapter showed how the data (that had been extracted from the DHIS) was analysed and presented by making use of descriptive statistics. Because a large number of indicators were used for measuring impacts, outcomes, outputs, processes and inputs in terms of *U5MR*-related health care, the resultant conclusions and interpretations were summarised under each particular section in Chapter 4. The present chapter includes a summary of the research, as well as a synthesis of the research findings into an *U5MR*-related performance profile in order to fulfil the third objective of the study. Chapter 5 also presents a discussion of the study limitations and offers a variety of conclusions and recommendations.

5.2 SUMMARY OF RESEARCH

It is one of the axioms of the WHO that existing effective and affordable interventions can save the lives of many children. Inadequate health systems can, however, result in health inequities and poor health outcomes because they prevent the implementation of effective interventions where they are most needed. This happens, not because of a lack of money, skills or knowledge, but because health care managers fail to apply existing resources and personnel in those areas where needs and deficiencies are the highest. Failures in HCSs also impede the implementation of global health initiatives and the achievement of global health goals such as the MDGs (WHO 2006b: 2-5).

Although South Africa has committed itself to PHC, and although it has a DHS and a DHIS and has implemented several strategies to improve child health, the *U5MR* indicate that the country is not on track towards achieving the MDG on child mortality. The researcher's experience, together with information gathered from the literature review, make it quite clear that health care managers do not use the information that is available to them from the DHIS for evidence-based decision-making.

The overall aim of the study was to determine how health care managers could use existing DHIS data to strengthen the HCS and thereby reduce the *U5MR* in the Free State province by:

- Determining whether the data and indicators in the DHIS are appropriate for measuring equity and progress of the HCS in terms of *U5MR*-related PHC.

- Exploring how existing DHIS data can be used to assist managers in strengthening the HCS to reduce the *U5MR*.
- Developing an *U5MR*-related performance profile that will support managers in evidence-based decision-making and in monitoring progress towards reducing child mortality.

The researcher used the DHIS data that had been gathered from all the public health care facilities in the Free State for the years 2001 to 2006. She followed a quantitative, exploratory, descriptive research methodology in order to conduct evaluative health systems research. The research findings were then summarised and described from a results-based systems perspective.

A data extraction framework (Annexure 3) was used to extract and summarise all relevant data and information from the DHIS. This data was analysed with the use of the DHIS software and pivot tables and was presented visually by means of graphs, tables and maps. The researcher also introduced the colour coding of indicator values during diagnostic evaluation, in order to identify more easily the best-performing areas as well as those districts, sub-districts and hospitals in the Free State where additional support will be needed to achieve the *U5MR* MDG of 20 deaths per 1,000 live births.

Because of the large number of indicators that are used to measure child health equity (in terms of impact, outcomes, outputs, processes and inputs), the findings that relate to the first two study objectives were summarised under each relevant section in Chapter 4. It was found that although the DHIS does not contain calculated values for all the selected indicators, it contains most of the data that is necessary for identifying the achievements and deficiencies of the HCS with regard to *U5MR*-related health care.

Priority indicators were selected to develop a diagnostic *U5MR*-related performance profile that would enable managers to identify both the achievements and the deficiencies of the HCS achievements for each district, sub-district and hospital.

5.3 SYNTHESIS OF THE FINDINGS INTO AN UNDER-FIVE MORTALITY RATE-RELATED PERFORMANCE PROFILE

Priority study indicators and data were integrated into a diagnostic *U5MR*-related performance profile that was based on the study findings and on information from a variety of international and national reports and other sources. This comprehensive diagnostic performance profile, which contains priority indicators that reflect the Free State's *U5MR*-related performance with

regard to all the stages of the HCS (impact, outcome, output, process and input), was developed to:

- Provide managers with a "snapshot" overview of the Free State *U5MR*-related performance during 2006 by district, sub-district and hospital.
- Identify the best performing areas so that they can serve as an example (these on track indicator values are identified by their green colouration in the profile).
- Identify those areas where support is needed urgently (these critical indicator values are identified by their red colouration in the profile).
- Identify inequities in terms of HCS impacts, outcomes, outputs, processes and inputs.
- Identify those particular areas and services where the Free State HCS needs to be strengthened and empowered to reduce the *U5MR*.

The purpose in constructing the *U5MR*-related performance profile and in discussing its implications was not to prescribe specific interventions, but rather to demonstrate how existing data can be effectively used to initiate and support cycles of evidence-based health management processes that will strengthen the whole HCS. Because hospitals provide unique *U5MR*-related services, the researcher developed a hospital performance profile that complements the district and sub-district performance profiles by identifying those public hospitals in which the greatest possible impact can be made on the *U5MR* in the shortest possible period.

The 2006 Free State diagnostic *U5MR*-related performance profile consists of the following four tables:

- A summary of the raw Free State province *U5MR*-related data for 2006 (Table 5.1)
- A Free State diagnostic *U5MR*-related district performance profile for 2006 (Table 5.2)
- A Free State diagnostic *U5MR*-related sub-district performance profile for 2006 (Table 5.3)
- A Free State diagnostic *U5MR*-related hospital performance profile for 2006 (Table 5.4)

While the sheer amount of data that is presented in these tables may appear to be overwhelming, it should be kept in mind that health care providers, as well as health service and program managers at different levels of the HCS, have different M&E responsibilities and information needs. Managers should select only the information that they need from the total picture. But the very fact that they have all the information on hand will enable them to compare the achievements of different areas and to identify the possible effects of health care

deficiencies on neighbouring sub-districts, districts and on the province as a whole. If a similar performance profile were to be compiled each quarter in the same format, it will enable managers to determine the extent to which the interventions that they implemented have been successful over time.

These four performance profile tables are displayed as a unit or a single performance profile because they support the reasoning that follows, as well as the interpretation of the data that is displayed in each table.

Table 5.1 Free State 2006 raw data to clarify the under-five mortality rate-related health care context

Free State Districts (5) and Sub-districts (20)	Demographic data						Health care facilities					Raw data - priority activities and results												
	Total population	Population under five years	Population under one year	% population under five years	% population under one year	Live births estimated	Mobiles	Clinics	Community Health Centers	District Hospitals	Hospital beds	PHC headcount under five years	PHC headcount - total	Hospital separations under five years	Termination of pregnancies	Caesarean sections	Deliveries in facility	Deliveries to mothers under 18 years of age	Live births	Still births	Maternal deaths	Neonatal deaths	Inpatient deaths under one year	Inpatient deaths under five years
District data																								
Fezile Dabi	514,568	53,043	10,881	10.3	2.1	11,316	25	33	4	4 + *1	536	178,152	1,094,846	3,513	3,162	1,410	8,742	758	8,599	233	23	107	266	343
Lejweleputswa	759,748	68,110	11,094	9.0	1.5	11,538	25	45	1	5 + *1	735	180,848	1,177,528	4,567	1,683	1,791	11,155	862	11,036	344	41	153	534	653
Motheo	786,001	80,716	17,375	10.3	2.2	18,070	20	69	2	4 + *2	1,825	253,822	1,442,272	7,216	2,680	3,481	14,538	1,151	15,597	448	45	231	309	496
T Mofutsanyane	765,464	83,585	17,573	10.9	2.3	18,276	21	66	1	8 + *2	862	375,021	1,864,057	5,359	1,923	2,229	14,656	1,389	14,361	426	38	287	491	622
Xhariep	132,934	13,081	2,505	9.8	1.9	2,605	21	17	1	3	80	53,159	327,262	912	1	6	1,761	196	1,745	42	2	16	64	89
Free State	**2,958,715**	**298,535**	**59,428**	**10.1**	**2.0**	**61,805**	**112**	**230**	**9**	**24 + *6**	**4,038**	**1,041,002**	**5,905,965**	**21,567**	**9,449**	**8,917**	**50,852**	**4,356**	**51,338**	**1,493**	**149**	**794**	**1,664**	**2,203**
Sub-district data																								
Mafube	64,395	7,516	1,542	11.7	2.4	1,604	5	8		1	29	28,639	152,686	214	29	150	1,090	116	1,075	24	1	10	20	32
Metsimaholo	129,541	12,885	2,643	9.9	2.0	2,749	4	7	1	1	82	37,424	220,146	719	3,130	524	2,358	205	2,299	61	4	16	48	66
Moqhaka	187,541	18,526	3,800	9.9	2.0	3,952	9	8	2	* 1	340	64,088	444,892	2,196	0	559	3,287	259	3,241	113	14	66	172	205
Ngwathe	133,091	14,116	2,896	10.6	2.2	3,012	7	10	1	2	85	48,001	277,122	384	3	177	2,007	178	1,984	35	4	15	26	40
Fezile Dabi	**514,568**	**53,043**	**10,881**	**10.3**	**2.1**	**11,316**	**25**	**33**	**4**	**4 + *1**	**536**	**178,152**	**1,094,846**	**3,513**	**3,162**	**1,410**	**8,742**	**758**	**8,599**	**233**	**23**	**107**	**266**	**343**
Masilonyana	74,787	6,625	1,079	8.9	1.4	1,122	5	9		1	55	25,273	146,859	250	0	65	389	29	388	5	0	2	26	32
Matjhabeng	470,424	39,832	6,488	8.5	1.4	6,748	7	25	1	2 + *1	613	101,717	703,790	3,439	1,683	1,633	8,886	646	8,753	313	37	144	443	532
Nala	114,384	10,849	1,767	9.5	1.5	1,838	6	4		1	38	28,791	176,196	476	0	93	1,114	87	1,133	16	1	6	36	47
Tokologo	37,865	3,898	635	10.3	1.7	660	3	4				9,805	62,745	0	0	0	752	2	14	0	0		0	0
Tswelopele	62,288	6,906	1,125	11.1	1.8	1,170	4	3		1	29	15,262	87,938	402	0	0	14	98	748	10	3	1	29	42
Lejweleputswa	**759,748**	**68,110**	**11,094**	**9.0**	**1.5**	**11,538**	**25**	**45**	**1**	**5 + *1**	**735**	**180,848**	**1,177,528**	**4,567**	**1,683**	**1,791**	**11,155**	**862**	**11,036**	**344**	**41**	**153**	**534**	**653**
Mangaung	696,431	70,596	15,197	10.1	2.2	15,805	12	57	2	3 + *2	1,637	218,806	1,259,193	6,938	2,680	3,458	13,812	1,081	14,871	440	43	212	295	469
Mantsopa	59,878	6,912	1,487	11.5	2.5	1,546	6	9		1	44	23,108	104,371	278	0	23	726	70	724	8	2	19	14	27
Naledi	29,692	3,208	691	10.8	2.3	719	2	3				11,908	78,708	0	0	0	0	0	2	0	0	0	0	0
Motheo	**786,001**	**80,716**	**17,375**	**10.3**	**2.2**	**18,070**	**20**	**69**	**2**	**4 + *2**	**1,825**	**253,822**	**1,442,272**	**7,216**	**2,680**	**3,481**	**14,538**	**1,151**	**15,597**	**448**	**45**	**231**	**309**	**496**
Dihlabeng	136,773	14,734	3,098	10.8	2.3	3,222	4	9		1 + *1	220	55,583	285,498	1,368	10	735	2,633	262	2,569	98	12	80	146	180
Maluti a Phofung	379,218	41,265	8,676	10.9	2.3	9,023	7	32		2 + *1	442	233,303	1,065,854	2,528	1,913	1,074	7,962	671	7,786	241	19	178	220	272
Nketoana	65,391	7,140	1,501	10.9	2.3	1,561	3	6		1	45	25,392	131,505	338	0	174	1,152	127	1,131	31	1	8	23	25
Phumelela	53,980	6,480	1,362	12.0	2.5	1,416	2	7		1	27	15,634	107,766	182	0	0	450	67	440	12	1	1	18	23
Setsoto	130,102	13,966	2,936	10.7	2.3	3,053	5	12	1	3	128	45,109	273,434	943	0	246	2,459	262	2,435	44	5	20	84	122
T Mofutsanyane	**765,464**	**83,585**	**17,573**	**10.9**	**2.3**	**18,276**	**21**	**66**	**1**	**8 + *2**	**862**	**375,021**	**1,864,057**	**5,359**	**1,923**	**2,229**	**14,656**	**1,389**	**14,361**	**426**	**38**	**287**	**491**	**622**
Kopanong	55,030	5,116	980	9.3	1.8	1,019	9	9		1	32	23,772	158,362	358	1	6	702	94	690	18	0	5	20	35
Letsemeng	42,221	4,610	883	10.9	2.1	918	6	4	1			15,014	92,220	0	0	0	913	8	152	5	0	0	0	0
Mohokare	35,683	3,355	642	9.4	1.8	668	6	4		2	48	14,373	76,680	554	0	0	146	94	903	19	2	11	44	54
Xhariep	**132,934**	**13,081**	**2,505**	**9.8**	**1.9**	**2,605**	**21**	**17**	**1**	**3**	**80**	**53,159**	**327,262**	**912**	**1**	**6**	**1,761**	**196**	**1,745**	**42**	**2**	**16**	**64**	**89**
Free State	**2,958,715**	**298,535**	**59,428**	**10.1**	**2.0**	**61,805**	**112**	**230**	**9**	**24 + *6**	**4,038**	**1,041,002**	**5,905,965**	**21,567**	**9,449**	**8,917**	**50,852**	**4,356**	**51,338**	**1,493**	**149**	**794**	**1,664**	**2,203**

* indicates regional or tertiary hospital

Table 5.2 Free State 2006 diagnostic under-five mortality rate-related district performance profile

Free State Districts (5)	Target population		Results of under-five mortality rate-related health care													Output/coverage indicators (%)							Inputs and processes (%) (available, accessible, acceptable & use)						
			Impact as public health facility deaths per * estimated live births					Outcomes as % of live births or children admitted for specific conditions in public health care facilities								Prevent unplanned pregnancies		Prevent HIV in babies			Prevent childhood diseases								
			*100,000	*1,000																									
	Population under five years	Live births estimated	Facility maternal mortality rate (T 100)	Facility perinatal mortality rate (B 15)	Facility neonatal mortality rate (B 8)	Facility infant mortality rate (B 15)	Facility under-five mortality rate (B 18)	Facility under-five mortality rate (%) (B 12)	Facility low birth weight rate (%) (B 8)	Facility still birth rate (%) (B 1.8)	Facility neonatal mortality rate (%) (B 1)	Malnutrition facility case fatality rate (%) (B 15)	Pneumonia facility case fatality rate (%) (B 5)	Diarrhoea facility case fatality rate (%) (B 5)	Number on track values	Number critical values	Couple year protection rate (B 40)	Termination of pregnancy rate (B 2)	Nevirapine pregnant women coverage (B 85)	Nevirapine baby coverage (B 85)	HIV test antenatal care rate (T 90)	Vitamin A 12-59 month coverage (T 45)	Measles 1st dose coverage (T 90)	Caesarean section rate (B 10)	Born before arrival rate (B 6)	Delivery in facility rate (B 90)	Antenatal care coverage (B 90)	DTP-Hib 1 coverage (T 90)	Number on track values	Number critical values
Fezile Dabi	53,043	11,316	203	25	9	24	30	15	15	2.6	1.2	23	8	8	0	7	35	1.9	68	38	77	41	85	16	8	75	83	95	4	5
Lejweleputswa	68,110	11,538	355	40	13	46	57	23	14	3.0	1.3	21	9	9	0	10	27	1.0	56	27	44	34	107	16	11	94	119	125	2	6
Motheo	80,716	18,070	249	34	13	17	27	10	12	2.8	1.4	25	9	10	1	8	29	1.0	67	47	65	34	81	24	6	78	94	95	2	7
T Mofutsanyane	83,585	18,276	208	31	16	27	34	20	13	2.9	1.9	22	19	10	0	12	32	0.7	78	38	55	36	85	15	11	78	91	101	1	6
Xhariep	13,081	2,605	77	22	6	25	34	15	15	2.4	0.9	34	13	10	2	6	31	0.0	73	50	71	40	96	0.3	18	66	95	108	2	6
Free State	**298,535**	**61,805**	241	32	13	27	36	16	13	2.8	1.5	24	11	10	0	10	30	1.0	68	38	60	36	89	18	9	80	96	103	2	4
Critical values			4	3	3	4	5	2	4	4	4	5	2	3	3	43	2	2	3	5	4	2	3	1	3	4	1	0	11	30
On track values			1	0	1	0	0	1	0	0	0	0	0	0	5%	72%	1	1	0	0	0	0	1	3	1	1	1	2	18%	50%

* B indicates benchmark and T indicates target

Table 5.3 Free State 2006 diagnostic under-five mortality rate-related sub-district performance profile

Free State Sub-districts (20)	Target population		Results of under-five mortality rate-related health care													Output/coverage indicators (%)							Inputs and processes (%) (available, accessible, acceptable & use)						
			Impact as public health facility deaths per * estimated live births					Outcomes as % of live births or children admitted for specific conditions in public health care facilities								Prevent unplanned pregnancies		Prevent HIV in babies			Prevent childhood diseases								
			*100,000	*1,000																									
	Population under five years	Live births estimated	Facility maternal mortality rate (T 100)	Facility perinatal mortality rate (B 15)	Facility neonatal mortality rate (B 8)	Facility infant mortality rate (B 15)	Facility under-five mortality rate (B 18)	Facility under-five mortality rate (%) (B 12)	Facility low birth weight rate (%) (B 8)	Facility still birth rate (%) (B 1.8)	Facility neonatal mortality rate (%) (B 1)	Malnutrition facility case fatality rate (%) (B 15)	Pneumonia facility case fatality rate (%) (B 5)	Diarrhoea facility case fatality rate (%) (B 5)	Number on track values	Number critical values	Couple year protection rate (B 40)	Termination of pregnancy rate (B 2)	Nevirapine pregnant women coverage (B 85)	Nevirapine baby coverage (B 85)	HIV test antenatal care rate (T 90)	Vitamin A 12-59 month coverage (T 45)	Measles 1st dose coverage (T 90)	Caesarean section rate (B 10)	Born before arrival rate (B 6)	Delivery in facility rate (B 90)	Antenatal care coverage (B 90)	DTP-Hib 1 coverage (T 90)	Number on track values	Number critical values
Mafube	7,516	1,604	62	20	6	12	20	25	14	2.2	0.9	38	9	10	2	3	36	0.1	77	43	77	35	79	14	9	66	64	82	2	7
Metsimaholo	12,885	2,749	146	28	6	17	24	15	14	2.6	0.7	7	10	19	2	4	31	7.6	78	34	64	42	90	22	7	83	87	106	0	2
Moqhaka	18,526	3,952	354	31	17	44	52	14	15	3.4	2.0	40	5	7	1	9	38	0	61	54	111	40	78	17	7	81	83	83	2	6
Ngwathe	14,116	3,012	133	16	5	9	13	19	12	1.7	0.7	8	16	4	5	3	34	0.1	68	14	48	44	93	9	12	65	88	108	2	6
Fezile Dabi	**53,043**	**11,316**	203	25	9	24	30	15	15	2.6	1.2	23	8	8	0	7	35	1.9	68	38	77	41	85	16	8	75	83	95	4	5
Masilonyana	6,625	1,122	0	4	2	23	29	23	20	1.3	0.5	0	8	43	2	5	26	0	46	19	46	30	121	17	7	34	149	162	1	7
Matjhabeng	39,832	6,748	548	63	21	66	79	25	14	3.5	1.6	20	8	8	0	10	29	1.7	60	30	47	32	109	18	10	128	122	127	1	5
Nala	10,849	1,838	54	12	3	20	26	19	15	1.4	0.5	8	11	6	6	4	21	0	67	17	22	34	107	8	11	59	116	121	0	8
Tokologo	3,898	660	0	0	0	0	0	0	0	0	0	0	0	0	0	0	29	0	24	54	45	37	102	0	7	2	97	95	2	7
Tswelopele	6,906	1,170	256	9	1	25	36	17	9	1.3	0.1	59	12	15	2	7	25	0	38	8	57	44	87	0	23	62	87	104	1	8
Lejweleputswa	**68,110**	**11,538**	355	40	13	46	57	23	14	3.0	1.3	21	9	9	0	10	27	1.0	56	27	44	34	107	16	11	94	119	125	2	6
Mangaung	70,596	15,805	272	38	13	19	30	10	13	2.9	1.4	26	9	10	1	9	29	1.1	70	46	66	34	82	25	6	85	97	95	3	5
Mantsopa	6,912	1,546	129	15	12	9	17	18	8	1.1	2.6	11	5	16	6	4	25	0	37	63	61	42	75	3	13	46	76	89	0	10
Naledi	3,208	719	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0	26	189	45	31	75	0	67	0	81	101	0	9
Motheo	**80,716**	**18,070**	249	34	13	17	27	10	12	2.8	1.4	25	9	10	1	8	29	1.0	67	47	65	34	81	24	6	78	94	95	2	7
Dihlabeng	14,734	3,222	372	52	25	45	56	26	14	3.7	3.0	18	17	13	0	11	34	0.2	66	40	73	35	86	28	9	79	81	108	0	6
Maluti a Phofung	41,265	9,023	211	31	20	24	30	17	12	3.0	2.2	31	27	12	0	11	33	1.4	88	38	48	43	91	13	10	86	99	106	3	2
Nketoana	7,140	1,561	64	24	5	15	16	11	12	2.7	0.7	7	3	8	6	2	33	0	89	56	77	29	75	15	15	72	93	91	2	6
Phumelela	6,480	1,416	71	9	1	13	16	23	13	2.7	0.2	33	14	0	2	5	31	0	43	20	64	28	65	0	18	31	58	81	0	11
Setsoto	13,966	3,053	164	21	7	28	40	25	14	1.8	0.8	18	11	9	1	6	26	0	69	28	47	24	80	10	14	78	90	94	1	9
T Mofutsanyane	**83,585**	**18,276**	208	31	16	27	34	20	13	2.9	1.9	22	19	10	0	12	32	0.7	78	38	55	36	85	15	11	78	91	101	1	6
Kopanong	5,116	1,019	0	23	5	20	34	20	12	2.5	0.7	18	14	13	0	5	33	0.1	69	42	59	43	104	1	22	67	104	111	0	7
Letsemeng	4,610	918	0	5	0	0	0	0	0	3.3	0	0	0	0	0	1	26	0	74	74	78	33	75	0	20	15	69	83	0	9
Mohokare	3,355	668	300	43	16	66	81	13	15	2.1	1.2	40	13	9	0	9	36	0	74	51	80	45	112	0	14	133	115	137	2	4
Xhariep	**13,081**	**2,605**	77	22	6	25	34	15	15	2.4	0.9	34	13	10	2	6	31	0	73	50	71	40	96	0.3	18	66	95	108	2	6
Free State	**298,535**	**61,805**	241	32	13	27	36	16	13	2.8	1.5	24	11	10	0	10	30	1.0	68	38	60	36	89	18	9	80	96	103	2	4
Critical values			8	7	7	8	11	12	13	10	7	8	9	8	36	108	9	16	13	18	15	10	9	8	11	14	7	4	22	134
On track values			4	3	4	2	4	2	2	4	2	4	3	2	15%	45%	3	0	2	0	0	3	0	8	1	0	3	2	9%	56%

* B indicates benchmark and T indicates target

Table 5.4 Free State 2006 under-five mortality rate-related hospital performance profile

District	Sub-district	Hospitals (30)	Usable beds	Raw data - prevent unplanned pregnancies				Raw data - outcomes and outputs							Outcomes as % of live births or admissions							Nevirapine newborn coverage (B95) (**process indicator**)	Born before arrival rate (B 6) (**Input indicator**)	Number on track values	Number critical values
				Family planning interventions	Sterilisation - female	Sterilisation - male	Termination of pregnancies	Caesarean sections	Total births	Still births	Maternal deaths	Neonatal deaths	Inpatient deaths under one year	Inpatient deaths under five years	Facility under-five mortality rate (%) (B 12)	Facility low birth weight rate (%) (B 8)	Facility still birth rate (%) (B 1.8)	Facility neonatal mortality rate (%) (B 1)	Malnutrition facility case fatality rate (%) (B15)	Pneumonia facility case fatality rate (%) (B 5)	Diarrhoea facility case fatality rate (%) (B 5)				
Fezile Dabi	Mafube	Mafube (Frankfort)	29	0	78	0	29	150	1,091	24	1	10	20	32	25	14	2.2	0.9	38	9	10	90	8	0	4
	Metsimaholo	Metsimaholo (Sasolburg)	82	341	73	2	1290	524	2,356	61	4	16	48	66	15	14	2.6	0.7	7	10	19	99	6	3	3
	Moqhaka	Boitumelo (Regional)	340	1,401	131	2	0	559	2,647	106	14	66	172	205	14	17	4.0	2.6	40	5	7	100	6	3	4
	Ngwathe	Parys	50	205	18	0	3	62	1,120	15	1	9	12	21	27	9	1.3	0.8	8	19	2	100	12	5	3
		Tokollo (Heilbron)	35	852	17	0	0	115	877	20	3	6	14	19	14	16	2.3	0.7	9	15	6	82	11	2	4
Lejweleputswa	Masilonyana	Winburg	55	406	11	0	0	65	393	5	0	2	26	32	23	20	1.3	0.5	0	8	43	118	7	2	3
	Matjhabeng	Bongani (Regional) (Goldfields)	450	0	265	0	378	1237	3,779	236	30	72	269	299	22	22	6.2	2.0	4	0	2	85	2	1	5
		Katleho (Virginia)	78	1,864	0	0	269	0	1,825	30	2	19	88	125	31	14	1.6	1.1	42	42	18	100	14	1	6
		Thusanong (Odendaalsrus)	85	2,538	45	0	100	396	2,269	37	5	53	86	108	28	10	1.6	2.4	20	17	10	97	13	2	5
	Nala	Nala (Bothaville)	38	1,188	1	0	0	93	1,145	16	1	6	36	47	19	15	1.4	0.5	8	11	6	102	11	4	4
	Tswelopele	Mohau (Hoopstad)	29	1,019	0	0	0	0	758	10	3	1	29	42	17	9	1.3	0.1	59	12	15	150	23	2	5
Motheo	Mangaung	Botshabelo	135	631	101	0	280	427	1,529	52	9	19	88	126	18	12	3.4	1.3	24	9	12	108	1	0	4
		Dr JS Moroka	180	380	0	0	657	321	977	25	5	23	50	81	19	13	2.6	2.4	35	13	22	0	3	1	8
		National District	124	8,099	136	0	1692	135	2,234	19	0	5	18	20	4	11	0.9	0.2	0	5	0	100	17	2	1
		Pelonomi (Regional)	710	742	449	0	0	2204	4,211	268	18	129	119	207	7	27	6.4	3.3	25	9	8	435	2	2	4
		Universitas (Tertiary)	632	1,815	140	49	51	317	566	47	11	36	20	35	9	65	8.3	6.9	0	0	0	106	1	1	3
	Mantsopa	Mantsopa (Ladybrand)	44	0	13	0	0	23	725	8	2	19	14	27	18	9	1.1	2.6	11	5	16	130	13	3	4
T Mofutsanyane	Dihlabeng	Dihlabeng (Regional) (Bethlehem)	135	560	87	2	10	363	624	50	12	69	110	124	32	28	8.0	12.0	38	30	16	104	0	0	7
		Phekolong	85	2,151	61	0	0	372	2,025	47	0	11	36	56	18	10	2.3	0.6	11	12	13	131	12	1	4
	Maluti a Phofung	Elizabeth Ross	111	5,526	0	0	1908	0	3,182	81	6	7	20	27	17	11	2.5	0.2	25	21	13	91	4	1	5
		Mofumahadi Manapo Mopeli (Regional)	260	0	256	4	0	867	1,786	108	11	145	161	201	17	27	6.0	8.6	29	30	15	126	5	1	7
		Thebe (Harrismith)	71	1,238	45	4	0	207	1,256	34	2	26	39	44	22	11	2.7	2.1	35	23	5	104	16	1	6
	Nketoana	Nketoana (Reitz)	45	1,175	93	0	0	174	1,153	31	1	8	23	25	11	12	2.7	0.7	7	3	8	99	15	4	3
	Phumelela	Phumelela (Vrede)	27	151	3	0	0	0	449	12	1	1	18	23	23	14	2.7	0.2	33	14	0	100	17	1	6
	Setsoto	Itemoheng (Senekal)	55	1,049	14	0	0	117	966	18	3	5	21	35	28	14	1.9	0.5	7	5	2	104	15	3	3
		John Daniel Newberry (Clocolan)	42	379	34	0	0	47	527	11	1	4	28	43	27	16	2.1	0.8	30	22	10	88	13	0	7
		Phuthuloha (Ficksburg)	31	1,020	9	0	0	82	979	14	1	11	35	44	22	13	1.4	1.1	33	9	12	100	12	2	5
Xhariep	Kopanong	Diamond/Diamant (Jagersfontein)	32	817	2	0	1	6	668	17	0	5	20	35	20	13	2.5	0.8	18	14	13	97	22	1	6
	Mohokare	Embekweni (Zastron)	25	934	0	0	0	0	531	9	1	2	22	32	25	13	1.7	0.4	68	10	13	96	9	2	4
		Stoffel Coetzee (Smithfield)	23	444	0	0	0	0	391	10	1	9	22	22	8	18	2.6	2.4	24	16	4	100	19	3	6
Free State 2006 hospital totals and averages			**4,038**	**36,925**	**2,082**	**63**	**6,668**	**8,863**	**43,039**	**1,421**	**149**	**794**	**1,664**	**2,203**	**16**	**16**	**3.3**	**1.9**	**24**	**11**	**10**	**104**	**9**		
Number critical values															21	22	15.0	11.0	16	16	16	5	17	54	139
Number on track values															4	3	7	5	5	5	5	12	7	20%	51%

* B indicates benchmark

5.3.1 Free State 2006 raw data to clarify the under-five mortality rate-related health care context

Table 5.1, which contains a summary of the raw Free State data for *U5MR*-related activities and achievements during 2006, offers managers an overview of the demographic data as well as the number of facilities and activities that took place in the province and in the various district and sub-districts. The total population, the under-five population and the estimated number of live births provide a rough indication of the need for child health care and delivery services in each of the districts and sub-districts. The raw data indicates that approximately one million of the nearly six million people (18 %) who made use of PHC services in the Free State during 2006 were under the five years of age, and that 21,567 children under five were admitted to hospitals where 2,203 (10%) of those who were admitted died. The estimated number of live births for the Free State in 2006 was 61,805 and 51,338 live births (83 % of the estimated number) were reported in the DHIS. The Free State also reported 1,493 still births and 9,449 TOPs during the same year.

Table 5.1 sets out the number of public health care facilities according to type, district and sub-district and provides an indication of the extent to which the province provided specific services or interventions in these geographical areas. The fact that three sub-districts, namely Tokologo, Naledi and Letsemeng did not have CHCs or district hospitals (indicated in orange), is a major cause for concern. It implies that no 24-hour delivery and emergency services were available to communities in these sub-districts during 2006. The other 11 sub-districts in the Free State that did not have CHCs (also indicated in orange in the column under CHCs) had hospitals that provided the necessary services after clinic hours.

5.3.2 Free State 2006 diagnostic under-five mortality rate-related district performance profile

Table 5.2 displays the diagnostic *U5MR*-related district performance profile which contains indicator values for the Free State as a province, as well as for each of the five districts. This section of the profile displays the results of under-five-related health care services by means of impact and outcome indicators, while the output, process and input indicators in Table 5.2 provide an indication of possible reasons for the high *U5MR*.

Detailed guidelines on how to interpret and use this data for evidence-based management purposes was provided in Chapter 4. Readers should refer to section 4.2.2.2.3 for diagnostic impact and outcome evaluations, to section 4.2.2.3.3 for diagnostic output/coverage evaluations, and section 4.2.2.4.3 for diagnostic process and input evaluations.

The diagnostic *U5MR*-related district performance profile may, for example, help managers to:

- Identify the best performing district in terms of results (impacts and outcomes) of under five health care services (these districts may be used as examples of best practice in the Free State).
- Identify the poorest performing districts so that support can be diverted to those districts where the greatest possible impact could be made.
- Identify potential reasons for the high *U5MR*, as well as the specific services and interventions (in terms of outputs, processes and inputs) that are needed to reduce the *U5MR*. The following examples serve to clarify this point.
    - The *DTP-Hib 1st dose coverage*, which ranges from 95% to 125% in the five districts, indicates that PHC facilities and services are available and accessible in each of the districts.
    - The *ANC coverage*, which ranges from 83% to 119% in the same districts, indicates that although PHC facilities appear to have been available and accessible, some of them may not have provided ANC services. The lower values may also indicate that pregnant women did not use these facilities for ANC to the same extent that they used them for immunisation services. The managers concerned may consider conducting an ANC acceptability assessment and/or health education on the importance of ANC in those districts where the *ANC coverage* is below 95%.
    - The *delivery in facility rate*, which ranges from 66% to 94%, shows that four out of the five Free State districts demonstrated critical shortcomings in terms of availability, accessibility and/or acceptability of delivery services. Three districts also reported critical values for *BBA rates*. This indicates that inadequate transport to health facilities may have been one of the reasons for the low *delivery in facility rate*. Since Table 5.1 clearly indicates shortcomings in terms of facilities that provide delivery services, the relevant managers may consider conducting both emergency medical service (ambulance) and health care facility assessments in areas where the *BBA rate* exceeds 10% and/or where the *delivery in facility rate* is below 90%.
    - Since four of the five districts show critical values for *HIV test ANC rate*, three show critical values for *nevirapine pregnant women coverage* and all five districts show critical values for *nevirapine baby coverage*, an improvement of PMTCT services is crucial for reducing the *U5MR*.

Table 5.2 can also be used to identify many other HCS and health care intervention achievements and shortcomings. The performance profile offers managers a variety of opportunities to identify and address the deficiencies that prevent a reduction in the *U5MR* in the Free State province.

The 2006 diagnostic *U5MR*-related district performance profile highlights major inequities among the five Free State health districts. The fact that only 5% of the indicator values for measuring the results of *U5MR*-related health care and only 18% of the indicator values for measuring possible reasons for underperformance were on track (green), is a cause for concern. Drastic interventions are required in each of these districts if the *U5MR* in the province is to be reduced.

If managers apply the principles that have been discussed in this text for identifying good and poor performances in the districts to sub-district data, they will enable managers to identify the particular sub-districts in which poor performance contributes to a high *U5MR* and *U5MR*-related inequities in the districts.

5.3.3 Free State 2006 diagnostic under-five mortality rate-related sub-district performance profile

Table 5.3 displays the diagnostic *U5MR*-related performance profile in terms of DHIS indicator values for each of the 20 sub-districts in the Free State province.

Detailed guidelines on how to interpret and utilise such diagnostic evaluations at the sub-district level were provided in Chapter 4. Readers should refer to section 4.2.2.2.3 and Table 4.4 for diagnostic sub-district impact and outcome evaluations, to section 4.2.2.3.3 and Table 4.7 for diagnostic output/coverage evaluations and to section 4.2.2.4.3 and Table 4.11 for diagnostic process and input evaluations.

The 2006 diagnostic *U5MR*-related sub-district performance profile highlights enormous inequities in terms of impact, outcome, output, process and input indicators among the 20 sub-districts of the Free State. Only 15% of the impact and outcome indicator values were on track and 44% were critical. In terms of outputs, processes and inputs, 9% of the indicator values were on track and 56% were critical. Drastic interventions are also required in each of the 20 sub-districts if the *U5MR* in the province is to be reduced.

Because South Africa has a comprehensive HCS, hospital data was included in the formative, summative and diagnostic evaluations that were conducted for the districts and sub-districts. But, since most of the deaths in public health facilities occur in hospitals, most of the impact and

outcome indicator data in the DHIS is reported by hospitals. By identifying the best and poorest performing hospitals in terms of specific *U5MR*-related services, managers can also single out those hospitals that can serve as an example to others and those that are in need of urgent support and resources. The researcher therefore synthesised the relevant raw data and indicator values into the Free State diagnostic *U5MR*-related hospital profile so that health managers would be able to recognise possible problems at a glance.

5.3.4 Free State 2006 diagnostic under-five mortality rate-related hospital performance profile

The hospital performance profile (Table 5.4) displays the 2006 colour-coded values for the nine relevant selected hospital indicators in the 30 Free State public hospitals. This provides a total of 270 hospital indicator values for evaluation.

In order to evaluate the performance of the 30 hospitals in terms of the nine selected indicators, the researcher counted the number of on track (green-coloured) values and the number of critical (red coloured) values horizontally and displayed them in the two grey-coloured columns to the right of Table 5.4.

To evaluate which of the nine selected services or interventions, represented by each of the nine indicators, were performing well and those for which additional support and resources were needed, the researcher counted the number of on track and critical values vertically and displayed them in the two grey rows at the bottom of Table 5.4.

Any analysis and interpretation of the hospital data should take into account that different *facility U5MR* can be expected at district, regional and tertiary hospitals, because mortality increases at higher levels of care (if one makes the assumption that very sick children are being referred upwards). Hospital indicators should therefore be analysed in terms of hospitals as a whole, as well as each respective level of hospital, if one wishes to obtain an accurate overview of the care that is being offered to children under five years of age. The same thresholds were used for colour-coding the indicators for all hospitals and the findings for the five regional hospitals and the one tertiary level hospital were displayed together with district hospital data in order to provide a comprehensive overview. The higher level hospitals, however, were identified in blue-coloured rows (Table 5.4) to enable a comparison to be made between the findings for hospitals of the same levels.

While it is accepted that many causes of deaths that occur in hospitals originate outside the hospitals themselves, an assessment of the performance of individual hospitals can help to identify possible health care deficiencies in these hospitals, as well as in individual surrounding

areas. The performance profile clearly indicates major health care outcome inequities that contribute to the high *U5MR* in the Free State province.

Because this study focused on principles and examples of how data can be interpreted and used for the comprehensive evaluation and strengthening of health care services and the HCS, the researcher did not include discussions for each indicator in each hospital. Since the information that is contained in the performance profile can be viewed in many different ways, it stands to reason that local health care managers (who are familiar with the geographical areas, the real needs of the communities and with the status of other sub-systems), will be best equipped to interpret and use the data to support evidence-based management decisions.

The DHIS hospital performance profile may, for example, assist managers to:

- Identify hospitals where data management should be improved so that evidence-based decision-making can be placed on a sound footing.
- Identify the poorest performing hospitals for further assessment and immediate support. Dihlabeng regional hospital, for example, reported no on track and seven critical indicator values for 2006. Dihlabeng appears to be the poorest performing regional hospital in the Free State Province – or at least a hospital where ineffective data management has created the impression of drastic underperformance.
- Determine why five hospitals failed to administer nevirapine to all the newborn babies of HIV positive women who delivered in these hospitals, or (alternatively) failed to report on all the cases in which they had administered nevirapine.
- Identify which interventions needed to be prioritised in specific hospitals and/or the areas that these hospitals served. A high *facility LBWR* may, for example, help managers to identify those areas in which ANC services need to be improved.
- Identify those hospitals that have not implemented (or else have failed to report on) interventions to prevent unplanned pregnancies. Thus, for example, only six of the 30 hospitals (20%) performed male sterilisations, and four of the hospitals (13%) either did not provide (or else failed to report) instances of oral or intramuscular contraception. Many of these hospitals did not provide (or failed to report on) TOP services.
- Identify those hospitals (seven out of the 30 hospitals) (23%) that need to be evaluated for reclassification as CHCs because they do not perform surgery under general anaesthesia (measured using caesarean sections as a proxy) on a regular basis.
- Identify those hospitals (seventeen of the 30 hospitals) (57%) with critically high *BBA rates* where improved transport may contribute towards reducing the high percentage of still births and neonatal deaths.

The following findings were made on the basis of the public hospital performance overview that is set out in Table 5.4:

- There were huge inequities between the 24 district hospitals, as well as between the five regional and one tertiary hospital, for the nine selected indicators during 2006.
- The on track values for each of the 24 district hospitals ranged from 0/9 (0%) to 5/9 (56%) and from 0/9 (0%) to 3/9 (33%) for the six higher level hospitals. The critical values for district hospitals ranged from 1/9 (11%) to 8/9 (89%) and the critical values for higher level hospitals ranged from 4/9 (44%) to 8/9 (89%).
- The number of on track values for each of the nine indicators in the 30 hospitals ranged from 3/30 (10%) to 12/30 (40%) while the critical values ranged from 5/30 (17%) to 22/30 (73%).
- While only 59/270 (20%) of the indicator values for the 30 hospitals were reported to be on track during 2006, 139/270 (51%) were critical.

The diagnostic *U5MR*-related hospital performance profile shows inequities among district hospitals as well as among the higher level hospitals. Drastic intervention is also required in the public hospitals in the Free State if the *U5MR* is to be reduced.

One may argue from a results-based systems perspective that the *U5MR* in the Free State was high in 2006 because health care inputs and processes were inadequate (WHO 2003b:35-36). The *U5MR*-related performance profile assists managers to use existing data to identify those districts, sub-districts and hospitals where the *U5MR* was higher than the target or higher than the Free State average. It can also help managers to identify shortcomings in health care inputs and processes that may play a role in contributing to the high *U5MR* and to measure progress after corrective strategies, designed to strengthen the HCS, have been implemented.

5.4 CONCLUSIONS

Only decisions that are based on sound evidence could be expected to contribute towards reducing mortality in children under five years of age.

The Free State has accumulated a six-year volume of reasonable quality data for the public health care sector right down to facility level. Although the DHIS does not contain all the necessary indicators for measuring the impacts, outcomes, outputs, processes and inputs of *U5MR*-related health care, it does contain most of the data that one needs for calculating these indicators. An extensive investigation of the available DHIS data by province, district, sub-district and hospital confirmed that the DHIS can be used to help managers in strengthening the HCS

to reduce the *U5MR* in the Free State from a results-based perspective. In those cases where underperformance in terms of impact and outcomes were identified, output, process and input indicators could be used to identify potential HCS shortcomings. The DHIS data can be used by health managers to make evidence-based decisions. They can use the DHIS data to identify problem areas (down to facility level), target specific services and interventions in those areas where the greatest possible gains could be made in the shortest possible period and monitor progress after corrective strategies have been implemented.

Possible problems in the interpretation and use of the large data set were minimised by means of colour-coded ranges that were developed for each indicator with the assistance of experts. Priority data elements and indicators were used to develop a colour-coded performance profile consisting of four tables, so that all the stages of the system could be covered at a glance. These tables contain the raw data about the *U5MR*-related health care that is provided in the Free State and selected impact, outcome, output, process and input indicators that are displayed in terms of health districts, sub-districts and hospitals. It should be possible for health service and programme managers at all levels of the HCS to select the data that they specifically need from these profiles to identify the deficiencies that they need to address. If health managers receive such performance profiles on a quarterly basis, it will enable them to measure the success of their interventions and to observe whatever progress is being made towards meeting the targets.

Although the DHIS data is deficient in terms of quality and although the system only contains data for public health care facilities and for the total (insured and uninsured) population of each province, district and sub-district, the selected proxy indicators are able to provide managers with important information about the quality and impact of the child health care that is being provided to approximately 85% of the total Free State population. If managers use DHIS data effectively, the quality and completeness of the data will improve and the data will help them to identify and address problems as they arise. Information obtained in this way also places health managers in a position to monitor progress towards achieving the MDG for child mortality in the interim periods between population censuses and large surveys such as the *Demographic and Health Survey*, which is conducted every five years.

The absence of financial and human resource data in the DHIS (data that is essential for monitoring the effectiveness and efficiency of health care services) proved to be a serious impediment for evidence-based management from a results-based perspective.

5.5 RECOMMENDATIONS

The recommendations that flow from this study are applied to different aspects of the problems that have been identified in this research. There are recommendations about how to strengthen the DHIS and how health managers can utilise DHIS data for evidence-based management. There are also recommendations about how the Free State HCS can be strengthened and how actions and interventions on the part of health care services could reduce the *U5MR*. Finally, there are recommendations about how future research might extend investigations into how routine health information could be utilised for management and research purposes.

5.5.1 Recommendations for strengthening the District Health Information System

The following recommendations present examples of how the existing data can be used for strengthening the DHIS so that it will be in a position to support managers as they make evidence-based decisions aimed at reducing the *U5MR*.

- Re-classify all public health facilities in the Free State DHIS according to the standardised health facility definitions published by the NDoH (SA 2006a:5-11).
- Create proxy population-based impact indicators for auto-calculation in the DHIS. Such indicators will support the prioritisation of interventions in those areas where the largest number of people is likely to benefit or where the biggest and most cost-effective gains could be made.
- Incorporate the uninsured population into the DHIS per province, district and sub-district. This will enable the calculation of indicator values that use public health facility data as numerators and the public health care dependent population as denominators (rather than the total population, which is currently used as denominators).
- Because community-based (or non-health facility-based) health care forms a major component of public health care services, incorporate community based health care data into the DHIS.
- Include data elements and indicators that monitor basic human and financial resources together with the service delivery data in the DHIS.
- Improve the quality of DHIS data by optimising validation measures such as validation rules and indicators for identifying inconsistencies in the data.

5.5.2 Recommendations for improving the use of available District Health Information System data

- Improve the availability and accessibility of *U5MR*-related data elements and indicators for health managers at all levels of the HCS by:

- Developing pivot table sheets that reflect the priority data elements and indicators contained in the performance profiles developed during this study.
- Setting up the district, sub-district and hospital performance profiles as auto-reports in the DHIS. These will provide auto-calculated colour-coded indicators that will make it easier for health managers to monitor whatever progress is being made in the reduction of the *U5MR*.
- Creating opportunities for health managers to use available evidence and for sharing their learning experiences with one another. By doing this they will be able to determine whether the policies and strategies intended to reduce child mortality are being properly implemented and whether they are working or not.

  Examples of such opportunities could be:

  - The drawing up and provision of quarterly performance profiles for all health managers and other role players who are concerned with the reduction of the *U5MR*.
  - The organisation of quarterly workshops in which health managers will be able to compare their progress and to plan corrective strategies and interventions and to learn from each other.

- Develop the skills of managers so that they will be able to use DHIS data for making evidence-based decisions to achieve the most effective and efficient results.
- Use DHIS data to make managers accountable for acts, omissions, achievements and underperformance.

5.5.3 Recommendations for strengthening the Free State health care system and under-five mortality rate-related health services

The DHIS data shows that, while there is no shortage of PHC facilities in the Free State, there is a critical shortage of CHCs to provide 24-hour delivery services in the province. This difference between *ANC coverage* and *delivery in facility rate* may mean that delivery services are insufficient or that the available facilities were not utilised because they were inaccessible or in some way unacceptable to the women who might have used them. The following recommendations may assist in strengthening the Free State HCS:

- Ensure that 24-hour services (especially emergency and delivery services) are provided in at least one facility in each sub-district where no CHCs currently exist. Where a lack of resources makes it impossible to provide 24-hour services, professional nurses could be placed on call.

- Use the routine information that is available in the DHIS to identify:
    - The kind of in-service training which health care professionals and other cadres of health care staff need at specific facilities and/or in specific sub-districts or districts. A high *SBR* in a specific hospital may, for example, indicate that the ANC and delivery skills of staff in the hospital and in clinics in the catchment population of the hospital need to be assessed and that further training needs to be provided.
    - Whether and where community needs such as the unreliability or absence of transport might be the cause of high *BBA rates*.
    - The necessity for community health education. Where the *delivery in facility rate* is low, a community might need to be educated about the dangers of delivering babies without the assistance and support of trained health care professionals.
    - Shortcomings in priority health care interventions such as, for example, HIV testing and nevirapine for pregnant women who are HIV positive and their babies. If health care facilities address service shortcomings of this kind, they will be able to prevent a large number of avoidable child deaths.
    - Identify those areas where additional support is needed to achieve priority health targets, to measure progress and to acknowledge achievements.

5.5.4 Recommendations for future research

Although this study has pioneered the use of existing routine health information in the DHIS for evaluative health systems research, further research is needed to refine the methodology. The following recommendations are offered to future researchers in this field:

- Refine the health systems research methodology that enables routine information to be used from a results-based systems perspective for evidence-based management, M&E.
- Develop and implement DHIS data elements and indicators that will measure finance and human resource inputs together with the other HCS inputs that have already been identified in this study.
- Develop initiatives that will make the benefits of research available in practice by:
    - Sharing the problems that are being identified by routine DHIS data analysis with managers, service providers, researchers and students who are interested in conducting health systems research.
    - Conducting rapid surveys in order to
        - validate routine information
        - identify shortcomings that result in poor performance

        - identify best practices that lead to the fulfilment of HCS targets
        - identify where additional data need to be collected to inform evidence-based decisions
    - Involving students, academics and the general population in strengthening the HCS by making routine public health information available in the public domain (in places such as, for example, the Department of Health website).
- Refine targets, benchmarks and threshold levels for each indicator to support colour-coding and quarterly feedback by means of performance profiles.
- Replicate this study for all the provinces of South Africa so that a national *U5MR*-related performance profile can ultimately be compiled.
- Develop a set of indicators (with targets, benchmarks and threshold levels for each priority health program and health related MDG to support evidence-based management of the comprehensive, integrated HCS in South Africa.

5.6 STUDY CONTRIBUTIONS

Although the DHIS contains a wealth of information that can be used to address health priorities by means of evidence-based decision-making, this data is not currently being used either for management or research purposes. This study has found that the data that is currently available in the DHIS can be used to measure the success or failure of *U5MR*-related public health care services in the Free State province, and to identify the specific HCS and health care service shortcomings (expressed in terms of inputs, processes, outputs and outcomes) that contribute to the current high *U5MR*. Because standardised elements and indicators were used for the study, these same indicators and principles can easily be used for monitoring *U5MR*-related needs and progress towards the *U5MR* MDG for management purposes in the periods between official surveys, in other provinces and in the country as a whole. A similar approach can also be followed for the kind of evidence-based management that is designed to achieve other MDGs and other national health priorities. The researcher hopes that this study will pave the way for:

- The utilisation of routine health information in the DHIS for health systems research.
- Developing the ability of managers to use this kind of routine evidence to identify and address shortcomings in the HCS and to use available resources to make the biggest possible impact in the most time-cost-effective way possible.
- Mobilising resources to strengthen the DHIS so that it will be able to meet the needs of managers as they engage in evidence-based management from a results-based perspective, and that it will be able to produce user-friendly reports containing all the information that is needed to address specific health priorities and goals.

5.7 STUDY LIMITATIONS

One of the most common limitations of research studies is that the findings of the study cannot, for various reasons, be generalised to wider populations. Because the findings of this study are applicable to only one province, there was never any intention to generalise these findings to the other provinces of South Africa. A study of this kind could, however, be easily replicated with data from the other provinces in South Africa.

The limitations of this study include the following:

- Because all the HCS stages in the research were addressed as though they represented a real-life situation, a great variety of indicators and data were incorporated into the study. Although all the indicator values are represented in the results, all individual indicator values were not discussed, except sometimes in passing, for each of the districts, sub-districts and hospitals in the province.
- Where targets were not available for the selected indicators, benchmarks were developed from the existing Free State data with the assistance of experts in their fields, after which threshold levels were developed based on these targets and benchmarks. It should be noted that these benchmarks and thresholds have no official status or sanction, and may therefore be disputed by managers and service providers.
- DHIS data-related limitations:
    - The DHIS contains only data from public health care facilities. It should be borne in mind that many children die in private health facilities and in communities, and that many health care interventions take place outside public health facilities.
    - Public health care facilities in the Free State DHIS are not classified in terms of the definitions that are published in the *Health Facility Definitions November 2006* (SA 2006a:5-11). Some facilities that are classified as district hospitals function as CHCs because they do not offer caesarean sections, some CHC functions as clinics because they do not provide 24-hour services and some clinics function as CHCs because they do in fact offer 24-hour services. Anomalies such as these hamper the effectiveness of trying to assess equity in terms of health facilities and health care interventions.
    - Although the DHIS contains data for the selected study indicators, all these indicators are not set up for auto-calculation by the DHIS software - several indicators had to be calculated by making use of Excel formulas.
    - Data about private and community-based public health care services such as home-based care and HIV testing are not available in the DHIS. This may contribute to the low *HIV test ANC rate* and the low *CYPR* reflected in the DHIS.

- The DHIS contains a limited amount of data about human resources and no financial data at all.

5.8 CONCLUDING REMARKS

South Africa is one of only 12 countries in the world where the incidence of child and infant mortality is increasing annually. At least 260 mothers, babies and children die in our country every day. Countries with far more circumscribed resources such as Malawi, Tanzania and Rwanda have made significant progress towards reducing maternal and child mortality over the past seven years. This stands in stark contradiction to South Africa which has better health care facilities, as well as more staff and other health care resources than most countries of Africa. What this indicates is that current health policies and programmes are clearly not producing the desired results and outcomes that were planned for South Africa as a whole and for the Free State province in particular. “Theoretically all the ingredients are in place but we need to consider this as the critical time to act and put these doable measures in place fast” (Thom 2008:1,2). Unless radical corrective measures are implemented soon, neither South Africa as a whole nor the Free State will meet the MDG target of 20 deaths per 1,000 live births in 2015.

This purpose of this study was to determine if the data in the DHIS is appropriate for measuring equity in inputs, processes, outputs, outcomes and impacts of interventions that are intended to diminish the *U5MR* and to show how evidence and information from the DHIS can be used to empower managers to make decisions that will strengthen the HCS to reduce the *U5MR*. The researcher accordingly developed a performance profile that would provide support for managers who wanted to make decisions based on evidence to identify areas of best practice as well as those that suffer from underperformance.

The key to addressing *U5MR*-related HCS inequities is, firstly, to analyse all available data and, secondly, to strengthen the HCS by implementing tried-and-tested priority interventions where they are most needed and where they will make the greatest possible impact on the *U5MR* in the shortest possible period of time (WHO 2006b:6-11).

This study has repeatedly emphasised the fact that, although the DHIS is less than perfect as it stands, it nevertheless contains a mine of valuable information that can be immediately used to strengthen the Free State’s HCS in terms of the inputs, processes, outputs, outcomes and impacts of *U5MR*-related health care. Although it was intended that the results of the study should only be applicable to the Free State Province, the DHIS has been operating as a national health information system since 2000 and it therefore contains public health care facility data for all nine provinces of South Africa. All this data is available to be used in replications of

this study for the other nine provinces of the Republic and for the support of measures which, if effectively applied, will drastically reduce the *U5MR* and put South Africa on track for 2015.

Despite the limitations of this study, it is possible to make constructive principle-based recommendations for strengthening and reinvigorating the DHIS, for making more intelligent use of routine health information for evidence-based initiatives that will improve the HCS as a whole, for improving specific healthcare interventions and for utilising routine health information for future evaluative health systems research.

The implementation of the study recommendations could contribute significantly towards addressing specific child health care problems at particular levels of service delivery level and thus towards reducing the *U5MR*, not only in the Free State province, but throughout South Africa.

> "We must do the right things. We must do them in the right places. And we must do them in the right way.... (Lee Jong-wook, Director General, WHO) (WHO 2006b:10).

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Annexure 1

Request for permission to use Free State DHIS data

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012 3299 055
083 412 1160
christa@hst.org.za

The HOD
Free State Department of Health
051 408 1108
ramelap@fshealth.gov.za

REQUEST FOR PERMISSION TO USE FREE STATE DATA IN THE DHIS

Dear Professor Ramela

I am doing my MA Cur in Health Service Management through UNISA. May I request permission to use the Free State data (as in the DHIS at NDoH in March 2007) for my study please? Because these data are of good quality (Free State appears to have the best quality hospital data in the system at this stage) they should enable me to provide evidence that existing routine information can support managers not only towards achieving the MDGs, but also towards strengthening the health care system and to ultimately improve the health status of our most vulnerable people.

The topic of my dissertation of limited scope is: **How can the DHIS be used to support managers in strengthening the health care system towards achieving the Millennium Development Goals (MDGs) on child and maternal mortality?**

The purpose of this study is to evaluate the appropriateness of the DHIS for measuring health equity (in terms of inputs, processes, outputs, outcomes and impact) related to the main causes of child and maternal mortality in South Africa.

I will determine whether the indicators in the DHIS are appropriate for monitoring equity in PHC service provision (in terms of the main causes of mortality in children under five years of age and in mothers) and identify DHIS shortcomings to be addressed from a national perspective. I also plan to explore how the existing DHIS data can be used to support managers in strengthening the health care system towards achieving the MDGs on child and maternal mortality.

Using data from a routine information system for Health Systems Research is ground breaking work and results should pave the way towards enabling managers to identify specific districts, sub-districts and hospitals doing well (to learn from) as well as those where additional support is needed towards reaching the MDGs on child and maternal mortality.

The data needed from the DHIS include indicators such as immunization coverage, delivery rate in facilities and low birth weight rate mainly for January to December 2006, with some annul averages

to assess trends where relevant. Because I need to use the data to illustrate how managers can use them for evidence-based management, it will be necessary to use integrated data from the PHC and hospital databases, by province, district and sub-district and in some instances by hospital, compared against targets. No direct data collection is needed, no field workers will be involved and only aggregated data will be used.

I am a caring and committed professional nurse with 28 years of public health experience, (of which I spent 10 years on data management at district (4yr), provincial (6m) and national level (6years) and believe the outputs of this health systems research study will be of value to the Free State (and hopefully to the rest of SA at a later stage).

Because I believe in a win-win approach, I am of opinion that the FS must benefit from assisting me (if you are willing to do so of course). Potential advantages for the FS may include:

- development of an integrated dataset (containing PHC and hospital data) in pivot table format, to monitor data quality AND progress of the Free State towards meeting the MDGs for child and maternal mortality
- support to the FS, (by means of e-mail) to identify strengths and potential shortcomings in terms of data quality (PHC and hospital datasets) identified during analysis (if you wish)
- a report to support managers at provincial, district, sub-district and hospital level to strengthen evidence-based management in terms of child and maternal health (if you wish)

I am also willing to negotiate about supporting the FS to meet realistic additional data or potential skills development needs that may arise from this, provided that it doesn't have direct cost implications for me.

I hope that you will be able to accommodate my request and I will appreciate feedback from you as soon as possible.

Best regards,

Christa van den Bergh
Health Systems Trust (HST)
National Health Information Systems (NatHIS) Project
National Department of Health
083 412 1160
christa@hst.org.za

Annexure 2

Permission from the Free State Head of Department of Health

FREE STATE PROVINCE

Health System Trust
National Health Information Systems (NatHIS) Project
National Department of Health
PRETORIA
0001

Dear Ms. C. van den Bergh

REQUEST FOR PERMISSION TO USE FREE STATE DATA IN DHIS

The above mentioned correspondence received from you bears reference.

Permission is hereby granted to use the data on the District Health Information System for your study on child and maternal mortality towards achieving the Millennium Development Goals.

Regards

PROF. PL RAMELA
ACTING HEAD: HEALTH

DATE: 31 JULY 2007

Department of Health ∓ Departement van Gesondheid • Lefapha La Bophelo Bo Botle
Acting Head: Health – Prof. P.L. Ramela • PO Box 227, Bloemfontein 9300 • Tel: 051-408 1107
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Annexure 3

Data extraction framework

System stages, measuring parameters and indicators to monitor lowering of mortality in children under five years of age						
Input indicators Measure **availability, accessibility and equitable distribution** of facilities in terms of numbers and types, staff, interventions to address priority health needs, essential drugs and the accessibility of health care facilities to the population.	**Process indicators** Measure how well services are planned, managed and delivered. They are monitored in terms of the **acceptability** and **utilisation** of health facilities in relation to the population in need of those services.	**Output indicators** Measure coverage by promotive, preventive, diagnostic, curative and rehabilitative interventions. Coverage is only meaningful if it is measured in terms of specific interventions aimed at addressing leading health problems.			**Outcome indicators** Measure effectiveness and efficiency in terms of: * specific interventions implemented * management of personnel and expenditure	**Impact indicators** Measure health status in terms of mortality and life expectancy
		Promotive and preventive	**Screening and early diagnosis**	**Curative and rehabilitative**		

Annexure 4

Study indicators with targets/benchmarks and thresholds

Study indicators with targets/benchmarks and thresholds

	DHIS Indicator OR new indicator created	Numerator	Denominator	Indicator type	Free State value 2006	Achievement to be > or < Target / Benchmark (T/B)	Target / benchmark	Source of target or benchmark	Thresholds for colour coding			
									Critical	Requires progress	On track	Unrealistic - motivate
1	*Antenatal care coverage*	ANC 1st visit	Estimated pregnant women	%	96	>T/B	**90**	Expert opinion	< 85	85 to 94	95 to 100	> 100
2	*Born before arrival rate* (availability & accessibility)	Babies BBA	Births in facility plus babies BBA	%	9	<T/B	**6**	Expert opinion	> 10	7 to 10	2 to 6	< 2
3	*Caesarean section rate* (availability & accessibility)	Caesarean section deliveries	Deliveries in facility	%	18	>T/B	**10**	Available data	< 5	5 to 8	9 to 20	> 20
4	*Couple year protection rate*	Contraceptive year equivalent	Female population 15-44 years	%	30	>T/B	**40**	Available data	< 30	30 to 34	35 to 50	> 50
5	*Delivery in facility rate* * (availability & accessibility)	Deliveries in facility	Estimated deliveries	%	80	>T/B	**90**	Expert opinion	< 80	80 to 89	90 to 100	> 100
6	*Diarrhoea facility case fatality rate (%)*	Diarrhoea under five years – deaths	Diarrhoea under five years – admitted	%	10	<T/B	**5**	Expert opinion	> 10	7 to 10	2 to 6	< 2
7	*DTP-Hib 1st dose coverage* (availability and accessibility)	DTP-Hib 1st dose	Population under one year	%	103	>T/B	**90**	SA (2006b:4)	< 85	85 to 94	95 to 100	> 100
8	*Facility infant mortality rate*	Inpatient deaths under one year	Estimated live births	1,000	27	<T/B	**15**	Expert opinion	> 20	13 to 20	5 to 12	< 5
9	*Facility low birth weight rate (%)* *	Live births in facility under 2500g	Live births in facility	%	13	<T/B	**8**	Available data	> 12	10 to 12	5 to 9	< 5
10	*Facility maternal mortality rate*	Maternal deaths	Estimated live births	1,000	241	<T/B	**100**	APP (2006:8)	> 150	120 to 150	50 to 119	< 50
11	*Facility neonatal mortality rate*	Inpatient deaths – neonatal	Estimated live births	1,000	13	<T/B	**8**	Expert opinion	> 12	10 to 12	5 to 9	< 5
12	*Facility neonatal mortality rate (%)*	Inpatient deaths – neonatal	Births in facility	%	1.5	<T/B	**1**	Expert opinion	> 1.4	0.65 to 1.4	0.3 to 0.64	< 0.3
13	*Facility perinatal mortality rate*	Inpatient deaths - perinatal	Estimated live births	1,000	32	<T/B	**15**	Expert opinion	> 25	19 to 25	10 to 18	< 10
14	*Facility still birth rate (%)*	Still births (in facility)	Births in facility	%	2.8	<T/B	**1.8**	Expert opinion	> 2.5	1.5 to 2.5	1 to 1.4	< 1
15	*Facility under-five mortality rate*	Inpatient deaths under five years	Estimated live births	1,000	36	<T/B	**18**	Expert opinion	> 25	20 to 25	10 to 19	< 10

	DHIS Indicator OR new indicator created	Numerator	Denominator	Indicator type	Free State value 2006	Achievement to be > or < Target / Benchmark (T/B)	Target / benchmark	Source of target or benchmark	Thresholds for colour coding			
									Critical	Requires progress	On track	Unrealistic - motivate
16	*Facility under-five mortality rate (%)*	Inpatient deaths under five years	Admissions under five years	%	16	<T/B	**12**	Expert opinion	> 16	12 to 16	5 to 11	< 5
17	*HIV test antenatal care rate*	Antenatal clients HIV tested - new	ANC 1st visit	%	60	>T/B	**90**	SA (2008:56)	< 75	75 to 84	85 to 100	> 100
18	*Malnutrition facility case fatality rate (%)*	Malnutrition under five years - deaths	Malnutrition under five years - admitted	%	24	<T/B	**15**	Expert opinion	> 20	11 to 20	5 to 10	< 5
19	*Measles 1st dose coverage **	Measles 1st dose	Population under one year	%	88	>T/B	**95**	Bryce et al (2006:1074) 90%; Expert opinion 95%	< 85	85 to 93	94 to 100	> 100
20	*Nevirapine baby coverage **	Nevirapine doses to newborn babies	Estimated live births to HIV positive women	%	38	>T/B	**85**	APP (2006:35) 70 %; Expert opinion 85%	< 70	70 to 79	80 to 100	> 100
21	*Nevirapine newborn coverage*	Nevirapine doses to newborn babies	Antenatal client HIV positive – new	%	53	>T/B	**95**	Available data	< 90	90 to 94	95 to 100	> 100
22	*Nevirapine pregnant women coverage **	Nevirapine doses to women in labour	Antenatal client HIV positive – new	%	68	>T/B	**85**	SA (2008:56) 80%; Expert opinion 85%	< 70	70 to 79	80 to 100	> 100
23	*Pneumonia facility case fatality rate (%)*	Pneumonia under five years – deaths	Pneumonia under five years – admitted	%	11	<T/B	**5**	Expert opinion	> 10	7 to 10	2 to 6	< 2
24	*Termination of pregnancy rate*	Terminations of pregnancy	Estimated pregnant women	%	1	>T/B	**2**	Available data	< 1	1 to 1.8	1.9 to 2.4	> 2.4
25	*Vitamin A 12-59 months coverage*	Vitamin A 12-59 months supplements	Population 12-59 months x 2	%	36	>T/B	**45**	SA (2008:50)	< 35	35 to 42	43 to 60	> 60

* Indicators in Bryce et al (2006: 1071)

Annexure 5

Study indicator definitions

Study indicator definitions

	DHIS Indicator OR new indicator created	Indicator abbreviated name	Numerator	Denominator	Indicator type	System stage
1	***Antenatal care coverage*** Pregnant women who had their first antenatal visit expressed as a percentage of the estimated pregnant women.	ANC coverage	**ANC 1st visit** A first visit by a pregnant woman to a health facility for receiving antenatal care.	**Estimated pregnant women** Population under one year multiplied by a factor of 1.15. The extra 0.15 (15%) is a rough estimate to make allowance for late miscarriages (10 to 28 weeks), still births (after 28 weeks gestation) and infant mortality.	%	Process/Input
2	***Born before arrival rate*** Babies born before arriving at health facilities expressed as a percentage of all births in health facilities plus babies born before arrival. BBA rate should not be higher than 3% for most facilities. BBA rate can be used as a proxy indicator for availability and accessibility of delivery services.	BBA rate	**Babies BBA** Live births and still births to women who delivered on their way to the health facility or who ended up delivering at home (due to lack of transport etc.) but where the mother had a booking and/or a clear intention to deliver in a health facility. Babies arriving later than 72 hours after birth should not be counted as BBAs. Live birth is when a baby breathes or shows any other evidence of life, such as a heart beat, pulsation of the umbilical cord or definite movement of involuntary muscles, whether or not the umbilical cord has been cut or the placenta is attached. Still birth is death prior to the complete delivery of the baby. Still births should only be counted when the foetus is of 26 or more weeks gestational age and/or weighs 500g or more. A still-born foetus might have been dead for a while (maserated) or died just before or during birth. Multiple births are counted as several live births or still births (or as a combination of live and still births, if one foetus is alive and another not).	**Births in facility plus babies BBA** Babies born in health facilities or on the way to health facilities, regardless of whether the babies were live births or still births. Note that this can be greater than `Deliveries in facility` if multiple births occur.	%	Process/Input
3	***Caesarean section rate*** Caesarean section deliveries expressed as a percentage of all deliveries in health facilities. Caesarean section rate can be used as a proxy indicator for availability and accessibility of hospitals performing surgery under general anaesthesia.		**Caesarean section deliveries** Women who delivered by means of caesarean sections.	**Deliveries in facility** Women who delivered in health facilities under the supervision of health professionals. Note that this number can be less than 'Total births in facility' if multiple births occur.	%	Process/Input

	DHIS Indicator OR new indicator created	Indicator abbreviated name	Numerator	Denominator	Indicator type	System stage
4	***Couple year protection rate*** Modern contraceptive usage (by females and males) expressed as a percentage of the female population aged 15-44 years. CYPR is an estimation of the couples aged 15-44 years that are protected against pregnancy by using modern contraceptives.	CYPR	**Contraceptive year equivalent** Intra Uterine Contraceptive Device (IUCD) * 4 + Male condoms distributed * 0.005 + Medroxyprogesterone injection * 0.2 + Norethisterone enanthate injection * 0.166 + Oral pill cycle *0.077 + Sterilisation – female *10 + Sterilisation – male * 20 Medroxyprogesterone acetate (Depo Provera / Petogen) is an injection given to women between 15 and 45 years. This injection provides contraceptive protection for 3 months. Norethisterone enantate (Nuristerate) is an injection given to women between 15 and 45 years. This injection provides contraceptive protection for 2 months. Oral contraceptives are pills issued to women between 15 and 45 years, each packet containing pills for one cycle (28 days). Female sterilisation is any planned operative procedure that results in a woman being sterilised. Male sterilisation is any planned operative procedure that results in a man being sterilised (also called vasectomy).	**Female population 15-44 years**	%	Output
5	***Delivery in facility rate **** Deliveries in health facilities expressed as a percentage of the total expected deliveries. Delivery in facility rate can be used as a proxy indicator for availability and accessibility of delivery services.		**Deliveries in facility** Women who delivered in health facilities under the supervision of health professionals. Note that this number can be less than 'Total births in facility' if multiple births occur.	**Estimated deliveries** Population under one year multiplied by a factor of 1.07. The extra 0.07 (7%) is a rough estimate to make allowance for still births (after 28 weeks gestation) and infant mortality.	%	Process/Input
6	***Diarrhoea facility case fatality rate (%)*** Children under five years of age who died of diarrhoea in public health facilities expressed as a percentage of those children that were admitted with diarrhoea.	Diarrhoea facility CFR (%)	**Diarrhoea under five years – deaths** Children under five years of age who were admitted with diarrhoea and then died in health facilities.	**Diarrhoea under five years – admitted** Children under five years of age who were admitted with diarrhoea in health facilities.	%	Outcome
7	***DTP-Hib 1st dose coverage*** Children under one year of age who received their first DTP-Hib dose expressed as a percentage of the under-one		**DTP-Hib 1st dose** DTP-Hib (Diphtheria/Tetanus/Pertussis-Haemophilus influenzae B) vaccine 1st dose given to a child under one year of age - preferably at around 6 weeks after birth.	**Population under one year**	%	Process/Input

	DHIS Indicator OR new indicator created	Indicator abbreviated name	Numerator	Denominator	Indicator type	System stage
	population. DTP-Hib 1 coverage can be used as a proxy indicator for availability and accessibility of PHC services.					
8	***Facility infant mortality rate*** Children under one year of age who died in public health facilities expressed per 1,000 estimated live births.	Facility IMR	**Inpatient deaths under one year** Children under one year of age who were admitted and then died in health facilities (including newborn babies who were not admitted separate from their mothers).	**Estimated live births** Population under one year multiplied by a factor of 1.04. The extra 0.04 (4%) is a rough estimate to make allowance for infant mortality.	1,000	Impact
9	***Facility low birth weight rate (%) **** Live babies born in public health facilities weighing less than 2500g expressed as a percentage of all live births in health facilities.	Facility LBWR (%)	**Live births in facility under 2500g** Live babies born in health facilities weighing less than 2500g.	**Live births in facility** Live babies born in health facilities. Live birth is when a baby breathes or shows any other evidence of life, such as a heart beat, pulsation of the umbilical cord or definite movement of involuntary muscles, whether or not the umbilical cord has been cut or the placenta is attached. Multiple births are counted as several live births or still births (or as a combination of live and still births, if one foetus is alive and another not).	%	Outcome
10	***Facility maternal mortality rate*** Maternal deaths in public health facilities expressed per 100,000 estimated live births.	Facility MMR	**Maternal deaths** Women who were admitted and then died in health facilities while pregnant or within 42 days of termination of pregnancy, irrespective of the duration and site of the pregnancy, from any cause related to or aggravated by the pregnancy or its management but not from accidental or incidental causes.	**Estimated live births** Population under one year multiplied by a factor of 1.04. The extra 0.04 (4%) is a rough estimate to make allowance for infant mortality.	1,000	Impact
11	***Facility neonatal mortality rate*** Neonatal deaths in public health facilities expressed per 1,000 estimated live births.	Facility NNMR	**Inpatient deaths – neonatal** Babies who died in health facilities within 28 days after birth.	**Estimated live births** Population under one year multiplied by a factor of 1.04. The extra 0.04 (4%) is a rough estimate to make allowance for infant mortality.	1,000	
12	***Facility neonatal mortality rate (%)*** Neonatal deaths in public health facilities expressed as a percentage of all births in health facilities.	Facility NNMR (%)	**Inpatient deaths – neonatal** Babies who died in health facilities within 28 days after birth.	**Births in facility** Babies born in health facilities, regardless of whether the babies were live births or still births. Note that this can be greater than `Deliveries in facility` if multiple births occur.	%	Outcome

	DHIS Indicator OR new indicator created	Indicator abbreviated name	Numerator	Denominator	Indicator type	System stage
13	***Facility perinatal mortality rate*** Perinatal deaths in public health facilities expressed per 1,000 estimated live births.	Facility PNMR	**Inpatient deaths - perinatal** Still births (in facility) plus early neonatal deaths. Still birth is death prior to the complete delivery of the baby. Still births should only be counted when the foetus is of 26 or more weeks gestational age and/or weighs 500g or more. A still-born foetus might have been dead for a while (maserated) or died just before or during birth. Multiple births are counted as several live births or still births (or as a combination of live and still births, if one foetus is alive and another not). Early neonatal deaths are babies who died in health facilities within 7 days after birth.	**Estimated live births** Population under one year multiplied by a factor of 1.04. The extra 0.04 (4%) is a rough estimate to make allowance for infant mortality.	1,000	Impact
14	***Facility still birth rate (%)*** Still births in public health facilities expressed as a percentage of all births in health facilities.	Facility SBR (%)	**Still births (in facility)** Dead babies born in health facilities. Still birth is death prior to the complete delivery of the baby Still births should only be counted when the foetus is of 26 or more weeks gestational age and/or weighs 500g or more. A still-born foetus might have been dead for a while (maserated) or died just before or during birth. Multiple births are counted as several live births or still births (or as a combination of live and still births, if one foetus is alive and another not).	**Births in facility** Babies born in health facilities, regardless of whether the babies were live births or still births. Note that this can be greater than `Deliveries in facility` if multiple births occur.	%	Outcome
15	***Facility under-five mortality rate*** Children under five years of age who died in public health facilities expressed per 1,000 estimated live births.	Facility U5MR	**Inpatient deaths under five years** Children under five years of age who were admitted and then died in health facilities (including newborn babies who were not admitted separate from their mothers).	**Estimated live births** Population under one year multiplied by a factor of 1.04. The extra 0.04 (4%) is a rough estimate to make allowance for infant mortality.	1,000	Impact
16	***Facility under-five mortality rate (%)*** Children under five years of age who died in public health facilities expressed as a percentage of those children that were admitted.	Facility U5MR (%)	**Inpatient deaths under five years** Children under five years of age who were admitted and then died in health facilities (including newborn babies who were not admitted separate from their mothers).	**Admissions under five years** Children under five years of age who were admitted in health facilities.	%	Outcome
17	***HIV test antenatal care rate*** Pregnant women who were tested for HIV expressed as a percentage of those women who had their first antenatal visit.	HIV test ANC rate	**Antenatal clients HIV tested - new** Pregnant women who were tested for HIV.	**ANC 1st visit** A first visit by a pregnant woman to a health facility for receiving antenatal care.	%	Output

	DHIS Indicator OR new indicator created	Indicator abbreviated name	Numerator	Denominator	Indicator type	System stage
18	***Malnutrition facility case fatality rate (%)*** Children under five years of age who died of malnutrition in public health facilities expressed as a percentage of those children that were admitted with malnutrition.	Malnutrition facility CFR (%)	**Malnutrition under five years - deaths** Children under five years of age who were admitted with malnutrition and then died in health facilities.	**Malnutrition under five years - admitted** Children under five years of age who were admitted with malnutrition in health facilities.	%	Outcome
19	***Measles 1st dose coverage **** Children under one year of age who received their first measles dose expressed as a percentage of the under-one population.		**Measles 1st dose** Measles vaccine 1st dose given to a child under one year of age - preferably at 9 months after birth.	**Population under one year**	%	Output
20	***Nevirapine baby coverage **** Newborn babies of HIV positive women who received Nevirapine expressed as a percentage of the estimated live births to HIV positive women.		**Nevirapine doses to newborn babies** Nevirapine doses given to newborn babies of HIV positive women within 72 hours after birth.	**Estimated live births to HIV positive women** Estimated live births multiplied by the antenatal prevalence as obtained from the annual antenatal survey. Estimated live births is the population under one year multiplied by a factor of 1.04. The extra 0.04 (4%) is a rough estimate to make allowance for infant mortality.	%	Output
21	***Nevirapine newborn coverage*** Newborn babies of HIV positive women who received Nevirapine expressed as a percentage of the pregnant women who tested HIV positive during antenatal visit.		**Nevirapine doses to newborn babies** Nevirapine doses given to newborn babies of HIV positive women within 72 hours after birth.	**Antenatal clients HIV positive – new** Pregnant women who tested positive for HIV during antenatal visit.	%	Output
22	***Nevirapine pregnant women coverage **** HIV positive pregnant women who received Nevirapine during labour expressed as a percentage of the pregnant women who tested HIV positive during antenatal visit.		**Nevirapine doses to women in labour** Nevirapine doses given to HIV positive pregnant women during labour.	**Antenatal client HIV positive – new** Pregnant women who tested positive for HIV during antenatal visit.	%	Output
23	***Pneumonia facility case fatality rate (%)*** Children under five years of age who died of pneumonia in public health facilities expressed as a percentage of those children that were admitted with pneumonia.	Pneumonia facility CFR (%)	**Pneumonia under five years – deaths** Children under five years of age who were admitted with pneumonia and then died in health facilities.	**Pneumonia under five years – admitted** Children under five years of age who were admitted with pneumonia in health facilities.	%	Outcome

	DHIS Indicator OR new indicator created	Indicator abbreviated name	Numerator	Denominator	Indicator type	System stage
24	***Termination of pregnancy rate*** Terminations of pregnancies expressed as a percentage of the estimated pregnant women.	TOP rate	**Terminations of pregnancy** Terminations of pregnancies performed in health facilities under the supervision of health professionals.	**Estimated pregnant women** Population under one year multiplied by a factor of 1.15. The extra 0.15 (15%) is a rough estimate to make allowance for late miscarriages (10 to 28 weeks), still births (after 28 weeks gestation) and infant mortality.	%	Output
25	***Vitamin A 12-59 months coverage*** Children aged 12-59 months who received vitamin A supplements (twice a year) expressed as a percentage of the population 12-59 months multiplied by a factor of 2.		**Vitamin A 12-59 months supplements** Vitamin A supplements given to children aged 12-59 months (twice a year).	**Population 12-59 months x 2** Population 12-59 months multiplied by a factor of 2 because vitamin A is administered twice a year.	%	Output

* Indicators in Bryce et al (2006: 1071)