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Laboratory tests at the maternity unit of Gordonia Hospital

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LABORATORY TESTS AT THE MATERNITY UNIT OF GORDONIA HOSPITAL

Milly Mavis Bok

A Research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Masters of Public Health in the field of Hospital Management

Johannesburg 2011

DECLARATION

I, Milly Mavis Bok, declare that this research report is my own work. It is being submitted for the Master in Public Health in the field of Hospital Management at the University of Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this University or any other University.

.....

Milly Mavis Bok

DEDICATION

This work is dedicated to:

My Heavenly Father who always provided in all my needs.

My husband Lionel and my son Renaldo for their support during the study period and who understood the times away from home.

ABSTRACT

BACKGROUND: Maternal health services have been an area of focus all over the world due to its impact on the mothers and newborn infant. The millennium development goals 4 and 5 have been formulated to focus on maternal health services. The Department of Health in South Africa aligned to the above targets, has outlined essential elements of maternal care in various levels of health facilities. In this regard, district hospitals play an important role in delivery of maternal health care. Gordonia Hospital, a district hospital situated in the Northern Cape Province offers maternal health services in a remote area of South Africa. This study will focus on the utilization and costs of laboratory test in this hospital.

AIM: To describe the laboratory tests undertaken in the Maternity unit of Gordonia Hospital during the study period and to use this information to support maternal health services provided.

METHODOLOGY: A cross-sectional study design was used to review routinely collected data from Gordonia Hospital Maternity Unit and the National Health Laboratory Service (NHLS) for one month period (September 2009). No primary data collection was done. The setting of this study was the maternity unit at the above district hospital, in the Northern Cape Province. MS Excel based tools were used to analyze the collected information about variables linked to the specific objectives of this study.

RESULTS: Laboratory tests from the maternity unit of the hospital are mostly requested for mothers presented with hypertensive disorders of pregnancies, especially pre-eclampsia, and for babies with neonatal jaundice. Laboratory costs for the unit are around 5% of the total hospital laboratory costs and test turn-around times as well as recording of test results in patient files are in place.

CONCLUSION: This is the first study done in the Northern Cape Province to systematically study the laboratory services. The researcher hopes that the Provincial Department of health will use the report from this study to improve maternal health services in the Province.

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TABLE OF CONTENT

DECLARATION ii
DEDICATION ii
ABSTRACT iii
ACKNOWLEDGEMENTS iv
TABLE OF CONTENT v
LIST OF FIGURES viii
LIST OF TABLES ix
DEFINITION OF TERMS x
LIST OF ABBREVIATIONS xi
CHAPTER 1 1
INTRODUCTION 1
1.1 BACKGROUND 1
1.2 STATEMENT OF THE PROBLEM 2
1.3 JUSTIFICATION FOR THE STUDY 2
1.4 RESEARCH QUESTION 2
1.5 STUDY OBJECTIVES 3
1.5.1 BROAD OBJECTIVE 3
1.5.2 SPECIFIC OBJECTIVES 3
1.6 SUBSEQUENT CHAPTERS 3
CHAPTER 2 5
LITERATURE REVIEW 5
2.1 MATERNAL HEALTH 5
2.2 LABORATORY TESTS USED IN MATERNITY 5
2.3 FACTORS INFLUENCING USE OF LABORATORY TESTS USED IN MATERNITY 6
2.4 COSTS OF LABORATORY TESTS USED IN MATERNITY 7
CHAPTER 3 9
METHODOLOGY 9
3.1 INTRODUCTION 9
3.2 STUDY DESIGN 9
3.3 STUDY SETTING 9
3.4 STUDY SCOPE 11
3.5 STUDY POPULATION 12
3.6 SAMPLE 12

3.7 MEASUREMENT AND DATA SOURCE 12
3.7.1 STUDY INSTRUMENT 12
3.7.2 VARIABLES 12
3.7.3 DATA COLLECTION 13
3.7.4 DATA MANAGEMENT 13
3.8 PILOT STUDY 14
3.9 ETHICAL CONSIDERATIONS 14
CHAPTER 4 15
RESULTS 15
4.1 LABORATORY TEST & THE CLINICAL PROFILE OF PATIENTS TESTED 15
4.1.1 NUMBER OF PATIENTS ADMITTED 15
4.1.2 NUMBER OF TESTS DONE 15
4.1.2.1. MOTHER 15
4.1.2.2. NEONATES 16
4.1.3 PROFILE OF PATIENTS 17
4.1.3.1. AGE 17
4.1.3.2. GRAVIDITY 18
4.1.3.3 PARITY 18
4.2 COST OF LABORATORY TESTS AND HEALTH EXPENDITURE 19
4.2.1 COST OF LABORATORY TESTS 19
4.2.1.1 MOTHERS 19
4.2.1.2 NEONATES 20
4.2.1.3 LABORATORY COSTS FOR MOTHERS AGAINST THOSE FOR BABIES 21
4.2.2. HEALTH EXPENDITURE 22
4.3 RECORDING OF LABORATORY RESULTS 22
4.3.1. RECORDING OF LABORATORY RESULTS FOR MOTHERS 22
4.3.2 RECORDING OF LABORATORY RESULTS FOR NEONATES 23
CHAPTER 5 25
DISCUSSION 25
5.1 INTRODUCTION 25
5.2 LABORATORY TESTS PERFORMED AND THE CLINICAL PROFILE OF PATIENTS IN THE MATERNITY UNIT 25
5.2.1. NUMBER OF TESTS DONE 25

5.2.1.1 MOTHERS 25
5.2.1.2. NEONATES 26
5.2.2. PROFILE OF PATIENTS 26
5.2.2.1. AGE 26
5.2.2.2. GRAVIDITY 26
5.2.2.3. PARITY 27
5.3 COST OF LABORATORY TESTS AND HEALTH EXPENDITURE 27
5.3.1 COSTS OF LABORATORY TESTS 27
5.3.1.1 MOTHERS 27
5.3.1.2 NOENATES 27
5.3.2. HEALTH EXPENDITURE 28
5.4 THE RECORDING OF TEST RESULTS BY DOCTORS IN PATIENT FILES AND TURN-AROUND TIME OF TEST 29
CHAPTER 6 30
CONCLUSIONS AND RECOMMENDATIONS 30
6.1 CONCLUSIONS RELATED TO THE OBJECTIVES OF THE STUDY 30
6.1.1 LABORARORY TESTS PERFORMED AND PROFILES OF PATIENTS IN THE MATERNITY UNIT 30
6.1.2 THE COSTS OF LABORATORY TESTS UNDERTAKEN IN THE MATERNITY UNIT 30
6.1.3 THE RECORDING OF TEST RESULTS BY DOCTORS IN PATIENT FILES AND TURN-AROUND TIME OF TEST 30
6.2 LIMITATIONS OF THE STUDY 31
6.3 RECOMMENDATIONS 31
6.3.1 USE OF FINDINGS OF THE STUDY 31
6.3.2 FUTURE RESEARCH 31
6.4 SUMMARY AND CONCLUSIONS 31
REFERENCES 32
APPENDICES 1
APPENDIX A: ETHICS CLEARANCE CERTIFICATE AND APPROVAL FROM NORTHERN CAPE DEPARTMENT OF HEALTH 2
APPENDIX B: DATA COLLECTION SHEETS 3

LIST OF FIGURES

Figure 3.1 Siyanda District Municipality..... 10

LIST OF TABLES

Table 2.1 Tests for maternal health services 6
Table 3.1 List of variables 13
Table 4.1 Number of laboratory tests done for mothers 16
Table 4.2 Number of laboratory tests done for neonates 17
Table 4.3 Age of the participants 18
Table 4.4 Gravidity status of the participants 18
Table 4.5 Parity of the participants 19
Table 4.6 Cost of laboratory tests (mother) 20
Table 4.7 Cost of laboratory tests (neonate) 21
Table 4.8 Costs of laboratory tests for mothers against those for babies 21
Table 4.8 Recording of laboratory tests for mothers 23
Table 4.9 Recording of laboratory tests for neonates 24

DEFINITION OF TERMS

District Health System: District health system (DHS): the most decentralised structure responsible for the governance and management of the health system, established in terms of the National Health Act (61 of 2003) along the boundaries of District and Metropolitan Municipalities. If deemed appropriate, the Act enables the demarcation of Districts into Sub-Districts. (Scheider and Barron, 2008)

Maternal death: Deaths of women while pregnant or within 42 days of termination of pregnancy from any cause related to or aggravated by the pregnancy or its management, but not from accidental or incidental causes. (Department of Health, 2005)

Laboratory test: A medical procedure that involves testing a sample of blood, urine, or other substance from the body. (www.mdanderson.org/patients public/about cancer/display.cfm)

LIST OF ABBREVIATIONS

Abbreviation	Meaning
AIDS	Acquired Immune Deficiency Syndrome
ALT	Alanine Transaminase
AST	Aspartate transaminase
CULGE	Genital Swab
CULSP	Sputum Culture
C/UP	Cut Up
CULUR	Urine Culture
DHIS	District Health Information System
FBC	Full blood count
GTT	Glucose tolerance test
Hb	Heamoglobin
HIV	Human Immunodeficiency Virus
HISTO	Histology
INR	International normalized ratio
LDH	Lactate Dehydrogenase
LFT	Liver Function Test
MCS	Urine Microscopy
NHLS	National Health Laboratory Service
PLT	Platelet
PTT	Partial Thromboplastin
RBG	Random blood glucose
RH	Rhesus
RPR	Rapid Plasma Reagin
S-UEC	Serum Urea & Creatinine
S-URIC/A	Serum Uric Acid
UA	Uric Acid
UECA	Urea Creatinine Electrolytes
UPROT	Urine Protein
USA	United States of America
VDRL	Venereal disease research laboratories

CHAPTER 1
INTRODUCTION

The purpose of this study was to describe laboratory tests undertaken in the Maternity unit of Gordonia Hospital during the study period and also to document their costs and recording of results in patient files. This introductory chapter will cover background and justification of the study, problem statement, and its aims and objectives.

1.1 BACKGROUND

Maternal mortality has been on the agenda of global health organizations for the last 20-30 years (Department of Health, 2006). There is a growing global commitment to reduce high maternal death rates in developing countries. The millennium development goals number 4 and 5 have been formulated to improve maternal health services (UNO, 2000). Progress towards this goal in South Africa demands national cooperation to assess the causes of maternal death, provide guidelines regarding maternity care, and to ensure that quality health services are rendered (Department of Health,2007) The Department of Health has identified essential elements of maternal care in various levels of care provided by the health facilities (Department of Health, 2007). In this respect, District hospitals play an important role in the delivery of maternal health care. The Department of Health has suggested availability of following essential services in a District Hospital (Annexure A): High risk antenatal care, ultrasound, 24 hours labour and delivery services, clinical procedures (such as caesarean section, vacuum extraction and manual removal of placenta), blood transfusion, laboratory services and postnatal care. The laboratory tests undertaken in the maternity unit forms an essential component of providing optimum maternal care at all hospitals.

Gordonia Hospital, a district hospital situated in the Northern Cape Province offers maternal health services in a remote area of South Africa and is the focus of this study.

1.2 STATEMENT OF THE PROBLEM

It is hypothesized that as a result of the increased burden of maternity patients and their disease profile (such as HIV), laboratory tests and the costs of tests have been increasing at this Hospital's Maternity Unit for the past few years. One of the essential components of effective maternal health services is availability of laboratory and radiological diagnostic facilities. The laboratory services which are rendered by the NHLS in South Africa have been increasingly receiving attention of the Provincial department of health due to cost of lab services and increasing volume of lab tests. No correlation exist that increasing lab expenditure reflect in improvement of health care benefits such as maternity care.

1.3 JUSTIFICATION FOR THE STUDY

The laboratory services in the health care continue to be one of the top cost drivers over the past few years. The improvement of maternal health services is one of the priority areas for the Department of Health. Laboratory tests requested from a maternity unit forms an essential component of providing optimum maternal care in the district hospitals. The 2008/9 expenditure report for Gordonia Hospital reports that out of its total operational costs, 10% is spends on laboratory costs. The contribution of maternity units towards lab costs has not been reported. A systematic study of laboratory test in the Maternity unit of this Hospital will therefore assist the Hospital.

1.4 RESEARCH QUESTION

To describe laboratory tests undertaken in the Maternity unit of Gordonia Hospital during the study period and also to document their costs and recording of results in patient files.

1.5 STUDY OBJECTIVES

1.5.1 BROAD OBJECTIVE

The aim of the study was to describe laboratory tests undertaken at the Maternity unit of Gordonia Hospital during the study period and also to document their costs and recording of results in patient files.

1.5.2 SPECIFIC OBJECTIVES

1. To describe the laboratory tests and the clinical profile of the patients for whom these tests were requested at the Maternity unit of the Gordonia Hospital during the study period.
2. To document the costs of laboratory tests undertaken in the maternity unit during the study period.
3. To document the recording of test results by doctors in patient files and to document the turn-around time for each test.

1.6 SUBSEQUENT CHAPTERS

Chapter one provided an overview of the study, defined the aim and objectives. The subsequent chapters are as follows:

Chapter Two: Literature Review

This chapter deals with relevant literature and studies related to the study and seeks to establish what current practices are in similar settings nationally and internationally.

Chapter Three: Research Methodology

In this chapter the research methodology, methods and techniques utilised are explained.

Chapter Four: Presentation of Results

The findings of the study pertaining to aims and objectives are analysed in this chapter.

Chapter Five: Discussion

This chapter focuses on the drawing parallels from the literature and results of the study in an effort to explain the aims and objectives.

Chapter Six: Conclusions and Recommendations

In this chapter conclusions emanating from the study are cited, recommendations are made with regards to future studies in the area of caesarean sections.

CHAPTER 2
LITERATURE REVIEW

In this chapter, relevant reports and articles from the literature review on laboratory tests with particular reference to the tests performed for maternity patients, and their costs will be reviewed.

2.1 MATERNAL HEALTH

The World Health Organization (WHO) and other international organizations gave increased attention to maternal health and more specifically maternal mortality and morbidity in developing countries over the last decade. In South Africa, The Department of Health established Confidential enquiries into maternal deaths which has produced a fourth report in 2008 (Department of Health, 2008). It has recorded a 20.1% increase in number of maternal deaths reported in (2005-2007) in comparison to the previous triennium (2002-2004). The 'big five causes of maternal deaths' were AIDS (43.7%), complications of hypertension (15.7%), obstetric haemorrhages (12.4%), pregnancy related sepsis (9%), and pre-existing disease (6%). The panel recommended improvement in four areas (knowledge development, quality of care and coverage of reproductive health services, establishing norms and standards and community developments). They recommended development and implementation of guidelines and protocols for effective management such as screening for HIV, hypertension, pre-existing medical conditions.

2.2 LABORATORY TESTS USED IN MATERNITY

Laboratory data are important in the medical decision making process and influence 70% of medical diagnosis (Erasmus, and Zemlin, 2009:593).

The Guidelines for Maternity Care in South Africa (2007:26) indicate essential screening investigations and screening tests that are not offered routinely. (Table 2.1). It further states that women admitted with pre-eclampsia need a full blood count including platelet count; serum urea and creatinine; serum uric acid; aspartate transaminase (AST) and urine dipstick test for protein. In suspected rhesus

incompatibility, the blood has to be sending for atypical antibody testing at 24, 32 and 36 weeks (Department of Health, 2007: 110).

Table 2.1 Tests for maternal health services

Routine tests	Non-routine tests
• syphilis serology (Rapid Plasma Reagin(RPR), Wassermann reaction(WR),Venereal disease research laboratories (VDRL); • Rhesus (D) blood group; • Heamoglobin (Hb) level; • HIV serology and • Urine dipstick for protein and glucose	• ABO group; • triple screen for Down's syndrome and neural tube defects; • rubella serology; • blood glucose screening; • cervical smear; • urine culture • full blood count (FBC)

The following tests are done at the laboratory: RPR; WR; VDRL; Rhesus blood group; HIV serology; ABO group; Down's syndrome; rubella serology; cervical smear; urine culture and full blood count.

In the developed countries like the United States of America (USA) the essential tests for maternal care include additional tests like, urine culture and sensitivity; blood count, Rhesus antibody screening; culture for gonorrhoea; papanicolaou smear; hepatitis; and rubella antibody screening (New Jersey Department of Health and Senior Services, 1997), autoimmune thyroid diseases (Dosiou, Sanders,, Araki, et al., 2008).

2.3 FACTORS INFLUENCING USE OF LABORATORY TESTS USED IN MATERNITY

Healthcare delivery organizations globally are utilizing various quality indicators to measure the efficacy of specific interventions as well as to identify healthcare improvement opportunities. These quality indicators are further being used for performance and outcome measurements as a means to measure, to monitor and to improve the quality of care and services. Evaluation of laboratory tests now started getting increasing attention due to spiralling cost of health care in both developed and developing countries.

Laboratory tests in maternity wards play an important role in screening, diagnosis and monitoring of maternity patients. However the use of these tests is influenced by various defined factors (such as clinical condition of patients) as well as ill-defined factors. For example, the facilities which cater for unbooked and walk-in patients have higher costs for laboratory tests than those that have booked patients. (Shaw, Gutierrez, Fridman, et al., 2008).

The knowledge of health professionals plays an important role in utilization of laboratory tests. Mepham, Bertel Squire, Chisuwo et al (2009) found in Malawi, that 25% of commonly requested laboratory tests were not utilized effectively and 36% of the results had no influence on patient management. This can be attributed due to failures of medical doctors to recognize the correct definitions for sensitivity and positive predictive value (Steurer, Fischer, Bachmann et al, 2002).

Lack of availability of test results does lead to health professionals to repeating the tests which does increase the cost. Repeat tests account for a considerable portion of overall laboratory testing in both developed and developing countries. In a study conducted in Canada reported that tests repeated within 30 days of the index test account for 30% of total laboratory utilization. (Van Walraven, Cernat, Austin, 2006).

Use of newer technologies (such as rapid testing for syphilis) also do play an important role and assist in improvement of maternal health services without increasing cost (Levin, Steele, Atherly, et al., 2007).

2.4 COSTS OF LABORATORY TESTS USED IN MATERNITY

Laboratory costs are one of the major costs drivers in hospitals (van Walraven and Naylor, 1998:550). Laboratory tests are examples of “little-ticket” health care technologies, because they are commonly used, and cost the health care system large amounts of money (van Walraven and Naylor, 1998:550). A study conducted in Ghana and Benin concluded that 62% of medical costs were due to drugs and medical supplies including laboratory tests (Borghi, Hanson, Adjei Acquah et al, 2003). However, they do not specify the actual laboratory costs.

In an effort to cut costs, healthcare organizations are studying test utilization and its impact on clinical outcomes. It was found that numerous tests were performed unnecessarily that lead to an unnecessarily high workload and unnecessary costs (Erasmus and Zemlin, 2009). This is true in developed as well as developing countries like Malawi (Mepham, Bertel Squire, Chisuwo, et al., 2009).

CHAPTER 3
METHODOLOGY

In this chapter the study design, setting, scope, population are covered. The chapter further describes data collection, research tools and specifies methods of data analysis and statistical tests.

3.1 INTRODUCTION

The Human Research Ethics Committee of the Witwatersrand approved this study; authorization was also obtained from the Head of the Department of the Northern Cape Department of Health

3.2 STUDY DESIGN

A cross sectional descriptive study design was used.

3.3 STUDY SETTING

The study took place in the Maternity Unit of the Gordonia Hospital in the Siyanda District of the Northern Cape Province.

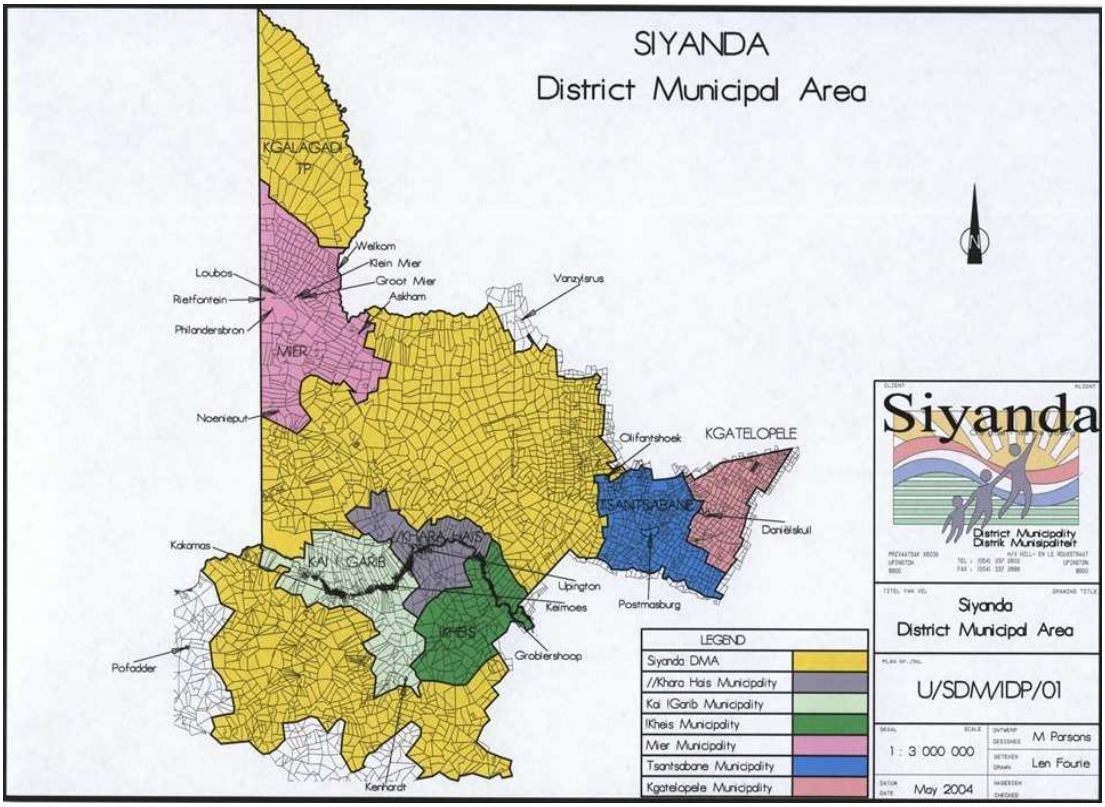


Figure 3.1 Siyanda District Municipality

Siyanda District

The Northern Cape Provincial Government has embraced District Health systems for improvement of health service delivery like the rest of South Africa. District health Services are rendered in all six local municipalities. .

Gordonia Hospital

Gordonia Hospital is a 191 bed district hospital in the Siyanda District of the Northern Cape Province that serve as a referral hospital for four out of the six sub-districts of the Siyanda District, as well as the nearby Namakwa District(Northern Cape Department of Health,2009). The total catchment population of 236 749 of the Siyanda District is spread over an area of approximately 10 901km², with a population density of 2.02 people per km² (Northern Cape Department of Health, 2009). The service package for this Hospital includes mainly level 1 service and limited level 2 hospital services including a 24-hour service for acute gynaecological and obstetric problems

and deliveries of most high-risk pregnancies. The hospital has a male, female, children's, maternity and a TB ward; a 24 hr casualty; 2 x theatres; a high care unit; specialist outpatient clinics and clinical support services for radiology, physiotherapy, occupational therapy, speech and hearing, pharmacy, dietetics and laboratory services.

The Maternity Unit has 26 beds (an average of 180 deliveries per month) and is responsible for all referred antenatal, intra-partum, postnatal, neonatal and premature care. Services include emergency obstetrics & gynaecology, ultrasound, prenatal diagnosis, basic urogynaecology, mid trimester abortions and adequate pain relief systems, basic oncology, menopause and screening programmes, and preliminary infertility investigations.

Due to remote geographical location of the Hospital, the maternity Unit has been receiving an increasing number of patients (A bed utilization rate of 108%in 2009, DHIS) over the last five years. In addition, the Maternity unit also has a high caesarean section rate (42.2% in 2009, DHIS) as no CS is done at the nearby hospitals that refer patients to Gordonia Hospital. This poses challenges of over-expenditure and infrastructure problems for the Hospital management. An initial review of Hospital expenditure for 2008/ 2009 revealed Laboratory expenditure of 10% of hospital operational expenditure (Northern Cape Department of Health Expenditure report 2008/9). Although the information for laboratory tests has been routinely available from the National Health Laboratory Services (NHLS) and the Hospital information system, no formal study has been done to systematically analyze this expenditure at this Hospital.

3.4 STUDY SCOPE

Data for this study was extracted from the records of the Maternity unit as well as the NHLS laboratory situated at the hospital. No primary data collection was done. No intervention was done as a part of this study. Records with more than 10% missing values were excluded.

3.5 STUDY POPULATION

Patient records of the maternity unit as well as laboratory invoices for the month of September 2009.

3.6 SAMPLE

All the patient records and laboratory invoices for the month of September 2009 were reviewed. The month of September was chosen as it is in the middle of a financial year and is not influenced by financial decisions.

Admissions for the study period were 183. Laboratory tests were requested for 52 mothers and 30 babies due to their underlying medical condition. A total of 82 patients did not have laboratory tests because all the necessary tests were done and recorded at Primary Health Care level and hence, not repeated. In 49 cases, the information was incomplete or the file was lost.

The sample size for the study period was 52 mothers and 30 babies.

3.7 MEASUREMENT AND DATA SOURCE

3.7.1 STUDY INSTRUMENT

Data collection tools based on MS excel (Appendix B) was developed and used to collected data from the patient records in the Maternity unit and the NHLS laboratory invoices for the month of September 2009.

3.7.2 VARIABLES

Variables that were used with their indicators highlighting what was being measured with each variable for each objective are listed in Table 3.1.

The list of variables is described in the Table 3.1.

Table 3.1 List of variables

Objectives	Tools	Variables	Indicators
1	**1 and 3**	Laboratory tests (types, clinical profile of patients)	• Types of laboratory tests (such as Haemoglobin, RPR, HIV) • Number of laboratory tests per category • Number of patients admitted • Proportion of admitted patients for whom laboratory tests were done • Proportion of admitted patients for whom laboratory tests were done according to age range • Proportion of admitted patients for whom laboratory tests were done according to gravidity(pregnancies) • Proportion of admitted patients for whom laboratory tests were done according to parity (children)
2	**2**	Cost of laboratory tests	• Unit cost per test • Total cost per test • Total cost for recorded and non-recorded tests • Expenditure on tests from the maternity unit as a proportion of total laboratory expenditure for the facility
3	**3**	Recording of laboratory results	• Proportion of tests results recorded in patient files • Proportion of test results within 1day.

3.7.3 DATA COLLECTION

Data was collected from the patient records and laboratory invoices for the specific period (September 2009). The maternity admission book, the maternity register, the patient files and the electronic printouts from the laboratory were used to collect the data to describe the laboratory tests and the clinical profile of the patients, the costs of laboratory tests, recording of test results by doctors in patient files and the turn-around time of tests. Tools based on MS excel were used to extract data in coded form.

3.7.4 DATA MANAGEMENT

Frequency tables were used in the case of categorical responses and means and standard deviations in the case of continuous responses.

3.8 PILOT STUDY

No pilot study was conducted as the data for this study were routinely collected through hospital information system.

3.9 ETHICAL CONSIDERATIONS

Approval to do the research was given by the Hospital Manager as well as the Head of Department of Health in the Northern Cape Province. Approval was also given by the Wits University Human Research Ethics Committee (M 10830). Confidentiality when working with patient records was assured by using codes. The result or outcome of the study will be available to the hospital manager as well as the head of department.

CHAPTER 4
RESULTS

The results obtained from the analysis of data are presented in this chapter

4.1 LABORATORY TEST & THE CLINICAL PROFILE OF PATIENTS TESTED

4.1.1 NUMBER OF PATIENTS ADMITTED

A total number of 183 patients were admitted during the study period.

4.1.2 NUMBER OF TESTS DONE

Laboratory tests were done for 52 mothers and 30 babies born during the study period.

4.1.2.1. MOTHER

The test done for mothers is described in table 4.1. There were a total of 524 tests done within 24 categories of tests. The most common tests done during the period was Uric Acid (UA) with 26 out of 52 pts, followed by Urea Creatinine Electrolytes (UECA) with 24, Platelets (PLT) with 23, and Aspartate transaminase (AST) & Lactate dehydrogenase (LDH) & Haemoglobin (HB) with 21, and Alanine transaminase (ALT) with 20. The highest number of tests done was UA with 35 out of the 524, UECA (32), PLT (30), LDH (29), followed by ALT, AST and HB all with 26 tests.

Other tests done were Rhesus factor (RH) with 13, Rapid plasma regain (RPR) - 11, Urine culture (CULUR - 7, Urine protein (UPROT) - 6, HIV & Liver function test (LFT) 5, International normalised ratio (INR) - 4, Genital Swap (CULGE) & Sensitivity & Full blood count (FBC) - 3, Sputum culture (CULSP) & Cut-up (C/UP) & Histology - 2 and Differential Count (DIFFM), Tuberculosis (TBA), CREATINE and UREA with 1.

Table 4.1 Number of laboratory tests done for mothers

Test Name	No pt	No tests
UA	26	35
UECA	24	32
PLT	23	30
LDH	21	29
AST	21	26
ALT	20	26
HB	21	26
RH	13	13
RPR	11	11
UPROT	6	8
HIV	5	7
CULUR	7	7
SENS	3	5
LFT	5	5
CULSP	2	4
INR	4	4
CULGE	3	3
FBC	3	3
TBA	1	3
C/UP	2	2
HISTO	2	2
DIFFM	1	1
CREATINE	1	1
UREA	1	1
TOTAL		524

4.1.2.2. NEONATES

The test done for neonates is described in table 4.2. There were a total of 163 tests done within 21 categories of tests. The most common tests done during the period was FBC with 24 out of 30 pts, followed by PBIL with 22, and CRP with 20. The highest number of tests done was Paediatric Bilirubin (PBIL) with 65 out of the 163, FBC with 34 and C-reactive protein (CRP) with 29 tests.

Other test done were LDH & UECA (5), Cystic fibrosis (CSF) & TBA (4), CULSP (3) and Microbiology Cathetetip (CULCT), Hematocrit (HCT),SENS, DIFFM, HERP, CULUR, TBCUL, CULPU, Microbiology Blood Culture (CULBC), Toxoplasmosis(TOXO), Cyto megalo virus(CMV), HB all with (1).

Table 4.2 Number of laboratory tests done for neonates

Test Name	No pt	No tests
PBIL	22	65
FBC	24	34
CRP	20	29
UECA	5	5
LDH	2	5
CSF	4	4
TBA	1	4
CULSP	1	3
HIV	2	2
CULCT	1	1
HCT	1	1
DIFF	1	1
HERP	1	1
CULUR	1	1
TBCUL	1	1
CULPU	1	1
CULBC	1	1
TOXO	1	1
CMV	1	1
HB	1	1
SENS	1	1
TOTAL		163

4.1.3 PROFILE OF PATIENTS

The profile of patients is described according to age, gravidity- and parity status.

4.1.3.1. AGE

The mean age (average age) for the participants is 26.4 years and the standard deviation (average deviation from the mean age) is 6.1 year.

Table 4.3 reflects the number/proportion of patients tested according to age range. Twenty four or 46.2% of the 52 patients that were tested was in the age range 26-35 years, followed by 20 or 38.5% within the range of 19 -25 years of age. Only 5 or 9.6 % of the tested patients were in the age range of 13 -18 year and 3 or 5.7% of the patients were in the age range ≥35 years.

Table 4.3 Age of the participants

Age in years	Number of patients tested	Proportion of patients tested
Median (IQR)		
Age groups		
13-18 years	5	9.6
19-25 years	**20**	**38.5**
26-35 years	24	46.2
≥35 years	3	5.7
Total	52	100

4.1.3.2. GRAVIDITY

Table 4.4 reflects the number/proportion of patients tested according to gravidity (pregnancies). In twenty eight percent or 15 of women tested it was the 1st pregnancy, 40.4 % or 21 had a gravidity status of 2-3 pregnancies; whiles 16 or 30.8% of patients were in the gravidity range of ≥4.

Table 4.4 Gravidity status of the participants

Gravidity	Number of patients	Proportion of patients
Median (IQR)	3 ()	
1	15	28.8
2-3	21	40.4
≥4	16	30.8
TOTAL	52	100

4.1.3.3 PARITY

Table 4.5 reflects the number/proportion of patients tested according to parity (children). Twenty one patients or 40.4% of patients tested were in the parity range of 1-3 children, whiles 16 or 30.8% and 15 or 28.8% of patients were in the parity ranges of ≥4 and 0 children respectively.

Table 4.5 Parity of the participants

Parity	Number of patients	Proportion of patients
Median (IQR)	1 (0-3)	
0	15	28.8
1-3	21	40.4
≥4	16	30.8
TOTAL	52	100

4.2 COST OF LABORATORY TESTS AND HEALTH EXPENDITURE

4.2.1 COST OF LABORATORY TESTS

4.2.1.1 MOTHERS

Table 4.6 reflects the unit as well as total costs per tests for the mothers tested. The expenditure for tests done for mothers was 62.1% of the total laboratory costs at the maternity unit. Liver Function Tests (LFT) was the most expensive test costing R256.56, followed by histology at R187.17, urine protein (UPROT) at R140.58 and UEAC at R96.28t. Other more expensive tests were sensitivity test cost R57.88, full blood count (FBC) cost R48.30 and urine culture cost R45.63. The rest of the test ranged from R37.84 to R15.03, HB costing R15.03.

The highest proportion of tests for mothers, were those of UECA with 23.3%, followed by 9.7 % for LFT, 8.5% for urine protein, 8.2% for AST, ALT and LDH.

The amount for the total repeat tests for mothers was R1985.12, 15% of the total expenditure for mothers.

Table 4.6 Cost of laboratory tests (mother)

Test	No pt	No tests	Unit cost per test	Total cost per test
UECA	24	32	96.28	3080.96
LFT	5	5	256.56	1282.80
UPROT	6	8	140.58	1124.64
AST	21	26	37.84	1097.36
ALT	20	26	37.84	1097.36
LDH	21	29	37.84	1097.36
UA	26	35	26.61	931.35
PLT	23	30	17.81	534.30
HB	21	26	15.03	390.78
HISTO	2	2	187.17	374.34
RH	13	13	28.49	370.37
CULUR	7	7	45.63	319.41
SENS	3	5	57.88	289.40
HIV	5	7	36.73	257.11
RPR	11	11	16.37	180.07
INR	4	4	39.40	157.60
FBC	3	3	48.30	144.90
CULSP	2	4	35.41	141.94
CULGE	3	3	35.41	106.53
TBA	1	3	31.27	93.81
C/UP	2	2	35.39	70.78
DIFFM	1	1	26.49	26.49
CREATINE	1	1	25.27	25.27
UREA	1	1	25.27	25.27
TOTAL		**524**		**13 220.20**

4.2.1.2 NEONATES

Table 4.7 reflects the unit as well as total costs per tests for the babies tested. The expenditure for tests done for neonates was 33.8% of the total laboratory costs for the maternity unit. Cystic Fibrosis(CSF) were the most expensive test at R106.19/test , followed by UEAC at R96.28/tests, TB Culture at R72.98/test, C-reactive protein(CRP) at R60.77/test, Full blood Count (FBC) at R48.30/test and Paediatric Bilirubin at R51.76/test. Other expensive tests were, culture urine (CULUR) at R45.63/test and LDH at R37.84/test. The rest of the test ranged from R36.73 till R15.03.

The highest proportion spend for babies per category of tests were those of paediatric bilirubin with 26.9%, followed by 24.5 % for CRP, 22.8% for full blood count (FBC) and 6.6 % for UECA.

The amount for the total repeat tests for neonates was R2364.09. That calculates to a 32.8% of the total expenditure for neonates.

Table 4.7 Cost of laboratory tests (neonate)

Test	No pt	No tests	Unit cost per test	Total cost per test
PBIL	22	65	29.38	1909.70
CRP	20	29	60.77	1762.33
FBC	24	34	48.30	1642.20
UECA	5	5	96.28	481.40
CSF	4	4	106.19	424.76
LDH	2	5	37.84	189.20
TBA	1	4	31.27	125.08
CULSP	1	3	35.41	106.23
HIV	2	2	36.73	73.46
TBCUL	1	1	72.98	72.98
SENS	1	1	57.88	57.88
HERP	1	1	52.87	52.87
CULUR	1	1	45.63	45.63
CULCT	1	1	35.41	35.41
CULPU	1	1	35.41	35.41
CULBC	1	1	35.41	35.41
TOXO	1	1	35.39	35.39
HCT	1	1	32.72	32.72
CMV	1	1	32.72	32.72
DIFF	1	1	26.49	26.49
HB	1	1	15.03	15.03
TOTAL		**163**		**7 192.30**

4.2.1.3 LABORATORY COSTS FOR MOTHERS AGAINST THOSE FOR BABIES

The average number of tests done for mothers was 10.1. This is twice that for babies, as the average number of tests for babies was 5.4. The average cost per patient for mothers were more than those for babies; however the average costs per test for mothers were almost half the costs less than per test for babies. Test for babies are more expensive in comparison with the test requested for mothers.

Table 4.8 Costs of laboratory tests for mothers against those for babies

	Mothers (n=52)	Babies (n=30)
Average number of laboratory tests	10.1	5.4
Average laboratory cost per patient	R254.23	R239.74
Average cost per laboratory test	R25.23	R44.12

4.2.2. HEALTH EXPENDITURE

The total expenditure for Gordonia Hospital during the study period was R27 719 475.84. The total expenditure for laboratory services for Gordonia Hospital during the study period was R423 470.17. The total laboratory costs for the maternity unit during the study period was R21 280. The proportion spends on the maternity unit as part of the total laboratory expenditure was 5% whiles the proportion spends as part of the total hospital expenditure was 0.08%.

The proportion spends on mothers as a part of the total maternity unit expenditure was 62.1%, while the proportion for neonates was 33.8%. The remainder 4.1% spending was on administrative costs.

A total amount of R4 349.21 was spending on repeat tests, 20.4% of the total laboratory expenditure for the maternity unit.

All tests were recorded in the patient files.

4.3 RECORDING OF LABORATORY RESULTS

The recording of laboratory results refers to turnaround times, repeat tests and recording in the patient files.

4.3.1. RECORDING OF LABORATORY RESULTS FOR MOTHERS

Table 4.9 presents recording of laboratory results for mothers. A total of 16.6% of test results were recorded within 2days. The categories of results reported within 2days was Rhesus factor (RH), Genital swap (CULGE), uric acid (UA) and urine culture.
Repeat tests were done for 41.6 % of the total categories of tests. The most repeats happened in a range of 1-3. Tests repeated for uric acid was 9, for UECA - 8, PLT - 7, and for AST and HB 5 each. All tests were recorded by the doctors in the patient files.

Table 4.9 Recording of laboratory tests for mothers

Test Name	No pt	No tests	Turnaround Time	Repeats	No Repeats	Check
RH	13	13	1 (1-2)	0	0	13
RPR	11	11	1	0	0	13
UECA	24	32	1	4	2 (1-3)	24
HIV	5	7	1	2	2	5
SPUTUM	2	4	1	1	1	2
DIFFM	1	1	1	0	0	1
CULGE	3	3	1 (1-2)	0	0	3
SENS	3	5	1	1	2	3
PLT	23	30	1	1	2	23
AST	21	26	1	2	3-4	21
ALT	20	26	1	3	1-3	20
LDH	21	29	1	4	1-3	21
UA	26	35	1-2	4	1-3	26
CULUR	7	7	1-2	0	0	7
C/UP	2	2	1	0	0	1
HISTO	2	2	1	0	0	1
HB	21	26	1	3	1-2	21
FBC	3	3	1	0	0	3
LFT	5	5	1	1	2	5
UPROT	6	8	1	1	2	6
INR	4	4	1	0	0	4
TBA	1	3	1	1	2	1
CREATINE	1	1	1	0	0	1
UREA	1	1	1	0	0	1
TOTAL		**524**				

4.3.2 RECORDING OF LABORATORY RESULTS FOR NEONATES

Table 4.10 presents recording of laboratory results for babies. All test results were recorded the same day.

Repeat tests were done for 19 % of the total tests. The highest total of repeats was in the range of 1-3. The repeat tests were for paediatric bilirubin with 43 repeats, full blood count with 10, CRP with 9 and sputum culture with 2 tests.

All tests were recorded by the doctors in the patient files.

Table 4.10 Recording of laboratory tests for neonates

Test Name	No pt	No tests	Turnaround Time	Repeats	No Repeats	Check
CRP	20	29	1	4	2-3	29
PBIL	22	65	1	11	2-7	65
UECA	5	5	1	0	0	5
HIV	2	2	1	0	0	2
CULSP	1	3	1	1	2	3
CULCT	1	1	1	0	0	1
HCT	1	1	1	0	0	1
SENS	1	1	1	0	0	1
CSF	4	4	1	0	0	4
DIFF	1	1	1	0	0	1
LDH	2	5	1	1	3	5
HERP	1	1	1	0	0	1
CULUR	1	1	1	0	0	1
TBCUL	1	1	1	0	0	1
TBA	1	4	1	0	0	4
FBC	24	34	1	3	3-4	34
CULPU	1	1	1	0	0	1
CULBC	1	1	1	0	0	1
TOXO	1	1	1	0	0	1
CMV	1	1	1	0	0	1
HB	1	1	1	0	0	1
TOTAL		**163**		**20**		**163**

CHAPTER 5
DISCUSSION

5.1 INTRODUCTION

This was the first study in District Hospital in the Northern Cape and it was undertaken against the backdrop of a rise in the laboratory expenditure in the Province and the austerity measures currently undertaken by the Department.

Data of a total of 52 mothers and 30 neonates who had been admitted in the Maternity unit of the Hospital during a period of one month was reviewed. The aim was to describe laboratory tests undertaken in the Maternity unit of Gordonia Hospital during the study period and also to document their costs and recording of results in patient files.

5.2 LABORATORY TESTS PERFORMED AND THE CLINICAL PROFILE OF PATIENTS IN THE MATERNITY UNIT

A total number of 183 patients were admitted during the study period. Fifty two patients (28.4 %) had laboratory tests. Eighty two mothers (44%) were not tested because the prescribed test were already done at primary health care level and was recorded as such. A total of 27% of patient files recorded in the maternity register could not be found at the facility. Laboratory tests were also done for 30 babies (16%) out of 183 born at the facility during the study period. Test for these babies were necessary as a result of their medical condition at birth. Sixty four percent (153) babies did not need to be tested.

5.2.1. NUMBER OF TESTS DONE

5.2.1.1 MOTHERS

There were a total of 524 tests done for mothers within 24 categories. The most common tests done during the period were Uric Acid, Urea creatinine & Electrolytes, and Platelets, Aspartate transaminase, Lactate dehydrogenase, Haemoglobin and

Alanine transaminase. Most of the patients tested, presented with hypertensive disorders of pregnancies and more specifically pre-eclampsia. The Guidelines for Maternity Care in South Africa (2007:26) states that women admitted with pre-eclampsia needs full blood count including platelet count; serum urea and creatinine; serum uric acid; aspartate transaminase and urine dipstick test for protein. These tests need to be repeated weekly depending on the grade of pre-eclampsia.

5.2.1.2. NEONATES

There were a total of 163 tests done within 21 categories of tests. The common tests done during the period was Full Blood Count, Paediatric Bilirubin, and C - reactive protein. The highest number of tests done was Paediatric Bilirubin (PBIL), followed by Full Blood Count and C-reactive protein (CRP). Full blood count was done as a baseline, routine tests for infants and the bilirubin and C - reactive protein were done for babies with neonatal jaundice. Although doctors at the hospital indicated that the hospital's protocol states that bilirubin test have to be taken every second day, the research shows that in some cases the tests were requested on a daily basis. .

5.2.2. PROFILE OF PATIENTS

5.2.2.1. AGE

The mean age (average age) for the participants is 26.4 years and the standard deviation (average deviation from the mean age) is 6.1 year. Patients tested within the age ranges 26-35 years and 19-25 years were 46, 2% and 38.5% respectively. These ages are also the reproductive years of women. . Only 9, 6 % and 5.7% were within the age ranges of 13-18 (teenage) and ≥35 years respectively.

5.2.2.2. GRAVIDITY

In twenty eight percent or 15 of women tested it were the 1st pregnancy, 40.4 % or 21 had a gravidity status of 2-3 pregnancies; whiles 16 or 30.8% of patients were in the gravidity range of ≥4. According to the Guidelines for Maternity Care in South Africa of 2007, pregnant women most susceptible for pre-eclampsia are women with 1st

pregnancies in the teenage and elderly ranges, women with multiple pregnancies with new partners, and women of age ≥35 years.

5.2.2.3. PARITY

Forty percent of women tested were in the parity range of 1-3 children, whiles 30.8% and 28.8% of women were in the parity ranges of ≥4 and 0 children respectively.

5.3 COST OF LABORATORY TESTS AND HEALTH EXPENDITURE

5.3.1 COSTS OF LABORATORY TESTS

5.3.1.1 MOTHERS

The expenditure for tests done for mothers was 62.1% of the total laboratory costs for the maternity unit. The most expensive tests were Liver Function Tests (LFT) at R256.56/test, followed by histology at R187.17/tests, urine protein (UPROT) at R140.58/test and UEAC at R96.28/test. Other expensive tests were sensitivity at R57.88/test, full blood count (FBC) at R48.30/test and culture urine (CULUR) at R45.63/test. The rest of the test ranged from R37.84 till R15.03.

The highest proportion spend for mothers per category of tests were those of UECA with 23.3%, followed by 9.7 % for LFT, 8.5% for urine protein, 8.2% for AST, ALT and LDH. Those were the common tests requested.

The amount for the total repeat tests for mothers was R1985.12, 15% of the total expenditure for laboratory tests for mothers and a 46% of total repeat tests.

5.3.1.2 NOENATES

The expenditure for tests done for neonates was 33.8% of the total laboratory costs for the maternity unit. The most expensive tests for neonates were Cystic Fibrosis (CSF) at R106.19/test, followed by UEAC at R96.28/tests, TB Culture at R72.98/test, C-reactive protein(CRP) at R60.77/test, Full blood Count (FBC) at R48.30/test and

Paediatric Bilirubin at R51.76. Other expensive tests were, culture urine (CULUR) at R45.63/test and LDH at R37.84/test. The rest of the test ranged from R36.73 till R15.03.

The highest proportion spend on tests were those of paediatric bilirubin with 26.9%, followed by 24.5 % for CRP, 22.8% for full blood count (FBC) and 6.6 % for UECA. Those were the most common tests done.

The cost for the total repeat tests for neonates was R2364.09 which is 32.8% of the total laboratory expenditure for neonates.

5.3.2. HEALTH EXPENDITURE

The total expenditure for Gordonia Hospital during the study period was R27 719 475.84. The total expenditure for laboratory services for at the Hospital during the study period was R423 470.17. The total laboratory costs for the maternity unit during the study period was R21 280.The expenditure for laboratory tests at the maternity unit as a proportion of total laboratory expenditure of the hospital is 5% and as a proportion of the total hospital expenditure is 0.08%.

The proportion spends on mothers was 62.1% of the total maternity unit expenditure, whiles the proportion for neonates was 33.8%. A 4.1% was spending on administrative costs.

A total amount of R4 349.21 was spending on repeat tests, 20.4% of the total laboratory expenditure for the maternity unit. Repeat tests were done on both mothers and babies.

All tests were recorded in the patient files which indicated no unnecessary laboratory costs.

5.4 THE RECORDING OF TEST RESULTS BY DOCTORS IN PATIENT FILES AND TURN-AROUND TIME OF TEST

5.4.1. MOTHERS

83.4% of tests results were back within a day which is within the norm. A total of 16.6% of test results were returned within 2days. The categories where results were returned within 2days were Rhesus factor (RH), Genital swap (CULGE), uric acid (UA) and urine culture.

Repeat tests were done for 41.6 % of the total categories of tests. The most tests that were repeated were within a range of 1-3. Repeat tests were done for uric acid, UECA, PLT, and for AST and HB. This relates to the fact that most mothers tested were diagnosed with pre-eclampsia and it was therefore necessary to repeat the specific test. All tests were recorded by the doctors in the patient files.

5.4.2 NEONATES

All test results were received and recorded the same day. Repeat tests were done for 19 % of the total categories of tests. The most tests that were repeated were within a range of 1-3. The high number of repeat tests happened for paediatric bilirubin, full blood count and CRP. These were also the test that was repeated according to the internal guideline of the hospital. Although the guideline stated for bilirubin every two days, the research shows in some cases tests were repeated daily. All tests were recorded by the doctors in the patient files.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS RELATED TO THE OBJECTIVES OF THE STUDY

6.1.1 LABORARORY TESTS PERFORMED AND PROFILES OF PATIENTS IN THE MATERNITY UNIT

Gordonia Hospital on an average admits 180 patients per month per year in the maternity unit. The study showed that for around 28% of the in - patients, laboratory tests are requested. Tests were requested mainly for patients with hypertensive disorders of pregnancy and more specific pre-eclampsia. 46.6 % of patients are in the reproductive ranges of age (22 -29). Most patients tested were in the gravidity range of 2-3 pregnancies, whiles parity was in the range of 1-3 children.

6.1.2 THE COSTS OF LABORATORY TESTS UNDERTAKEN IN THE MATERNITY UNIT

It can be concluded that laboratory expenditure from the maternity unit was 5% of the total laboratory expenditure of the hospital for September 2009. The costs of laboratory tests for mothers are twice more than those for neonates. The repeated tests calculated to 20.4 % of the total laboratory expenditure of the maternity unit and are therefore an area of concern. There is a concern around the repeat tests for the babies around the number and the frequency of repeats.

6.1.3 THE RECORDING OF TEST RESULTS BY DOCTORS IN PATIENT FILES AND TURN-AROUND TIME OF TEST

Test turnaround times were mostly within 1day except for a few that returned within two days. Almost all tests were recorded in the patient files for the study period which showed no wastage.

6.2 LIMITATIONS OF THE STUDY

Incomplete patient records and missing files were a limitation to the study.

6.3 RECOMMENDATIONS

6.3.1 USE OF FINDINGS OF THE STUDY

The results of this study will be presented to the District and Provincial Health Departments with the view of presenting a model that can be used in other hospitals with similar challenges. It can also be used to improve maternal health care because it has showed that most tests were linked to hypertensive disorders of pregnancies. Emphasis therefore will be on the antenatal services within primary health care. The study outcomes also showed the gaps in the record system to be improved on and outlined areas of saving on laboratory costs. It further shows the good practises in the hospital.

6.3.2 FUTURE RESEARCH

Future research needs to look at repeated tests as well as the use of tests for improvement of the clinical conditions of patients. Another area for future research is the reason why patient files were lost.

6.4 SUMMARY AND CONCLUSIONS

The study showed that laboratory tests from the maternity unit of the hospital are mostly requested for mothers who presents with hypertensive disorders of pregnancies, especially pre-eclampsia, and for babies with neonatal jaundice. Laboratory costs for the unit are around 5% of the total hospital laboratory costs and test turn-around times as well as recording of test results in patient files are of a good standard.

REFERENCES

Borghi J, Hanson K, Adjei Acquah C, et al, 2003: Costs of near-miss obstetric complications for women and families in Benin and Ghana, Health Policy and Planning, Oxford University Press, 2003

Department of Health, Republic of South Africa, 2007: Guidelines for Maternity Care in South Africa, third edition

Department of Health, Republic of South Africa, 2005: Saving Mothers: Third Report on Confidential Enquiries into Maternal Deaths in South Africa 2002 -2004

Department of Health, Republic of South Africa, 2008: Saving Mothers: Fourth Report on Confidential Enquiries into Maternal Deaths in South Africa 2005 – 2007

Dosiou C, Sanders G D, Araki Sally S et al, 2008: Screening pregnant women for autoimmune thyroid disease: a cost – effectiveness analysis, European Journal of Endocrinology, 158, 841 – 851

D Souza Z and D Souza D, 2004: Urinary tract infection during pregnancy – dipstick urinalysis vs culture and sensitivity, Journal of Obstetrics and Gynecology, vol. 24, no1, 22 – 24

Erasmus RT, Zemlin AE, 2009: Clinical audit in the laboratory

Levin, CE, Steele, M, Atherrly, et al. 2007. Analysis of the operational cost of using rapid syphilis tests for the detection of maternal syphilis in Bolivia and Mozambique. Sexually transmitted diseases, vol. 34, no. 7, pp. S47 – S54.

Mepham SO, Bertel Squire S, Chisuwo L, et al , 2009: Utilisation of laboratory services by health workers in a district hospital in Malawi, Journal of Clinical Pathology, Volume 62, 2009

Municipal Demarcation Board. 2010. Municipal statistics. http://www.demarcation.org.za/ [accessed31/08/2010]

New Jersey Department of Health and Senior Services, 1997: Healthstart Comprehensive Maternity Care Services Program Guidelines

Northern Cape Department of Health, 2009: Siyanda District Health Plan 2009-2010

Schneider H, Barron P, 2008: Achieving the Millennium Development Goals in South Africa through the Revitalization of Primary Health Care and a Strengthened District Health System, position paper, 1st draft

Shaw K J, Gutierrez M, Fridman M et al, 2008: Health care costs associated with changing clinics and “walk-in” deliveries: evidence supporting a regionalized health information network, American Journal of Obstetrics & Gynecology, 707

Steurer J, Fischer J E, Bachmann L M, et al, 2002: Communicating accuracy of tests to general practitioners: a control study, BMJ Volume 324, 2002

Van Walraven C, Cernat G, Austen P C, 2006: Effect of Provider Continuity on Test Repetition, Clinical Chemistry 52:12, 2219-2228

Van Walraven C, Naylor D, 1998: Do we know what inappropriate laboratory utilization is? A systematic review of laboratory clinical audits, Jama Volume 280, No.6, 1998

World Health Organization, 2009: Assessment of the safety and quality of hospital care for mothers and newborn babies in Gaza strip: mission report

APPENDICES

APPENDIX A: ETHICS CLEARANCE CERTIFICATE AND APPROVAL FROM NORTHERN CAPE DEPARTMENT OF HEALTH

APPENDIX B: DATA COLLECTION SHEETS