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HOSPITALISATION RATES, LENGTH AND COST OF HOSPITALISATION OF DIABETIC AND NON-DIABETIC PATIENTS IN A TERTIARY HOSPITAL IN JOHANNESBURG

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A research report submitted to the Faculty of Health Sciences, University of Witwatersrand, Johannesburg, in partial fulfillment of the requirements for the degree

Of

Master of Science in Medicine in Pharmacotherapy.

Johannesburg

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DECLARATION

I, Tryphine Ncube declare that this research report is my own work. It is being submitted for the degree of Master of Science in Medicine (Pharmacotherapy) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

SIGNATURE DATE

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Abstract

Background: Diabetes consumes between 5% and 10% of most countries' health budgets with the majority of the costs being for hospitalisation, making analysis of hospital costs an integral part in the estimation of the costs of managing diabetes and its complications. Analysing direct costs makes a greater impact as these are costs that the healthcare professional best understands and deals with on a daily basis. The number of diabetes patients is on the increase worldwide with type 2 being the most prevalent and South Africa is no exception. The number of type 2 diabetic patients is expected to grow by 9% per annum and by 2012 will comprise about 93% of the entire diabetic population in South Africa. Diabetes mellitus was the sixth leading cause of death in 2008 in South Africa.

Aim: The main aim of the study was to compare the costs and length of hospitalisation between diabetic and non-diabetic patients for a cross-section of patients discharged with cerebrovascular diseases, ophthalmic conditions, cardiovascular diseases, renal conditions, neurological diseases (of the peripheral nervous system) and peripheral vascular diseases.

Methods: A cross-sectional retrospective audit of medical records of all patients discharged from Chris Hani Baragwanath Academic Hospital with the above mentioned six specific conditions between 1st and 31St December 2009 was conducted. These patients were identified using Medicom®, the hospital's software system, and then grouped by ICD-10 codes listed on the database. The medical records were then manually analysed to determine the diabetes status of the patients, obtain information on lab tests and medical procedures performed and drugs prescribed during the admission period for which the patient was discharged during the period of the 1st to 31st December 2009. The frequency of hospitalisation of these patients during 2009 was also investigated.

Results:

Diabetic patients comprised 38.08% (N= 407) of the study sample. Average total hospitalisation costs per patient were significantly higher for diabetic cohorts; R27 216-06 ± R19 476-65 compared to R18 185-05 ± R16 725-90 for the non-diabetic patients, $p<0.00001$. The average length of stay for diabetic patients was longer; 13.04 ± 9.29 days vs. 8.86 ± 8.33 days ($p<0.00001$) for non-diabetic patients. Average admission rate per patient per year in

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2009 was higher in diabetic patients 1.8 ± 0.8 times vs. 1.5 ± 0.6 times in non-diabetic patients, ($p<0.00004$).

Conclusion:

This study showed that patients with diabetes had higher costs and longer in-patient stays than non-diabetic patients for the admission episode for which they were discharged between 1st and 31st December 2009. Diabetic patients' average total hospitalisation costs were 44% more than that of non-diabetic patients. Diabetes patients had a significantly higher average frequency of hospitalisation per patient for the year 2009. Cardiovascular disease was the most prevalent in both groups. Results from this study should be used to advocate for improved diabetes prevention awareness, improved patient understanding of the reasons for strict diabetes control measures and keen attendance in out-patient clinics to avoid unnecessary hospitalisation which leads to increased costs.

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- Dr Dumburashe - NHLS, CHBAH
- Prof A.G. Gous –MSc Med Lecturer

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Dedication

I dedicate this project to the memory of my mother, the unsung heroine whose sacrifices nurtured and instilled the belief in my capabilities. I am grateful to both my parents for this wonderful set of genes, and to my family; Nqoe, Mimi and Ntonga for their great sense of humour that makes my world a brighter place.

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List of Abbreviations and Acronyms

AIDS	Acquired Immuno Deficiency Syndrome
CHBAH	Chris Hani Baragwanath Academic Hospital
CVD	Cerebrovascular Disease
CVS	Cardiovascular System
DKA	Diabetic Keto-Acidosis
DRG	Diagnostic Related Group
HIV	Human Immuno Deficiency Virus
ICD-10	The International Statistical Classification of Diseases and Related Health Problems, 10th Revision
ICU	Intensive Care Unit
IDF	International Diabetes Federation
IT	Information Technology
Medicom®	Hospital Computer Software
MIMS	Monthly Index of Medical Specialties
NDoH	National Department of Health
Neuro	Neurologic
NHLS	National Health Laboratory Services
Ophth	Ophthalmic
PDE	Patient Day Equivalent
PVD	Peripheral Vascular Disease
RCT	Randomised Control Trials
RVU	Relative Value Unit
TB	Tuberculosis
USA	United States of America
WHO	World Health Organisation

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Chapter 1 : Introduction

1.1 Background

Chris Hani Baragwanath Hospital is located in Soweto, Johannesburg and is the largest hospital in South Africa with 2982 useable beds. The hospital had an annual expenditure of nearly 2 billion Rands in 2009 with 132 313 in-patient admissions in that year. (CHBAH 2009.) Patients are admitted to the hospital with a wide range of medical conditions of varying severity coming from the surrounding Johannesburg areas, other parts of South Africa and from neighbouring countries such as Zimbabwe, Lesotho, Mozambique, Swaziland and Zambia. It is a public academic hospital specialising in diverse clinical disciplines such as internal medicine, oncology, renal, cardiology, endocrine, psychiatric and various paediatric specialties.

Diabetes is a modern day pandemic (Bottomley & Raymond 2007) whose prevalence is on the rise worldwide and South Africa is no exception. Frost and Sullivan (2007) estimated that type 2 diabetic population in South Africa is expected to grow by 9% per annum, and by 2012 will comprise about 93% of the entire diabetic population in South Africa. Diabetes was the sixth leading cause of death in males and seventh in females during 2008, contributing 2.6% (n= 302 744) of the deaths in males and 4.1% (n=288 544) in females ahead of other public health priorities like HIV/AIDS (Statistics South Africa 2010). South African diabetes statistics estimates from the International Diabetes Federation (IDF 2010) indicate that there was a 4.5% prevalence of diabetes in the age group 20 to 79 years, 45 957 deaths attributable to diabetes and a mean health expenditure per person with diabetes of US$ 674 in 2010.

A search on the hospital's Medicom® database by the author revealed that of all hospital discharges at CHBAH, in December 2009, more cases of documented diabetic patients (ICD-10 codes E10; E10.0; E10.1; E10.4; E10.9; E11, E11.5; E13.1; E14; E14.1; E16.1; E16.2; and R73.9) were discharged than either HIV or TB (4.1% vs. HIV 3.24% and TB 1.93%
(n= 10 171). This therefore implies that diabetes may be a significant contributor to the overall healthcare expenditure at CHBAH in particular and in South Africa generally. Hence, a study of the cost of diabetes care is warranted.

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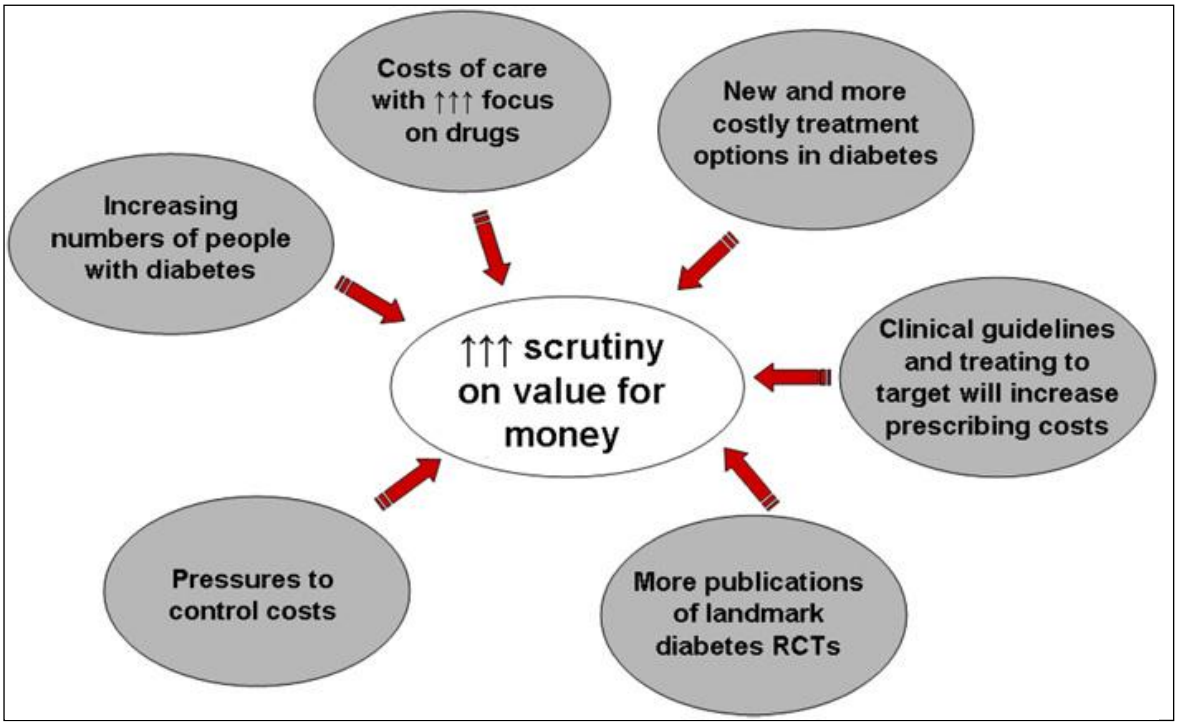
Diabetes' pharmaco-economics is influenced by many factors as noted in **Fig. 1.1**. These include the increasing diabetic patient population, increased healthcare resources used as new and more costly treatment modalities become available, clinicians' desire to treat to target and pressures to control costs among other factors.



RCT- Randomised Control Trials

Figure 1.1 Global trends and their impact on pharmaco-economics of diabetes. Adapted from Bottomley & Raymond 2007

Given the high number of cost drivers associated with diabetes as noted above, the medical research community is likely to have a difficult time reaching a uniform method of defining its cost (Campbell & Campbell 1997). However despite the fact that estimation of the total direct costs of diabetes may be difficult to achieve due to paucity of cost data and underreporting of diabetes in most hospital records, cost of hospitalisation can still be estimated.

About half of all the money spent on diabetes care goes towards the costs of managing diabetic complications with cardiovascular complications being the most prevalent. The trend of escalating diabetes prevalence with its impact on cardiovascular disease will, in all likelihood

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lead to an immense financial burden in many countries unless action is taken to prevent both diabetes and its complications. (IDF 2003.) The increased use of resources by diabetic patients is related to a range of factors which include higher out-patient costs, higher pharmaceutical costs, higher rates of hospitalisation and longer hospital stays (Gilmer *et al* 2005).

1.2 Rationale for the study

Diabetes is on the increase in South Africa and was among the top seven causes of death in 2008, (see **Table 1.1),** making a case for the investigation of its economic burden. To date, very few studies have been done on the comparison of hospitalisation costs incurred in the care of diabetic patients with the costs for non-diabetes patients admitted with diseases commonly seen in chronic diabetes in South Africa. The conditions chosen were based on the organ systems most affected in chronic diabetes. The International Diabetes Federation (2003) states that although evidence of tissue damage can be found in many organ systems, it is the kidneys, eyes, peripheral nerves and vascular tree, which manifest the most significant, and sometimes fatal, diabetic complications. Therefore, it was decided that a study on the comparison of hospitalisation costs between diabetic and non-diabetic patients for six specific diseases i.e. cerebrovascular, ophthalmic, cardiovascular disease, renal conditions, neurological diseases (of the peripheral nervous system) and peripheral vascular diseases at Chris Hani Baragwanath Academic Hospital was needed in order to determine if it is consistent with the trends in other countries.

Hospital costs contribute a significant portion to the total cost of caring for patients with diabetes and this can be estimated within a geographic area in a given country (Gagliardino *et al,* 2000). Chris Hani Baragwanath Academic Hospital (CHBAH) located in Johannesburg was chosen as the study site for the comparison of hospitalization costs between diabetic patients and their non-diabetic counterparts because the vast majority of diabetes cases in South Africa are managed at the study site given its size of 2 625 useable beds. Studies published by Pepper *et al* (2007) at GF Jooste Hospital (with 200 beds) and van Zyl and Rheeder (2009) at Kalafong Hospital with 700 beds indicate that fewer patients are seen at the smaller institutions. For instance, in Pepper *et al*'s study, there were only 53 cases of hyperglycemic admissions in two months and only 164 cases of all types of diabetic admissions documented at Kalafong Hospital over a period of 8 months. In contrast, there were 73 cases of

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hyperglycemia admitted at CHBAH and 207 cases of other acute diabetic complications (diabetes coma, DKA, complications of gestational diabetes and hypoglycemia) in the month of December 2009, as documented on Medicom®. Hence analysis of cost of care between the two groups at CHBAH is desirable and may prove useful. Moreover, analysis of these direct costs makes a greater impact as these are costs that the healthcare professional best understands and deals with on a daily basis, (Campbell &Campbell, 1997). Furthermore, the International Diabetes Federation (2003) recommended that decision makers should evaluate the economic impact of diabetes and determine how this impact compares with that of other health problems.

Table 1.1: The ten leading underlying natural causes of death for males and females in South Africa, 2008 Based on ICD-10 (1992). (Adapted from Statistics South Africa, 2010)

Condition	**Males**			**Females**		
	Rank	Number	Percentage	Rank	Number	Percentage
Tuberculosis (A15-A19)	1	41 034	13.6	1	33 746	11.7
Influenza and Pneumonia (J10-J18)	2	22 243	7.3	2	23 290	8.1
Intestinal infectious diseases (A00-A09)	3	18 187	6.0	3	21 095	7.3
Other forms of heart disease (I30-I52)	4	11 862	3.9	4	14 511	5.0
Cerebrovascular disease (I60-I69)	5	10 170	3.4	5	14 187	4.9
Chronic lower respiratory diseases (J40-J47)	6	8 392	2.8	N/A		
Diabetes (E10-E14)	**7**	**7 738**	**2.6**	**6**	**11 814**	**4.1**
HIV (B20-B24)	8	7 210	2.4	9	7 873	2.7
Ischaemic Heart Disease (I20-I25)	9	7 026	2.3	N/A		

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Condition	**Males**			**Females**		
	Rank	Number	Percentage	Rank	Number	Percentage
Certain disorders involv. Immune mechanisms (D80-D89)	10	6 599	2.2	8	8 029	2.8
Hypertensive diseases (I10-I15)	N/A			7	8 741	3.0
Other viral diseases (B25-B34)	N/A			10	6 475	2.2
Other natural causes		121 788	40.2		126 644	43.9
Non-natural causes		40 495	13.4		12 336	4.3
All causes		302 744	100		288 544	100

•***What is the economic impact of diabetes?***

Diabetes consumes between 5% and 10% of most countries health budgets with the majority of the costs being for hospitalisation. However most policy makers in developing countries do not know how costly the burden of diabetes is, on their healthcare systems. Consequently, this has led to huge gaps in available information which makes it difficult to analyse costs in most developing countries. (Gagliardino *et al* 2000.) This view is supported by the IDF (2003) which contends that there is no data in many countries to quantify the burden of diabetes financially yet hospital in-patient costs for the treatment of diabetic complications are the largest single contributor to direct healthcare costs worldwide. By comparing costs between diabetic and non-diabetic patients, the results obtained will in part help to answer this question at CHBAH.

•***How does this impact compare with that of other current health problems?***

A database search on Medicom® by the author revealed a relatively high incidence of documented (according to ICD-10 codes) diabetes-related admissions in December 2009, relative to other prevalent diseases like HIV/AIDS and TB. Given this information and the costly budget in operation at CHBAH it is important to compare the costs incurred in the care of diabetes patients to the costs for non-diabetes patients with similar chronic conditions as a starting point.

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By conducting this study it is hoped that some contribution to the available literature can be made which will assist in diabetes financial monitoring and strengthening the referral system so that only critical cases are seen at CHBAH. This study's findings may also be used to promote diabetes education and prevention of hospitalisations due to diabetes complications which are preventable with quality out-patient care and adequate patient self-management of their condition, (Jiang *et al* 2003).

1.3 Aim of the study

This study compared the total costs of hospitalisation between diabetic and non-diabetic patients admitted in hospital for similar disease conditions. The study's aim was to describe the difference in hospitalisation costs and length of hospitalisation between diabetic and non-diabetic patients in a cross-section of patients discharged during the same period with cerebrovascular, ophthalmologic, cardiovascular disease, renal conditions, neurological disease (of the peripheral nervous system) and peripheral vascular diseases at Chris Hani Baragwanath Academic Hospital. The cost and length of stay data collected was limited to the specific admission episode for which the patient was discharged between December 1st and 31st 2009. The number of times these patients were hospitalised during the course of 2009 was also documented.

1.4 Specific objectives

a) To extract from the Medicom® database, hospital discharges at Chris Hani Baragwanath Hospital (CHBAH) from 1st to 31st December 2009 for patients diagnosed with cerebrovascular, ophthalmic, cardiovascular disease, renal conditions, neurological disease (of the peripheral nervous system) and peripheral vascular diseases

b) To categorise these discharges by diabetes status in each diagnostic group through a manual review of patients' medical files.

c) To compare the mean length of stay in each diagnostic group between diabetic patients and non-diabetic patients.

d) To calculate the cost of board and room per day from the cost per Patient Day Equivalent (PDE) provided by the IT department for the patients discharged during the

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above mentioned period.

e) To calculate and compare the cost of pharmaceuticals and laboratory tests and procedures for diabetic and non-diabetic patients.

f) To calculate and compare the total cost of hospitalisation for diabetic and non-diabetic patients per diagnostic group for the discharge episode that occurred during this period.

g) To document the frequency of hospitalisation during 2009, for diabetic and non-diabetic patients.

1.5 Study overview

The first chapter deals with the introduction, discusses the rationale of the study leading to the aims and objectives of this paper. The second chapter is a summary of the literature that the researcher went through that relates to the comparison of cost of care of diabetes patients with that of non-diabetes patients and the methods utilised in carrying out these studies. The literature is quoted from local, regional and international studies. Chapter three deals with the methods used in conducting the study and in the analysis of the data collected. The results of the study are outlined in chapter four with the discussion of the results and limitations of the study following in chapter five. The conclusions drawn from the results of the study and consequently recommendations arising from the analysis of the results make up chapter six. The last chapter is a list of references used in the write up and the appendices attached.

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Chapter 2：Literature Review

From a literature search, most studies performed in the developed world utilised the Diagnostic Related Group (DRG) concept to assign costs, (Colin *et al* (2007), Olveira-Fuster *et al* (2004), Gargliardino *et al* (2004) and Carral *et al* (2002)). DRGs are based on the case mix and are assigned by a computerized program based on the ICD-10 code, diagnoses, surgical procedures, age, sex and discharge status. The cost per DRG point is the same regardless of the number, scope or intensity of services utilised. However, there were two studies on diabetes performed in Denmark by Kornum *et al* (2008) and Maldonado *et al* (2003) in the USA respectively that helped formulate the methodology for the present study in addition to the study done by Thomas (2006) at CHBAH on costing of HIV services.

The International Classification of Diseases (ICD) is the World Health Organisation (WHO) international standard diagnostic classification for all epidemiological data and is also used for clinical and health management purposes. It is used to classify diseases and other health problems recorded on medical records including death certificates. In addition to enabling the storage and retrieval of diagnostic information for clinical, epidemiological and quality purposes, these records also provide the basis for the compilation of national mortality and morbidity statistics by WHO Member States. (WHO 2004.) The ICD-10 classification is used to categorise patients by medical conditions on the Medicom® database.

Kornum *et al* (2008) in a study in Denmark examined whether diabetes was a risk factor for hospitalisation in patients with pneumonia. They first identified patients with pneumonia using the hospital registries and associated ICD-10 codes. From this group of pneumonic patients, they then identified patients who were diabetic using the prescription database. They identified patients with at least one recorded prescription for insulin or an oral hypoglycemic agent as being a diabetic patient.

A similar method to Kornum *et al'*s (2008) of identifying patients was applied to the present study. A database search was performed on Medicom® to establish which patients had been diagnosed with the six diseases associated with chronic diabetes. After identifying these

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patients, a manual inspection of their medical records was then carried out to identify who amongst them was diabetic. The only difference is that Kornum *et al* (2008) were able to map out the diabetic status using the electronic databases whereas in the present study a physical analysis of files had to be used because no such information is available on Medicom® and the pharmacy uses manual records. The downside of physical file inspection is that it is totally dependent on the ability of the records department to keep files in order and if a file is lost or pages fall out, then the integrity of the data collected is compromised.

Maldonado *et al* (2003) analysed in-patient costs of treating diabetic keto-acidosis (DKA) in a hospital in Houston, USA. The information on in-patient resource utilization for treating each patient with DKA was obtained from the hospital's Resource Utilisation Department and itemized costs were recorded. Cost information for their study was recorded in specific categories viz: laboratory, hospital room (per day), ICU days, radiological tests, medical supplies, electrocardiograms, respiratory therapy, emergency room, operating room, physical therapy, occupational therapy, cardiologic tests, renal dialysis and anesthesia. In their study costs for laboratory tests and radiological procedures were calculated using a weighted procedure method in which each test or procedure is allocated a certain weight or a number of relative value units (RVU). Each relative value unit or weight is allocated a certain monetary value. Therefore the cost, for instance of two chest X-rays, using an RVU of 2 for a chest X-ray and an RVU being equivalent to US $4 will be US $8. Pharmaceuticals, intravenous therapy and supplies were calculated using the surcharge method in which the hospital applied a 25% surcharge on the cost value. Emergency room and ICU were calculated using a standardized hourly rate method of $45/hour for Emergency Room and $60/hour, at the time, for ICU. The costs for room and board which includes such services as maintenance, laundry, housekeeping, etc were calculated using the "per diem" method in which each day in hospital was assigned a cost of $385. This method is similar to that used by Thomas (2006) in the costing of HIV services at CHBAH.

Pepper *et al* (2007) studied the financial implications of hyperglycemic emergencies at GF Jooste Hospital in Cape Town, South Africa using the ingredient approach which takes into account all individual cost components used. Their total costs included patient specific costs, (medication, lab tests, procedures and clinical staff costs) and non patient-specific costs - capital costs (which included building and equipment), and overhead costs. They collected data

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prospectively for each component of the patients' admission from arrival at the emergency unit to admission in the ward and discharge. The duration of stay in each department, doctor's consultation, laboratory investigations, nursing costs per emergency visit and in-patient days were itemized. Capital cost and overhead costs were obtained from a previous study carried out in their study site. Although Pepper *et al* (2007) performed their study in a public hospital with similar opportunities and constraints to CHBAH; theirs is more suitable to a prospective study which could not be applied to the present retrospective analysis. With Pepper *et al*'s (2007) method, the researcher has to be present to actively observe the patient from the time the patient presents, throughout their stay until the point of discharge or death. Consequently Thomas' method, which is described briefly below, was the preferred one for this study as it was a retrospective database search.

In a study of costing of HIV services at CHBAH Thomas (2006) used the cost per patient day equivalent (cost per PDE) method. A patient day equivalent (PDE) is the equivalent of one patient staying in hospital for one full day. The cost of one PDE is the cost of caring for one patient for one full day in hospital. The patient day equivalent method utilises patient volumes (in-patient days, day patients, casualty patients and out-patients) each contributing a certain weight to the total hospital expenditure per given month as shown in equation 1 and 2 below. A day patient is a patient that undergoes a medical procedure in the hospital that does not require overnight stay. The hospital expenditure includes all costs - capital costs, overhead costs, maintenance, electricity, room and board, consumables, etc. The PDE is calculated every month using the data for in-patient days, day patients, casualty and out-patient head counts as shown below.

Calculation of Patient Day Equivalent (PDE) (all values are per month)

$$PDE = \frac{Number.\ of\ Day\ patients}{2} + Number.\ of\ In\text{-}patient\ days + \frac{(Out\text{-}patient\ headcount + casualty\ head\ count)}{3} \quad \textbf{(1)}$$

$$Average\ Cost\ per\ PDE = \frac{Total\ monthly\ expenditure}{Calculated\ PDE\ for\ the\ month} \quad \textbf{(2)}$$

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For research purposes this method was modified so as to get the cost of board and room per patient per day. This is done by deducting from the total monthly expenditure, the patient-specific costs like pharmaceuticals, laboratory tests and procedures. The remainder represents the cost of room and board per patient day, (see equation 3). These specific costs for pharmaceuticals and lab tests are assigned to the patient based on consumption. This method was used in the present study because as far as possible all overhead costs of the hospital are catered for in the PDE costing as it utilises the monthly actual overall expenditure for the hospital in its calculation.

*Cost of Board &room /day= **{**Total Monthly Expenditure - (Laboratory +Pharmaceuticals' Expenditure)**}** ÷ PDE for the month.* ***(3)***

Total hospitalisation cost per patient = (average lodging cost per day x number of days in hospital for the specific patient) + cost of pharmaceuticals used per specific patient for the hospital stay + cost of laboratory tests and procedures per specific patient for the stay)…….. ***(4)***

The total costs of hospitalisation per patient then becomes the sum of board and room cost, pharmaceuticals, labs and procedures per patient, for the hospital stay for which the patient was discharged between December 1st-31st 2009, (see equation 4)**.** This method is similar to Maldonado *et al's* (2003) technique of itemised costs for certain services and per diem costs for room and board. This was the preferred approach for the present study as the cost information is readily available from the IT department. The disadvantage of the cost per PDE method is that it is an average value which gives an upper limit to board and room costs incurred by a patient without catering for the obvious differences in resource utilisation between an ICU patient and a day patient. This drawback is set off slightly to an extent by the disaggregation of patient specific costs like drugs, Labs, and X-rays.

According to the Uniform Patient Fee Schedule used for billing fee-paying patients in the public sector, a facility fee is charged for all fee-paying patients depending on the level of care utilised i.e. general ward vs. ICU. The facility fees are gazetted annually by the government using national average annual figures for expenditure and patient numbers for all institutions. This facility fee reflects the overhead costs such as electricity, provision of general equipment as well as the cost of consumables and staff salaries which are necessary in the provision of the

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health care service to the patient. This system was devised to cut down itemised billing although itemising still remains for pharmaceuticals and assistive devices both whose costs fluctuate from time to time (NDoH 2000.) However the facility fee was not used in this study for overhead costs, instead the PDE method was used because the calculation of the cost per PDE uses actual expenditure for the month which is a more accurate reflection of the operational costs of running the hospital from month to month as opposed to using data obtained from national estimates for all hospitals whether or not actual expenditure differs.

No study currently exists, to the best of my knowledge that deals with a comparison of hospitalisation costs between diabetes and non-diabetic patients in the South African public hospital context. However, Pepper *et al* (2007) and van Zyl & Rheeder (2009) carried out their studies on diabetes in GF Jooste Hospital (200 bed hospital) and Kalafong Hospital (700 bed hospital), respectively.

Pepper *et al* (2007) analysed the duration of stay, reasons for admission and the cost incurred by the hospital in treating diabetic patients admitted for hyperglycaemic emergencies. In this study there were 53 hyperglycemic cases admitted during the two month period of investigation. They found that sepsis, non-compliance with therapy and newly diagnosed cases of diabetes were the predominant reasons for admission. The mean duration of stay was 4 days and mean cost per patient was R5 309 (in 2007).

Van Zyl & Rheeder (2009) evaluated practices in the management of glycaemic control of diabetic in-patients at Kalafong Hospital, a secondary level hospital in South Africa. They conducted an audit of clinical hospital records of all diabetic adult patients hospitalised, regardless of the reason for admission or severity of disease over an eight month period. The median length of stay was 7.5 days with a range of 1-87 days. During the study period 164 patients were admitted with diabetes.

Given that CHBAH is much bigger (2 625 beds) than the two hospitals described above, the number of cases of acute diabetic complications admitted is likely to be much higher as exemplified by the data for December 2009, extracted from the Medicom® database. In just a

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month, there were 73 cases of hyperglycemic admissions and 203 cases of other acute diabetic complications such as diabetic coma, DKA, hypoglycemia and gestational diabetic complications. This therefore implies that costs for care of these acute complications of diabetes are more likely to have a great impact on the hospital budget at CHBAH.

Feleke and Enquselassie (2007) studied the cost of hospitalisation of diabetic patients admitted at a specialized hospital in Addis Ababa Ethiopia using a case control study. The study was conducted on 146 diabetic patients and 142 non-diabetic controls admitted to medical wards of a specialised hospital. They found that the average total cost of hospitalisation was significantly higher in diabetic patients than in the controls with $p<0.03$. Fifty-seven percent of these costs were used on treatment of acute and chronic complications of diabetes. The average treatment and laboratory costs were significantly higher among the diabetic patients, $p=0.013$ and $p<0.001$ respectively.

In a Tunisian study by Soltani *et al*, (1993) based on admissions data, 5.9% of the study population was diabetic of which 39.4% of the cases were cared for at a university hospital. The mean hospital stay for diabetic patients was 10.3 days versus 8 days for all the other patients. The cost of hospital care was dependent on the level of care involved with lower costs for district hospitals and higher for the university hospital, US $173 vs. US $372 respectively.

A number of studies on comparison of hospitalisation costs between diabetic and non-diabetic patients have been documented in the developed world setting. Carral *et al* (2002) and Oliveira-Fuster *et al* (2004) carried out such studies in Spain while Colin *et al* (2007) compared length of hospital stay between diabetic and non-diabetic patients in a French hospital. Gargliardino *et al* (2004) also did a similar study in La Plata, Argentina and these studies are summarized briefly below.

Carral *et al* (2002) assessed the rate of hospital admissions, length of stay, readmissions, mortality and costs for both diabetic and non-diabetic patients in a Spanish hospital. They found out that those patients with diabetes accounted for 10.9% of total hospital discharges (2 453 discharges), 15.3% of total stays (30 771 days) and 16.1% of total costs. They estimated a

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hospitalisation rate of 135 per 1000 patients with diabetes compared with 95 per 1000 non-diabetic patients. Diabetic patients were hospitalized, on average, for 4 days longer than non-diabetic patients (12.5±14.5 (±SD) vs. 8.5±10.6 days; $p<0.001$) and had higher risks of readmission (RR: 1.47 (95% CI: 1.33–1.62)) and of mortality during the in-patient period (2.29 (1.91–2.74)) than non-diabetic patients. The overall hospitalisation cost was significantly higher (55% higher) in diabetic than in non-diabetic patients. They concluded that the hospital care resource utilisation and economic burden due to diabetes mellitus in the study hospital was substantial and disproportionate to the number of affected people.

In another Spanish study, Olveira-Fuster *et al* (2004) estimated the excess hospitalisation, hospital days and in-patient costs attributed to diabetes in 37 Spanish hospitals during 1999 through an analysis of all discharges. Excess costs were calculated as the difference between costs for diabetic patients and non-diabetic patients. The relative risk of hospitalization was estimated by dividing the rate of hospitalization of individuals with diabetes by the rate of hospitalization of individuals without diabetes. People with diabetes accounted for 9.7% of all hospital discharges, 13.8% of total stays and 14.1% of the total cost. Of the total cost for individuals with diabetes, 58.3% were excess costs, of which 47% were attributable to cardiovascular complications and 43% to admissions for co-morbid diseases. The rate of admissions during the study year was 145 per 1 000 inhabitants for individuals with diabetes compared with 70 admissions per 1 000 inhabitants for individuals without diabetes.

Colin *et al* (2007) examined whether or not diabetic patients required more human and material resources than average in the medical management of the acute phase of diabetic complications. They restricted the analysis to in-patient care in a French setting for five cardiovascular events-stroke, myocardial infarction, unstable angina, cardiac revascularisation and cardiac arrest. They found that the average length of stay for patients with diabetes were significantly longer than that of non diabetic patients for cardiovascular events. The mean number of medical procedures by stay was also higher in the diabetic group. Hospital costs for diabetic patients with non -fatal stroke and non -fatal myocardial infarction were 23.9% and 10.4%, more than the average costs, respectively. For unstable angina and coronary revascularization, hospital costs were 6.1% and 9.1% higher than average costs respectively. The mean length of stay ranged from 6.6 to 16.3 days for diabetic patients as compared to a range of 4.7 to 12.8 days for non-diabetic patients for the different conditions.

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Jiang *et al* (2003) in a study of multiple hospitalisations among diabetic patients in five American states, found out that among diabetic patients who had been hospitalised, 30% had two or more stays accounting for > 50% of total hospitalisations and hospital costs. Results revealed that among diabetic patients with multiple stays, about 90% of adults had cardiovascular diseases, 25% had renal diseases and 40% had lower extremity diseases. They also found out that some of the multiple hospitalisations that resulted from these complications as well as some of the complications themselves were preventable with quality outpatient care and improved self-management of the condition.

Gagliardino *et al* (2004) examined the prevalence, characteristics and costs of hospitalisation and re-hospitalisation of diabetic and non-diabetic patients in La Plata, Argentina. They studied all in-hospital registries of diabetic patients enrolled in a health maintenance organisation. For each of the 127 diabetic patients, characteristics of two other hospitalised non-diabetic patients matched by age and gender were simultaneously recorded. Of the recovered 2200 hospitalisations, 5.8% were for diabetic patients, accounting for 10.5% of the hospitalisation costs. Cardiovascular diseases were the major causes of hospitalisation in both groups. Per capita hospitalisation costs for diabetic patients were significantly higher US $1 628-50 ± US $1 754 vs. US $833 ± US $842 p= 0.0002. Re-hospitalisation rate was five and a half times higher in diabetic patients (p=0.0001) and significantly associated with a history of severe episodes of acute complications (odds ratio 3.61 {95% CI 1.11-11.70} p = 0.03) and chronic complications (odds ratio 4.26; {95% CI 1.6- 11.29}; p =0.004).

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Chapter 3：Methodology

3.1 Study Population

The target group consisted of all patients discharged in December 2009 with cerebrovascular, ophthalmic, cardiovascular disease, renal conditions, neurological disease (of the peripheral nervous system) and peripheral vascular diseases as identified by the ICD-10 codes used on Medicom®. In this group a detailed audit of clinical records was done from September 2010 to November 2010, through a manual review of patients' medical files to identify the diabetic patients, drugs prescribed and laboratory tests and medical procedures carried out on the patient.

3.2 Sample Inclusion/Exclusion criteria

All medical records for patients discharged from the medical wards over the period of 1st - 31st December 2009 with cerebrovascular, ophthalmic, cardiovascular disease, renal conditions, neurological disease (of the peripheral nervous system) and peripheral vascular diseases were analysed. The month of December was chosen so as to meet the objective of calculating the annual hospitalisation frequency retrospectively for the study patients for the entire year from January to December 2009. Hence the hospitalisation frequency for those patients discharged in December took into account all the prior admissions that might have occurred during the year culminating in the admission episode/s that occurred in December. Patient records of those who died whilst in hospital were excluded. Neonatal and maternal discharges were excluded from the analysis. Maternal discharges were identified from Medicom® as starting with the prefix O- in the ICD 10 listing and neonatal as starting with the prefix P-. Only the records that have all the following information were included in the analysis for both diabetic and non-diabetic patient files:-

3.2.1 Patient demographic details- age, sex, hospital number (GT or GP Number)
This information was necessary to match the information on Medicom® with the patient file in order to identify the study subjects.

3.2.2 Doctor's notes with discharge diagnosis written on the patient file and signed for with the name and qualifications of the attending doctor. The researcher had to confirm on the patient file if the Medicom® ICD-10 assigned to the patient's discharge diagnosis matched with the description of the patient's condition on the file in order to allocate the patients in the relevant diagnostic group.

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3.2.3 Dates of admission and discharge

To ensure that the data collected for pharmaceuticals and procedures was for the discharge episode required for the study

3.2.4 Treatment details: procedures and laboratory tests ordered and medication prescribed, frequency and dosages

This information was required for confirmation of diabetes status were none was specified. It was also used for costing of pharmaceuticals administered and medical procedures and laboratory tests done per patient.

3.2.5 Nursing care notes as signed for by the nursing sister with the name of the attending nurse to help in identifying the patients' disease conditions.

3.3 Sampling procedure

The discharge list obtained from Medicom® for the month of December 2009 was used as the primary source of data for the study subjects. Discharge data is stratified by ward and by ICD codes on the hospital Medicom® software system. From the Medicom® database, it was found that 10 171 patients were discharged over the month of December 2009. Of these, 685 were diagnosed with the selected conditions of interest according to the ICD codes and were then grouped by class of condition i.e. cardiovascular, neurological etc. Data collection was carried out retrospectively for the patients discharged in the month of December 2009. A similar method of identifying patients was used by Kornum *et al* (2008) in Denmark as mentioned above.

3.4 Identification of diabetes patients

A manual method of identifying diabetic patients from the discharge list had to be employed because the Medicom® database does not list other disease conditions as a secondary diagnosis where present other than the presenting condition e.g. diabetes status. Three steps were used to identify patients as diabetic using the patient's hospital file. Firstly the researcher used the risk profile page (pink page) at the start of the in-patient file that lists the different chronic diseases among which diabetes is one. This list is used by the nursing care staff to identify patients admitted with the different conditions. Secondly the admitting doctor also has to specify on the admission file cover (blue cover) the different conditions the patient is suffering from including the provisional and final diagnoses. Lastly the pharmacy prescription chart was used wherever

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there was doubt to check the medication history of the patient. If insulin or any of the oral hypoglycaemic agents were prescribed, it was then assumed that the patient was diabetic. Type of diabetes was not examined.

3.5 Costing method

The costing method used is similar to Maldonado *et al* (2003) and adapted by Thomas (2006) as mentioned above (see chapter 2). The total hospitalization cost is comprised of lodging costs, the cost of pharmaceuticals and medical procedures and laboratory costs (see **equation 4)**. The mean total hospitalisation cost for diabetic and non-diabetic patients was compared within each disease group.

Total hospitalization cost per patient = (average lodging cost per day x number of days in hospital for the specific patient)+ cost of pharmaceuticals used per specific patient for the hospital stay + cost of laboratory tests and procedures per specific patient for the stay)……..(4)

3.5.1 Lodging costs (Board and room)

The cost per PDE as given by the hospital's IT department was modified to calculate the lodging costs for each patient (see **Table 3.3**). For the purposes of this study, the expenditure for patient-specific items like pharmaceuticals and laboratory procedures was excluded in the calculation and these were calculated per patient as outlined in Chapter 2.

$$PDE = \frac{\text{Number of Day patients}}{2} + \text{Number of In-patient days} + \frac{\text{(Out-patient headcount + casualty head count)}}{3} \quad \textbf{(1)}$$

$$\text{Average Cost per PDE} = \frac{\text{Total monthly expenditure}}{\text{Calculated PDE for the month}} \quad \textbf{(2)}$$

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The average monthly PDE cost used was for the three months from October to December 2009 (see **Table 3.2**). This was done to cater for the calculation of the hospitalisation cost for those patients that were admitted in November for instance, but discharged in December.

*Average cost of Board &room /day= **{**Total Monthly Expenditure - (Laboratory +Pharmaceuticals' Expenditure)**}** ÷ Average PDE for the month* **(3)**

Table 3.2 Number of PDE and cost per PDE per month (October-December 2009) provided by CHBAH Information Technology department

Month	Number of Day patients	Number of Inpatient Days	Out-Patients' Head count	Casualty Head-Count	Number of PDE **(Equation 1)**	Total Expenditure* (In Rands)	Cost per PDE (In Rands) **(Equation 2)**
Oct	3 285	65 765	38 427	10 012	83 554	220 694 137	2 641-34
Nov	3 302	65 024	41 214	9 531	83 590	180 931 686	2 164-51
Dec	3 283	59 608	42 533	9 271	78 518	145 509 323	1 853-20

Table 3.3 Calculation of the cost of board and room (lodging) per month (October to December (2009)

Month	Total Expenditure*	NHLS Expenditure**	Pharmacy Expenditure***	Board & Room Cost **(Equation 3**)
October	R220 694 137	R12 632 211-07	R20 638 029-16	**R2 243.15**
November	R180 931 686	R12 853 278-69	R18 951 139-71	**R1 784.03**
December	R145 509 323	R10 443 390-09	R15 104 331-66	**R1 527.82**

Figures obtained from CHBAH: * Ms Maria Matabane IT Department

** Ms Cecilia Venter Finance Department

*** Ms Tshilidzi Shabangu Drug Controller

Average Board & room per day =R (2243-15+1784-03+1527-82) ÷3

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= **R1851-66**

Lodging costs for length of admission = ***R 1851-66*** *X Number of days in hospital…… (****5****)*

*Total hospitalisation cost per patient = (average lodging cost per day x number of days in hospital for the specific patient) + cost of pharmaceuticals used per specific patient for the hospital stay + cost of laboratory tests and procedures per specific patient for the stay) (4***)**

3.5.2 Laboratory tests and medical procedures costs

The costs of individual tests performed on each patient were calculated according to the fees charged by the National Health Laboratory Services (NHLS) as outlined in the NHLS State Price List of 2009. Cost of labour was not included in the calculation of laboratory costs because it is already incorporated in the invoiced amount to the hospital. Procedures e.g. radiology, theatre procedures, dialysis etc. for each patient were obtained from the files and the cost of procedures was calculated individually from the National Department of Health Uniform Fee Schedule 2009. The fees shown under facility level 3, specialist category were charged as per the billing procedure for fee-paying patients at CHBAH. The facility fee was excluded from the costs as this fee is the equivalent of PDE in this particular study.

3.5.3 Pharmaceuticals costs

Drugs given to patients were charged according to the pharmacy price list availed by the Drug Controller, Ms Tshilidzi Shabangu. This price list is used for audit purposes in costing the value of the stock at the end of the Financial Year. As with the laboratory costs, the labour costs of dispensing were not included because staff salaries form part of expenditure with which the IT department calculates the cost per PDE. Drugs prescribed for the patient and actually administered for the duration of the admission episode were obtained from individual patient files.

3.6 Hospitalisation rate

Hospitalisation rate for the study was defined as the number of times a specific patient was admitted into the hospital in the year 2009. The number of times a patient was hospitalised during 2009 was extracted from Medicom® using the unique patient identifier number with the prefix GP or GT. The annual average frequency of admission per patient for the year was

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compared between diabetic and non-diabetic patients within diagnostic groups.

3.7 Data analysis

The total cost of hospitalisation and the length of admission for the discharge episode in December 2009 were entered in the data form and transferred into Microsoft Excel. The frequency of hospitalisation in 2009 was also entered. Statistical analysis was performed on Microsoft Office Excel 2003 using the student t-test and descriptive statistics with a p-value of <0.05 being significant. Tables and graphs were also used to present data by category.

3.8 Ethical Clearance

Ethics clearance was obtained from the Human Research (Medical) Ethics Committee of the University of Witwatersrand (appendix 4).

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Chapter 4 Results

The main aim of the study was to compare the hospitalisation costs and length of hospitalisation between diabetic and non-diabetic patients for discharges that occurred during December 2009.

4.1 Sample characteristics

Figure 4.1 and **Table 4.1** show how many patients were eligible for analysis, using the study's inclusion and exclusion criteria, from the Medicom® database search. There were 10 171 patients discharged from CHBAH from December 1st 2009 to December 31st 2009. Of these, only 685 matched the inclusion criteria with 278 records not being available for analysis leaving 407 records to be studied as shown below on **Figure 4.1**.

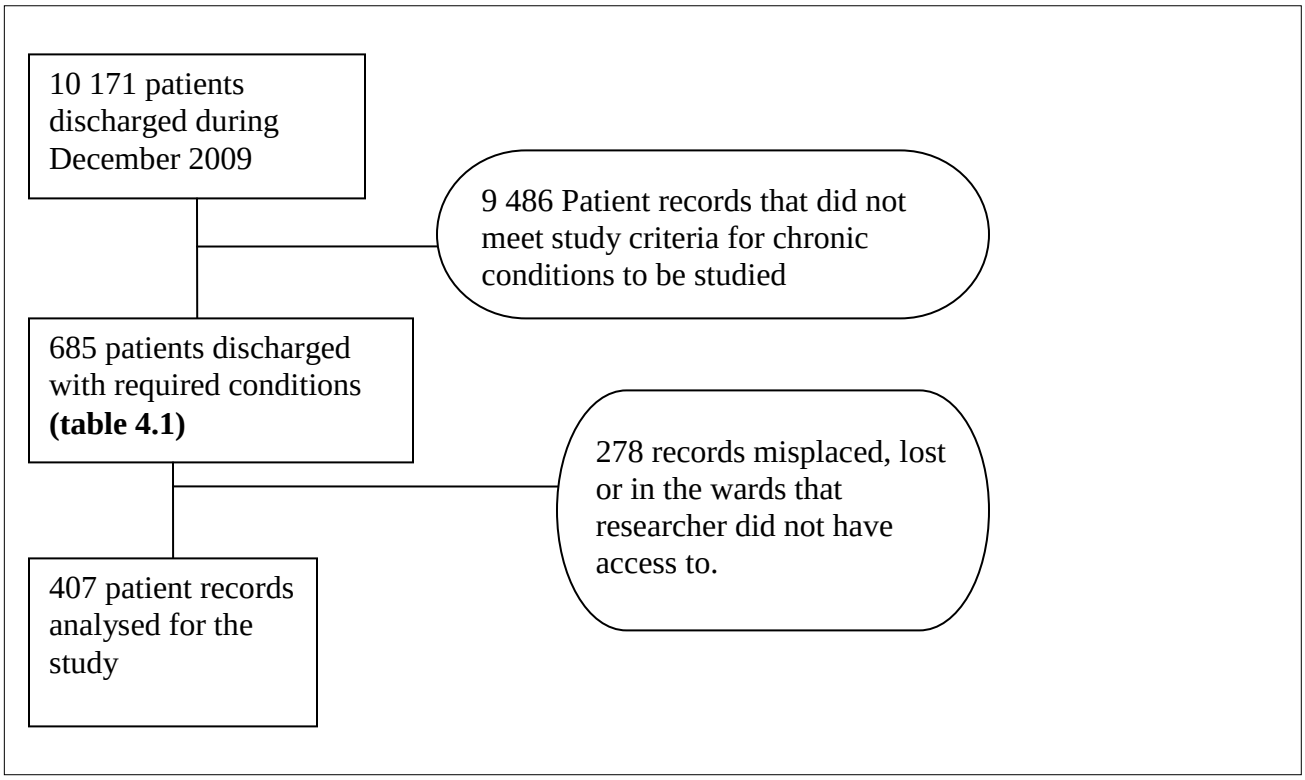

Figure 4.1 Study sample identification procedure

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Table 4.1 All Patients (diabetic and non-diabetic) discharged with the required conditions in December 2009 as per Medicom®

Group	ICD 10 Listing	ICD 10 Condition	Number
Neurological	G61.8	Polyneuropathies	14
	G62	Peripheral neuropathies	13
		total	**27**
Ophthalmic	H18.4	Corneal degeneration	10
	H26.9	Cataracts	58
	H33, H35.0	Retinal disorders	10
	H40.5	Glaucoma	12
	H46,	Optic neuritis	13
		total	**103**
cardiovascular	I42	Cardiomyopathy	28
	I10, I15, I15.8, I15.9	Hypertension	158
	I20.0, I21, I24, I25.5	Ischaemic heart disease	14
	I45.5, I46.9	Cardiac arrest	17
	I11, I11.0	Hypertensive heart disease	30
	I50, I50.0, I50.1, I50.9	Heart failure	101
		total	**348**
Cerebrovascular conditions	G81, G81.9	Hemiplegia	27
	I67, I67.9	Cerebrovascular disease	51
		total	**78**
Vascular	I73, I73.8, I73.9	Peripheral vascular diseases	33
	I81, I82.3, I82.9	Thrombosis	10
		total	**43**
Renal	N04, N04.8, N04.9	Nephrotic syndrome	6
	N11.0, N11.1, N13.0, N13.	Nephritis	22
	N17.0, N17.9	Acute renal failure	33
	N18.0, N18.8, N19	Chronic renal failure	25
		total	**86**
Total			**685**

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From this final sample size of 407 patient records, 155 (38.08%) were for diabetic and 252 (61.92%) were non-diabetic patients (**Table 4.2)**

Table 4.2: Study patients categorized by condition and stratified by diabetes status

Condition	**Non-diabetic**	**Diabetic**	**Total**
Cardiovascular	79	59	138
Neurological	13	6	19
Ophthalmic	49	29	78
Renal	42	30	72
Cerebrovascular	39	21	60
Vascular disease	30	10	40
Total	**252**	**155**	**407**

4.2 Cost results

Table 4.3 below summarises the results in terms of totals for each disease condition. For these patients discharged in December 2009, diabetic patients spent a total of 2021 in-patient days while the non-diabetic patient spent 2233 inpatient days in hospital. **Table 4.4** summarises the mean values for diabetic and non-diabetic patients per disease group.

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Table 4.3: Summary of Results for Total In-Patient Days and Total Costs for Lodging, Labs & Procedures and Pharmaceuticals

Diabetic Patients							**Non-Diabetic Patients**					
		Total costs in Rands for all patients							Total costs in Rands for all patients			
Condit-ion	**N**	**In-pt days**	**Lodging**	**Labs & Procedure**	**P'ceuticals**	**Total costs**	**N**	**In-pt days**	**Lodging**	**Labs &Procedures**	**Pharmaceuticals**	**Total costs**
CVS	59	597	1 105 441-02	45,184.95	70,016.82	1,221,239.79	79	577	1 068 407-82	33,191.14	60,902.14	1,163,078.10
Ophth	29	360	666 597-60	29,335.12	50,526.60	746,459.32	49	225	416 623-50	17,432.84	25,000.22	459,056.56
Renal	30	410	759 180-60	54,604.67	64,594.64	878,789.91	42	310	574 014-60	28,690.38	48,746.60	651,451.58
PVD	10	151	279 600-66	12,347.72	14,713.26	306,661.64	30	408	755 477-28	19,585.40	36,537.27	811,599.95
Neuro	6	103	190 720-98	8,034.16	9,210.24	207,965.38	13	247	457 360-02	12,122.84	19,526.38	489,009.24
CVD	21	400	740 664-00	42,966.39	73,742.63	857,373.02	39	466	862 873-56	53,689.78	91,874.41	1,008,437.75
Totals	**155**	**2021**	**3 742 204-86**	**192,473.02**	**282,804.14**	**4,218,489.02**	**252**	**2233**	**4 134 756-78**	**164,712.38**	**282,587.01**	**4,582,633.17**

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Table 4.4 Summary of Mean values (± s.d) for In-patient days and cost values

Diabetic Patients							**Non-Diabetic Patients**				
Mean costs per patient ± s.d for all patients (2009 South African Rands)							Mean costs per patient ± s.d for all patients (2009 South African Rands)				
Condit-ion		In-patient Days	Lodging	Labs & Procedures	P'ceuticals	Total costs	In-patient Days	Lodging	Labs & Procedures	P'ceuticals	Total costs
CVS	Mean	10.11	18 736-29	765-85	1 186-73	20 698-98	7.30	13 524-15	420-14	770-91	14 722-51
	S.D	6.97	12 902-58	908-66	1 087-63	14 281-93	5.86	10 851-17	342-88	720-67	11 581-47
Ophth	Mean	12.41	22 986-12	1 011-56	1 742-30	25 739-98	4.59	8 502-52	355-77	510-21	9 368-50
	S.D	11.41	21 126-77	1 171-25	1 996-07	23 894-02	4.05	7 492-16	294-68	489-26	8 063-57
Renal	Mean	13.67	25 306-02	1 820-16	2 153-15	29 293-00	7.38	13 667-01	683-10	1 160-63	15 510-75
	S.D	7.72	14 296-11	2 293-14	1 209-32	16 749-50	6.80	12 584-86	491-32	1 135-61	13 948-15
PVD	Mean	15.1	27 960-07	1 234-77	1 471-33	30 666-16	13.60	25 182-58	652-85	1 217-91	27 053-33
	S.D	9.89	18 319-06	511-31	925-42	18 990-51	10.24	18 962-03	405-78	978-71	20 125-73
Neuro	Mean	17.17	31 786-83	2 295-47	2 631-50	41 881-51	19.00	35 181-54	932-53	1 502-03	37 616-10
	S.D	10.11	18 716-12	1 277-39	977-50	20 824-41	15.81	29 267-56	1 372-25	1 372-25	30 800-58
CVD	Mean	19.05	35 269-71	2 046-02	3 511-55	40 827-29	11.95	22 124-96	1 376-66	2 355-75	25 857-38
	S.D	10.69	19 791-78	1 282-86	1 812-55	22 373-56	8.06	14 916-16	589-68	2 163-76	16 943-15

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4.3 Length of hospitalisation (in-patient days)

The mean length of admission for all diabetic patients in the study was 13.04 ± 9.29 days vs. 8.86 ± 8.33 days for non-diabetic patients; p<0.00001 (see **Figure 4.2**). When comparing within groups, diabetic patients were admitted for a significantly longer period of time than the non-diabetic patients in the cardiovascular diseases (CVS) (p=0.006), ophthalmic (p<0.0001), renal (p=0.0002) and cerebrovascular diseases (CVD) (p=0.002) groups. However, there were no significant differences in the length of stay for the peripheral vascular diseases (PVD) (p=0.3) and the neurological diseases (p=0.4) groups respectively.

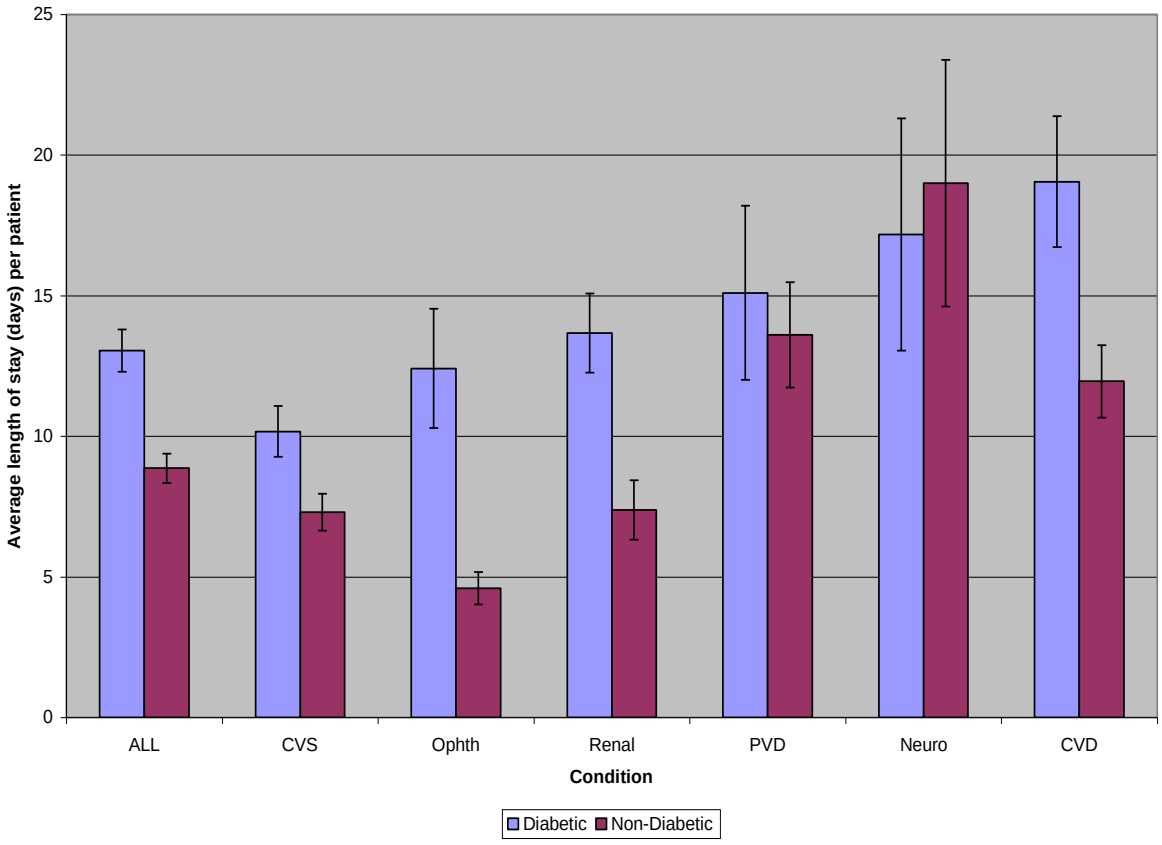

Fig 4.2 Average hospital stay per patient

4.4 Total costs of hospitalisation

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Average total hospitalisation costs per patient for diabetic patients were significantly higher than those for the non-diabetic patients with mean total costs of R27 216-06 ± R19 476-65 for all diabetic subjects compared to R18 185-05 ± R16 725-90 $p<0.0001$ for the non-diabetic patients. Average total costs within disease groups were significantly higher in the diabetic group than in the non-diabetic group for CVS ($p=0.004$), ophthalmic ($p<0.00001$), renal ($p=0.0002$), and CVD ($P=0.003$). However, in the PVD and neurology groups, there was no significant difference in the total cost of hospitalisation with $p= 0.3$ for PVD and $p=0.4$ for the neuropathy group respectively as shown in **Figure 4.3**. Diabetic patients in the neuropathy and cerebrovascular diseases group were the most expensive due to the longest stay encountered in this group of patients.

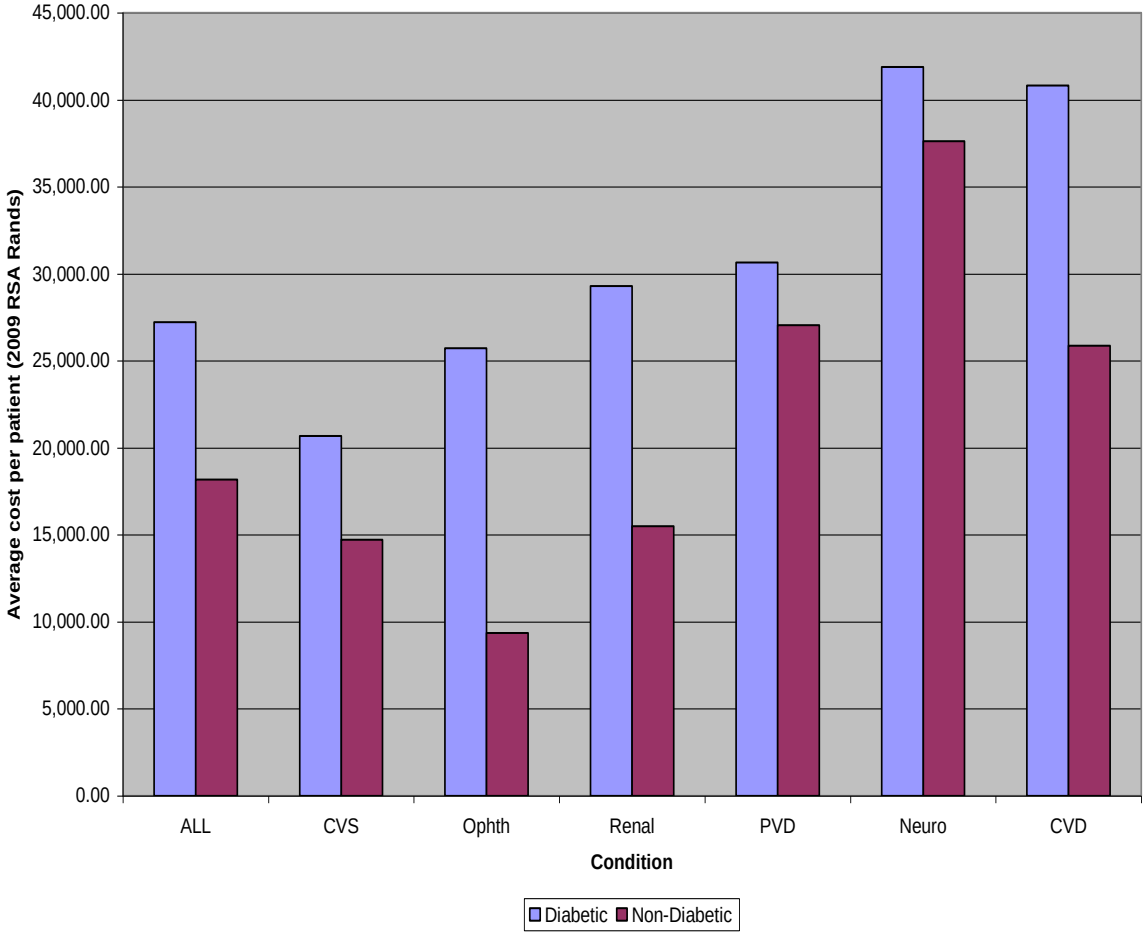

Fig 4.3 Average total cost of hospitalisation per patient

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4.5 Cost of pharmaceuticals

The total cost of pharmaceuticals for all diabetic cohorts was R282 804-14 while for non-diabetic patients it was R282 587-01. The mean cost per patient for diabetic patients was significantly more than that for non-diabetic patients, R1 824-54 ± R1 590-82 vs. R1 121-38 ± R1 297-90; respectively, $p<0.00001$. The cost of pharmaceuticals in the diabetic group was significantly higher for the CVS ($p=0.004$), ophthalmic ($p<0.0001$), renal ($p=0.0003$) and CVD ($p=0.02$) groups. However there was no significant difference found in the neurological ($p=0.13$) and PVD ($p=0.2$) groups, see **Figure 4.4** below.

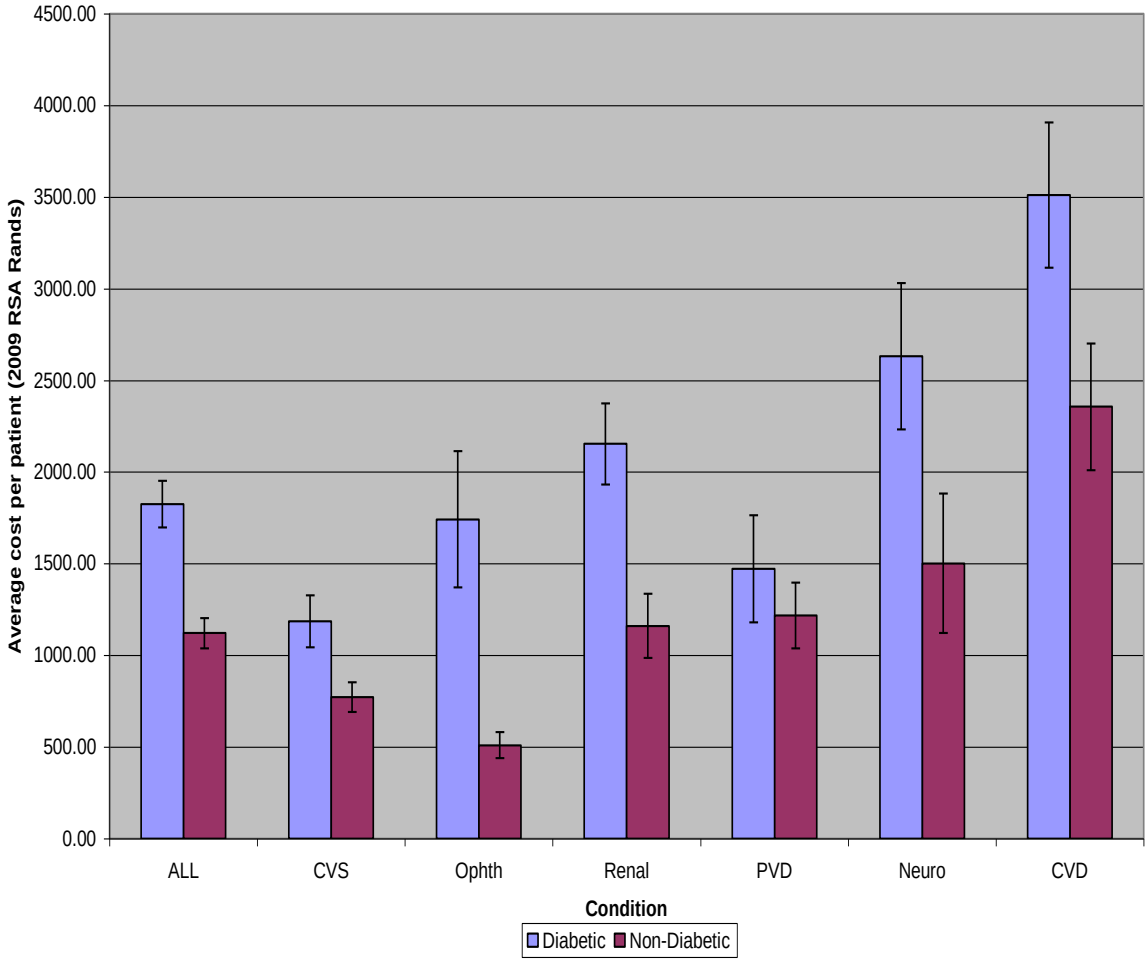

Fig. 4.4 Average cost of pharmaceuticals per patient

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4.6 Cost of laboratory tests and procedures

The total cost of all laboratory tests and medical procedures for all diabetic patients was R192 473-02 and R164 712-38 for all non-diabetic patients. The mean cost per patient of laboratory tests and procedures was significantly higher for diabetic patients than for the non-diabetic patients R1 241-76 ± R1 443-30 vs. R653-62 ± R543-72; $p<0.0001$, see **Figure 4.5** below. Within disease groups diabetic patients' mean costs were significantly higher than those of non-diabetic patients in the CVS ($p=0.001$), ophthalmic ($p=0.0002$), renal ($p=0.001$), PVD ($p=0.0004$) and CVD ($p=0.004$). However, there was no significant difference in the average laboratory costs between the diabetic and the non-diabetic patients in the neurology group with $p=0.5$.

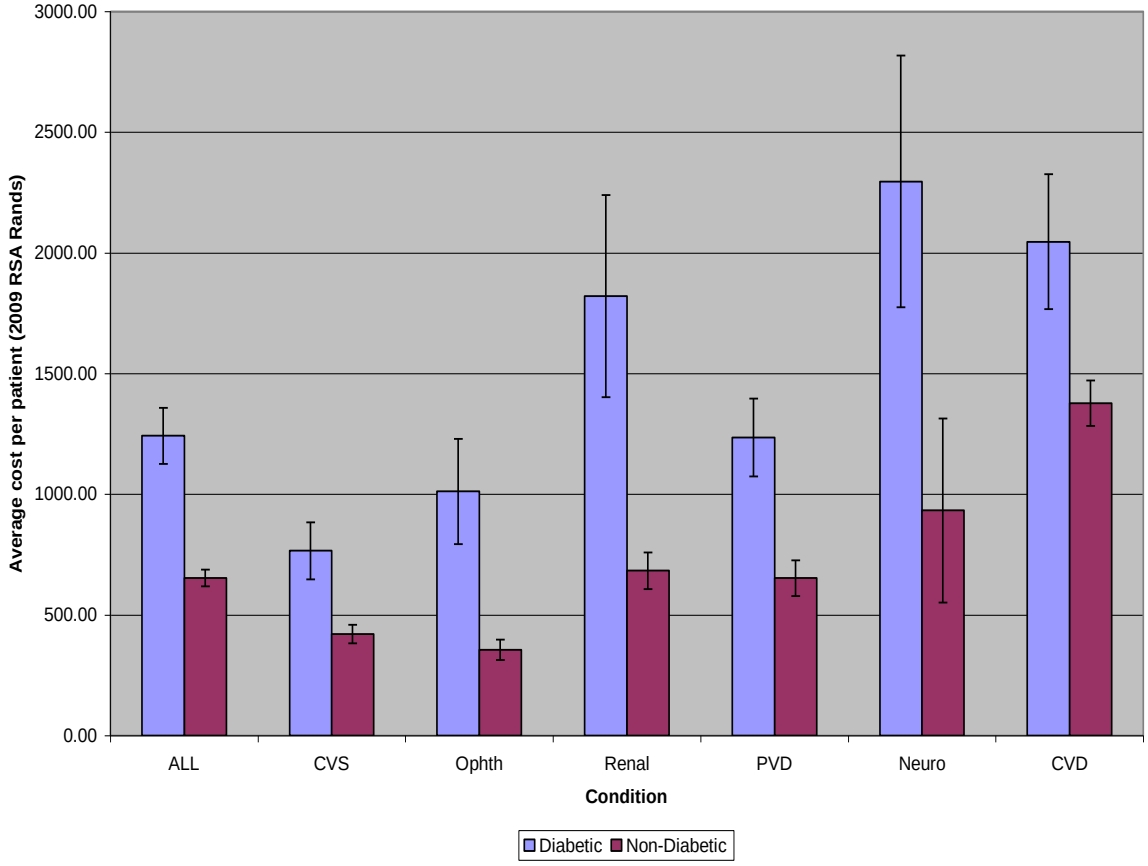

Fig. 4.5 Average cost of laboratory tests and procedures per patient

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4.7 Average rate of hospitalisation per patient per year (in 2009)

Diabetic patients had a significantly higher average hospitalisation rate per patient of 1.8 ± 0.8 times compared to 1.5 ± 0.6 times per year in 2009, p<0.00001, **Figure 4.6**. Within the disease groups, the average frequency of hospitalisation per patient for the year 2009 was significantly higher in diabetic patients than in non-diabetic patients for cardiovascular (p= 0.013), renal (p=0.003) and cerebrovascular (p=0.0000934) conditions. However, no significant difference was seen in the ophthalmic (p=0.25), peripheral vascular (p=0.41) and neurological groups (p=0.29).

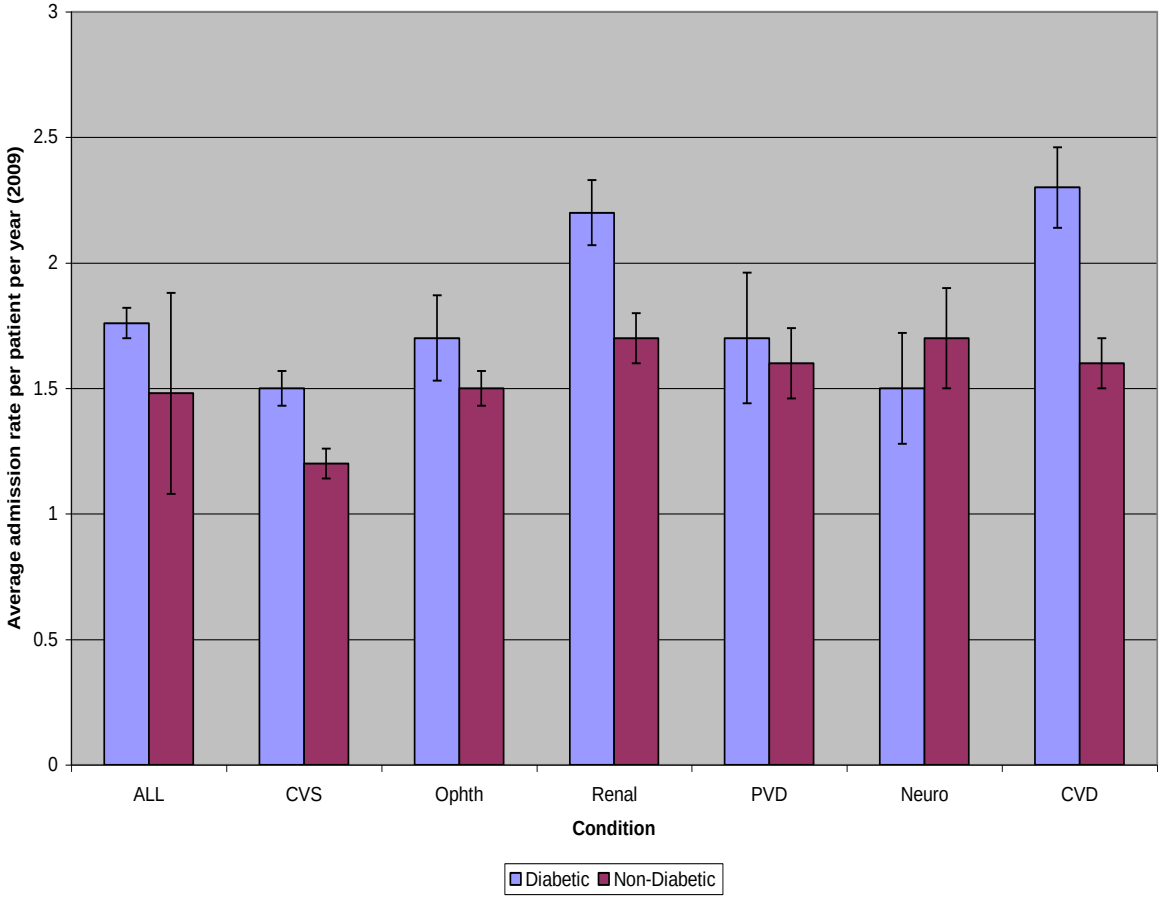

Fig. 4.6 Average rate of hospitalisation per patient per year

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Chapter 5 Discussion and Limitations

5.1 Discussion

The prevalence of diabetes among the study sample was 38.08% (N=407). This group of diabetic patients was not accounted for on Medicom since secondary diagnoses are not documented. This is a common problem as noted in many studies that hospital databases under-report diabetes for in-patient related discharges by as much as 40%, a challenge especially in patients with co-morbidities (McCandless 2002).

Cardiovascular disease was the most prevalent in the both groups, (31.3 % of the non-diabetic patients studied and 38% of the diabetic patients). When combined cardiovascular patients in both groups were the most expensive and were in the majority, further highlighting the grave danger of the rise of cardiovascular diseases in the community. This is not a new trend as explained by the IDF (2003) that cardiovascular complications frequently account for the bulk of the costs as reflected in the patterns of hospital admissions for the treatment of complications. Jiang *et al* (2002) in USA and Gargliardino *et al* (2000) in the Argentinean study also found the same trend.

Diabetic patients were hospitalised for longer periods than non-diabetic patients; 13.04 ± 9.29 days vs. 8.86 ± 8.33 days, ($p<0.001$). The length of stay for the non-diabetic patients in the present study is comparable to the average of 5.9 days for all patients discharged in December 2009 as calculated by the CHBAH's Information Technology department. This shows that the non-diabetic patients studied were within the overall hospital range, further consolidating the accuracy of this study while the diabetic patients stayed for longer. These findings for length of hospitalisation of diabetic patients are close to the results obtained by Van Zyl and Rheeder (2009) for Kalafong hospital who reported a median stay of 7.5 days with a range of 1 to 87 days. Diabetic patients in the current study were hospitalized for longer than the patients studied in Groote Schuur hospital by Pepper *et al* (2007*)*. In that study the mean length of stay for diabetic patients was 4 days. This could be explained by the fact that in Groote Schuur, Pepper *et al* (2007*)* were only investigating

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hyperglycemic emergencies which in certain cases can be managed in a relatively shorter period of time. However, the results are consistent with the findings of studies done by Soltani *et al* (1993) in Tunisia, Carral *et al* (2002) in Spain and Colin *et al* (2007) in France. Soltani *et al* (1993) found a mean length of hospital stay of 10.3 days for diabetic patients vs. 8 days for the non-diabetic study population. In the Spanish study by Carral *et al* (2002), the mean duration of hospital admission was 12.5 ± 14.5 days for diabetic patients and 8.5 ± 10.6 days for the non-diabetic patients. In the study done by Colin *et al* (2007) the mean length of stay per condition ranged from 6 to 16.3 days for diabetic subjects and from 4.7 to 13.5 days for non-diabetic patients.

The length of stay for all the patients studied ranged from 1 day to 49 days. From this perspective patients only admitted for a day at CHBAH seemingly are the less serious cases which could be seen at lower levels of care if a proper referral system is in place. In this regard the community should be sensitised about the advantages of following the proper referral system so that only the cases deserving to be attended to in a tertiary hospital are seen at CHBAH with the relevant resources and this might improve the allocative efficiency of resources in the institution. In addition the admission policy needs to be interrogated to determine how hospitalisation decisions are made.

According to the Uniform Patient Fee Schedule released in November 2009, the facility fees for the different levels of care i.e. chronic care, day patient, general ward, high care ward to Intensive Care Unit (ICU) ranged from R269 for a chronic care facility to R2 793 for ICU with a median of R1105-00 (general ward). The facility fees are gazetted by the national government for all hospitals. It is the fee that a fee- paying patient would pay in any public hospital. However PDE costs are calculated by the individual hospitals based on their actual expenditure and their actual patient numbers as described in the methodology. Although not used for charging patients per se, PDE costs are a more accurate reflection of what it costs the hospital to care for a patient for a day.

On the other hand, the average PDE cost used in this study was R1 851-66, about 50% more than the facility fee gazetted for a general ward fee. This PDE calculated for the study seems very high which could raise questions about allocative efficiency of resources

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at CHBAH. It could mean that there is a disproportionate expenditure to the patient day equivalents or both patient volumes and expenditure are inappropriately high. There is room to improve the costing functions at CHBAH so as to allow for a wider and deeper research with more reliable and accurate results.

The diabetic subjects had significantly higher overall total hospitalisation costs, pharmaceuticals and laboratory and procedures' costs. This is expected due to diabetic patients' longer duration of stay. Hospital in-patient costs for the treatment of diabetes complications are the largest single contributor to direct healthcare costs (IDF 2003). The present study's findings concurred with this. From the study results, 118 of the 155 (76.1 %) diabetic patients were on some form of insulin and this might have contributed to the higher cost of pharmaceuticals for diabetic patients. Laboratory and procedure costs for diabetic patients were significantly higher than costs for non-diabetic patients. This could be explained by the more stringent requirements for diabetic care monitoring. However, the higher costs in the diabetic study patients are not necessarily attributable to the presence of diabetes alone because this study is of a purely descriptive nature and the confounding factors like age, gender, race, weight, etc. were not controlled.

There could have been an under-estimate of pharmaceutical and procedures because for pharmaceuticals and laboratory costs, the researcher had to rely on the handwritten data in the medical records. In most instances it was not stated what tests had been done or any procedures carried out and the only information that was accurately available was the length of hospitalisation which is a direct determinant of lodging costs. In addition, the prices of pharmaceuticals availed were much lower than the government gazetted single exit prices which was not clear whether the prices are what the government actually pays the pharmaceutical companies taking advantage of economies of scale or the data had simply not been updated. For instance the single exit prices extracted from Monthly Index of Medical Specialties (MIMS) of July 2009, a pack of 50 Cyclosporine 25 mg capsules had a price of R499-25 for the cheaper generic equivalent and the brand being used at CHBAH (Sandimmun Neoral)) cost R602-10 yet the price list at CHBAH quoted the same product at a cost of R175.48 as at March 2009. This could have also contributed to the low cost values associated with pharmaceuticals in this study.

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This study also looked at the hospitalisation frequency for the patients for the year 2009. Diabetes patients had a significantly higher average frequency of hospitalisation per patient for the year 2009, for cardiovascular, renal and cerebrovascular conditions. This could be explained by the complications associated with renal failure such as the constant need for dialysis which require chronic in-patient care. Cardiovascular disease is also the major complication of type 2 diabetes and is responsible for more than 50% and up to 80% of deaths in people with diabetes as well as for very substantial morbidity and loss of quality of life (IDF 2003). There was no significant difference in the frequency of hospitalisation for ophthalmic, peripheral vascular disease and neuropathy patients. This could be explained by small sample sizes and the fact that some patients have more than one GT or GP number which was used in the study to ascertain the rate of hospitalisation.

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5.2 Limitations of the study

- Records of patients who died in hospital where not included in the study which might have caused an underestimate of diabetes costs as diabetes is a major cause of mortality.
- The researcher did not have access to all medical records as some were presumed lost or were still in the wards, which is a major limitation of retrospective data analyses.
- A small sample size and a short study period used in the comparison of diabetic and non-diabetic patients within specific disease groups means that the study results cannot be generalized to all patients seen at CHBAH or to South Africa as a whole.
- Using the month of December may have distorted the morbidity patterns because there are fewer patients admitted to CHBAH due to the holidays in that month. However there was no major difference in discharge numbers in December relative to the other months (appendix 2) and hence the month of December was chosen to simplify data extraction for the annual hospitalisation frequency.
- Although Medicom® is a fairly comprehensive data capturing system; it is not fully utilized at CHBAH. Important sections like medication prescribed and actually given to the patient, procedures and tests carried out are left blank. The researcher had to rely on the hand written records to decipher the relevant information with the assumption that what was found was all there was to the file yet in reality it may not be so. This weakens a retrospective analysis when compared with a prospective one under these circumstances.
- In some instances one hospital number had been issued to more than one patient and in others one patient had more than one hospital number. In addition where a patient had more than one hospital number it distorts the information on admission rates by the same patient.
- There was also the problem of categorising diseases like neuropathy on Medicom® only being referred to as pain.
- Not all diabetic patients seen in December were included in the study. Those registered as hypoglycemic or hyperglycemic were not included so as to allow comparison of diabetic patients with non-diabetic patients of similar conditions. This caused an under estimate of the prevalence of diabetes in the community.

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- It was not clear on Medicom® for the above mentioned patients whether the hypo- or hyperglycemia was the primary diagnosis or these conditions had been precipitated by other conditions e.g. peripheral vascular disease which effectively reduced the sample size.
- The study only calculated the hospitalisation rate without looking at the reasons for hospitalisation. This information does not reflect much on the trends of morbidity and especially in diabetic patients were re-hospitalisation may be a function of poor glycemic control.
- Cost data for pharmaceuticals was not the same as the single exit price gazetted by the government which led to a low value for pharmaceuticals.

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Chapter 6 Conclusions and recommendations

6.1 Conclusions

Within specific disease groups, this study showed that diabetic patients discharged in December 2009 from the CHBAH wards consume on average significantly more resources than non-diabetic patients with similar conditions. Diabetic patients had a longer duration of hospitalisation and their total hospitalisation costs were 44% more than that of non-diabetic patients. The greatest numbers of patients in both groups had cardiovascular diseases.

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6.2 Recommendations

- Data capture clerks and medical personnel need to be sensitised to the importance of accurate data management. Their appreciation of the fact could be enhanced by availing to them the research findings from the data systems they use, so that they can have a better understanding and a willingness to co-operate (WHO 1999)
- A comprehensive financial accounting system and a computerized database for resource consumption by individual patients is required so that costing studies can be done accurately.
- The referral system should be effectively implemented to avoid unnecessary congestion at tertiary hospitals.
- Further prospective studies on diabetes cost should be carried out on larger samples and for a longer duration.
- Admissions policy needs to be reviewed, especially where ambulatory care is a possible alternative.

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6.3 Implications for the pharmacist

- As the health care professional most accessible to the general public, pharmacists should be actively involved in diabetes prevention efforts in communities by encouraging healthy lifestyles, being involved in diabetes care , patient education and blood sugar monitoring with active follow up on those found to be having diabetic symptoms or inadequate control of established diabetes.
- Pharmacists should play an active role in clinical pharmacy as part of the Outpatient clinics in hospitals where pharmacists interact with patients at their level and educate them on medicines identification and compliance with their treatment so as to reduce hospitalisation episodes.
- Improved stock management is a pre-requisite for optimal diabetic care. By ensuring consistent adequate supplies of quality medications to both non-diabetic and diabetic patients, many hospitalisation episodes can be avoided.
- Patients need to be educated by trained pharmacists regarding the use of their medicines especially the use of insulin particularly when vials are switched with flexi-pens due to supplier problem or unavailability of one or the other.
- Pill counting may be a possible alternative in monitoring patients' compliance with medication. This could also be handy in situations where there is a change of packaging due to a change in supplier which often happens due to the tendering process in place in public institutions.
- Pharmacists can also be involved at ward level to enhance pharmaceutical care by, ensuring appropriate and rational drug selection which might improve patient care and potentially reduce costs.

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Chapter 7

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Appendices

1. DATA COLLECTION FORM

DIABETIC Yes No MALE FEMALE

GT number	
Age	
Number of previous admission episodes in the 12months prior to current admission episode	
Diagnosis on current discharge	
Length of current hospitalisation	

Drugs

Drug	Quantity	Cost/Unit	Total Cost
Total			

Laboratory Tests

Test	Quantity	Cost/unit	Total cost
Total			

-

Procedures

Procedure	Quantity	Cost/unit	Total cost
Total			

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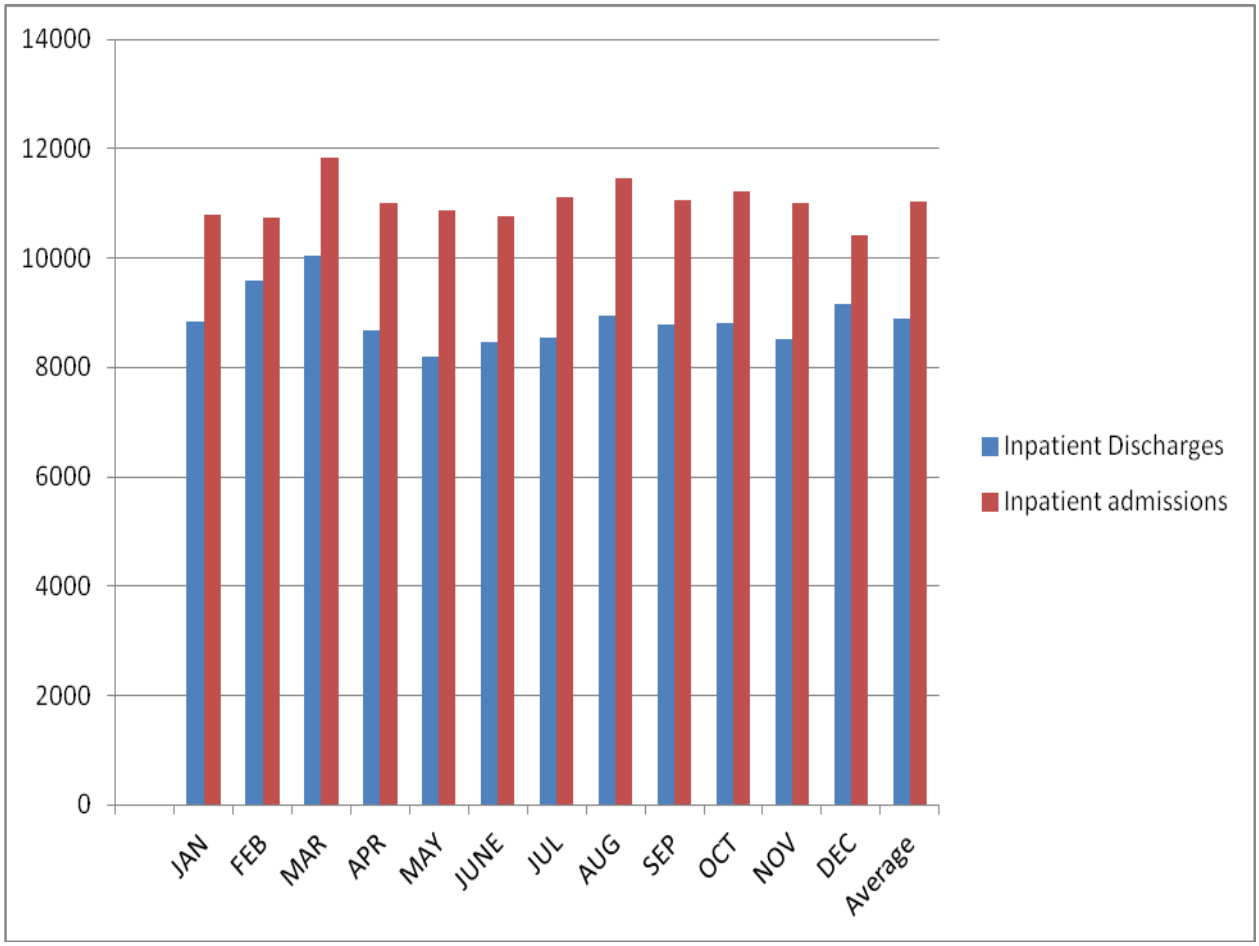
2. CHRIS HANI BARAGWANATH ACADEMIC HOSPITAL INPATIENT ADMISIONS AND DISCHARGES BY MONTH 2009

(Extracted from Indicators Management Report, 2009)



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3. MEDICAL SUPPLIES PRESCRIBED FOR THE STUDY PATIENTS

ITEM	PRICE
ABCIXIMAB (C 7E3 FAB) INJECTION 2MG/ML; 5ML	3 559.61
ACETAZOLAMIDE TABLETS 250MG;30'S	56.02
ADENOSIDE INJECTION 3MG/ML; 2ML	127.29
ADULT TOTAL PARENTERAL NUTRITION ITN 5004 BAG	1380.17
ADULT TOTAL PARENTERAL NUTRITION ITN 8005A BAG	1491.36
ALFACALCIDOL CAPSULES 0,25MCG; 30'S	116.43
ALFACALCIDOL CAPSULES 1,0MCG; 30'S	378.51
ALLOPURINOL TABLETS 100MG; 500'S	26.15
ALLOPURINOL TABLETS 300MG; 30'S	98.52
AMIODARONE HCL INJECTION 50 MG/ML; 3ML	46.18
AMIODARONE HYDROCHLORIDE TABLETS 200MG; 30'S	32.51
AMITRIPTYLINE HCL TABLETS PATIENT READY PACK: 25MG;28'S	42.96
AMLODIPINE BESYLATE TABLETS 5MG; 30'S	5.25
AMOXYCLAV 625MG TABLETS; 15	17.14
AMOXYCLAV 1.2G INJECTION	21.38
AMPHOTERICIN B INJECTION ; 50MG/VIAL	230.85
AMPICILLIN SODIUM INJECTION: 250MG PER VIAL	5.36
ATENOLOL INJECTION 0,5MG/ML; 10ML	40.00
ATENOLOL TABLETS 50MG; 28'S	14.97
ATORVASTATIN TABLETS 10MG ;30'S	26.79
ATORVASTATIN TABLETS 20MG;30'S	33.06
ATROPINE SULPHATE OPHTHALMIC DROPS 1%;0,5ML;20'S	169.00
BETAMATHASONE SODIUM PHOSPHATE 0.1%; EYE OINTMENT: 3G	47.03
BETAMETHASONE;5ML INJECTION	105.00
BETAXOLOL 5MG/ML OPHTHALMIC DROPS; 5ML	27.15
BEZAFIBRATE CONTROLLED RELEASE TABLETS 400MG; 30'S	95.36
BIMATOPROST,OPTHALMIC DROPS 0,3MG/ML;3ML	32.00
BIPERIDEN HYDROCHLORIDE TABLETS 2MG; 500'S	70.98
BUSERELIN ACETATE IMPLANT 9,9MG;3-MONTH DEPOT IMPLANT;	1 368.00
CALCIFEROL TABLETS 50000IU; 100'S	161.64
CALCIUM CARBONATE AND GLYCINE TABLETS 420MG /180MG; 28S	8.72
CALCIUM CHLORIDE INJECTION 10%; 10ML	2.41
CAPTOPRIL TABLETS 25MG; 56'S	12.00
CARBAMAZEPINE CONTROLLED RELEASE TABLETS 200MG; 30'S	14.36
CARBIDOPA AND LEVODOPA TABLETS 25MG;100MG; 100'S	73.26
CARBIMAZOLE TABLETS: 5MG; 100'S	302.07
CARVEDILOL TABLETS 12,5MG;30'S	23.54
CARVEDILOL TABLETS 25MG; 30'S	25.95
CARVEDILOL TABLETS 6,25MG;30'S	22.36
CEFEPIME INJECTION; 2G/VIAL	22.42
CEFTAZIDIME FOR INJECTION: 2G PER VIAL	49.37
CEFTRIAXONE SODIUM FOR INJECTION 1GM PER VIAL;W/OUT DILUENT	24.86
CEFUROXIME SODIUM FOR INJECTION: 750MG PER VIAL	9.80
CHLORAMPHENICOL AND DEXAMETHASONE EYE DROPS: 0,5%;0,1%; 5ML	21.63
CHLORAMPHENICOL EYE DROPS 0.5%; 10ML	22.71

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CHLORAMPHENICOL EYE OINTMENT 1%; 3,5GM	11.67
CHLORAMPHENICOL SODIUM SUCCINATE IV INJECTION: 1G/VIAL	8.16
CICLOSPORIN CAPSULE: 100MG; 50'S	601.92
CICLOSPORIN CAPSULES: 25MG; 50'S	175.48
CIPROFLOXACIN HCL 3.5MG/ML EYE DROPS; 5ML	27.55
CITALOPRAM (AS HYDROBROMIDE) TABLETS 20MG; 28'S	41.51
CLARITHROMYCIN INJECTION: 500MG/VIAL	120.50
CLARITHROMYCIN TABLETS XL(MODIFIED RELEASE);500MG;10'S	89.63
CLINDAMYCIN PHOSPHATE INJECTION: 600MG PER 4ML AMPOULE	32.00
CLONIDINE HYDROCHLORIDE TABLETS 25MCG; 100'S	36.64
CLOPIDOGREL HYDROGEN SULPHATE TABLETS 75MG;30'S	24.97
CLOTRIMAZOLE VAGINAL CREAM: 10MG/G W/SIX APPLICATORS; 50G	5.98
CLOXACILLIN SODIUM FOR INJECTION 250MG	4.99
CYCLOPENTOLATE HCL OPHTHALMIC DROPS;1%;0,5ML;20'S	169.00
DABIGATRAN 110MG 30S (PRADAXA)	223.65
DABIGATRAN 75MG 30S	222.60
DEXAMETHASONE 0,1% EYE DROPS; 5ML	11.84
DEXAMETHASONE INJECTION 4MG/ML; 1ML	3.39
DEXMEDETOMIDINE HCL INJECTION PRECEDEX;100MG/ML	1 584.60
DEXTROSE INJECTION IV SOLUTION;20%;PLASTIC;500ML;1'S	29.77
DIAZOXIDE CAPSULES 25MG;100'S	415.45
DICLOFENAC SODIUM TABLETS;25MG;42'S	3.00
DICLOPHENAC INJECTION 75MG/3ML	37.79
DIGOXIN TABLETS;0,25MG; 14'S	5.74
DILTIAZEM HCL TABLETS: SLOW RELEASE 90MG; 60'S	43.79
DILTIAZEM TABLETS 60MG; 50'S	35.21
DIPYRIDAMOLE TABLETS 25MG;100'S	51.54
DOXAZOSIN MESYLATE TABLETS: 4MG; 30'S	99.11
ENALAPRIL MALEATE TABLETS 10MG; 28'S	39.27
ENALAPRIL MALEATE TABLETS:20MG;28'S	29.36
ENOXAPARIN INJECTION 80MG/0,8ML;	16.43
ENOXAPARIN INJECTION: 40MG/0,4ML; 1'S	12.76
EPLERENONE (INSPRA) 50MG	351.13
EPTIFIBATIDE INJECTION 0,75MG/ML;100ML	1 463.57
ERYTHROMYCIN STEARATE 250MG CAPSULES; 20'S	7.93
ERYTHROPOIETIN FOR INJ IV/SUBCUT;HUMAN RECOMBINANT;30 000IU; 0,6ML	900.00
ERYTHROPOIETIN RECOMBINANT HUMAN; 4000 IU/AMP	143.37
ERYTHROPOIETIN,RECOMBINANT HUMAN; 10000 IU/1ML	300.00
ESTROGENS CONJUGATED TABLETS :0,625MG;500'S	71.29
ESTROGENS CONJUGATED TABLETS :1,25MG;500'S	1 000.50
FLUCONAZOLE CAPSULES 200MG; 28'S	164.12
FLUCONAZOLE INJECTION 2MG/ML; 100ML	148.20
FLUORESCEIN SODIUM OPHTHALMIC SOLUTION 2%;0,5ML;20'S	147.99
FLUOROMETHOLONE 0.1% EYE DROPS; 5ML	14.10
FLUOXETINE HCL TABLETS 20MG; 30'S	43.85
FUROSEMIDE INJECTION 10MG/ML; 5ML	1.08
FUROSEMIDE TABLETS 40MG;28'S	1.50
FUSIDATE SODIUM IV; 500MG/VIAL	153.85
FUSIDATE SODIUM TABLETS 250MG; 100'S	1 858.50
FUSIDIC ACID ANHYDROUS 10MG /G;EYE DROPS; 5G	36.89

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GABAPENTIN CAPSULES 100MG; 100'S	48.79
GABAPENTIN CAPSULES 300MG; 100'S	73.93
GANCICLOVIR SODIUM INJECTION 500MG/VIAL; 1'S	383.74
GLIBENCLAMIDE TABLETS 5MG; 28'S	11.20
GLICLAZIDE TABLETS 80MG; 60s	31.50
GLUCAGON INJECTION; 1MG/VIAL PLUS DILUENT AND SYRINGE; KIT	84.29
GLUCOSE INJECTION 35% 1000ML ; 1'S	29.78
GLYCERYL TRINITRATE INJECTION 1MG/ML; 50ML	70.06
GLYCERYL TRINITRATE TABLETS 0,5MG; 50'S	26.21
GOSERELIN INJECTION 10,8MG;DEPOT;SINGLE DOSE APPLICATOR	1 767.00
HEPARIN SODIUM INJECTION 5000IU/ML; 5ML	21.11
HOMATROPINE HBR / HYPROMELLOSE EYE DROPS; 2% /0,5%; 5ML	8.96
HYDRALAZINE TABLETS 10MG; 500'S	87.58
HYDRALAZINE TABLETS 25MG; 500'S	166.66
HYDROCHLOROTHIAZIDE TABLETS 25MG; 28'S	2.19
HYOSCINE BUTYLBROMIDE TABLETS 10MG;100'S	33.28
ILOPROST INJECTION 0,05MG/0,5ML;0,5ML	710.22
IMIPENEM/ CILASTATIN SODIUM FOR INJECTION :500MG / 500MG;VIAL; 1'S	121.10
INDAPAMIDE TABLETS 2,5MG; 30'S	5.36
INSULIN INJ: HUMAN, BIOSYNTHETIC, E-COLI , SOLUBLE 30%, ISOPHANE 70%; 100IU/ML; 10ML	69.65
INSULIN INJECTION: HUMAN; BIOSYNTHETIC/E-COLI DERIVATIVE; SOLUBLE; 100U/ML; 10ML	69.65
INSULIN INJECTION: ISOPHANE, HUMAN, BIOSYNTHETIC; E-COLI DERIVATIVE; 100U/ML; 10ML	69.65
ISOSORBIDE DINITRATE INJECTION 1MG/ML; 10ML	56.21
ISOSORBIDE DINITRATE TABLETS :10MG;50'S	7.12
ISOSORBIDE DINITRATE TABLETS :SUBLINGUAL;5MG;50'S	5.20
ISOSORBIDE MONONITRATE TABLETS 20MG;56'S	24.92
IVABRADINE	Donated
LABETALOL HCL INJECTION 5MG/ML; 20ML	13.95
LATANOPROST EYE DROPS 5MG/ML;2.5ML	49.00
LENS,OPHTHALMIC,SPHERE INTRA OCULAR LENS FOR PLACEMENT IN ANTERIOR CHAMBER;	5 485.33
LENS,OPHTHALMIC,SPHERE INTRA OCULAR LENS FOR PLACEMENT IN POSTERIOR CHAMBER;	518.56
LENS,SURGICAL INTRA-OCULAR;ANTERIOR;POLYPROPYLENE;DIOPTER 23;MANIPULATION HOLES;	245.00
LENS,SURGICAL INTRA-OCULAR;ANTERIOR;POLYPROPYLENE;DIOPTER 24;MANIPULATION HOLES;	1 995.00
LEVOBUNOLOL 0.5% EYE DROPS; 5ML	15.95
LEVOCABASTINE 0.5MG/ML EYE DROPS; 4ML	75.39
LEVOTHYROXINE SODIUM TABLETS;100UG;28'S	21.14
LEVOTHYROXINE SODIUM TABLETS;50UG;28'S	14.77
LIGNOCAINE HCL INJ 1% ; 20ML	10.41
LINEZOLID INJECTION 600MG/300ML;300ML	260.50
LINEZOLID TABLETS 600MG;10'S	2 565.86
LIOTHYRONINE SODIUM TABLETS 20MCG; 50'S	66.91
LODOXAMIDE (AS TROMETHAMINE) EYE DROPS: 1MG/ML; 10ML	40.46
LOSARTAN TABLETS 50MG;30'S	17.10
LUBRICANT,OPHTHALMIC ANHYDROUS LIQUID LANOLIN 3% AND MINERAL OIL TO 100%; 3,5G	55.19

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MAGNESIUM CHLORIDE SLOW RELEASE TABLETS 535MG;60'S	23.94
MEROPENEM TRIHYDRATE ANHYDROUS INJECTION; 500MG/VIAL	223.82
METFORMIN HYDROCHLORIDE TABLETS;850MG;56'S	68.57
METHYLDOPA TABLETS 250MG; 84'S	224.90
METOPROLOL 100MG TABS 40S	136.94
METRONIDAZOLE INJECTION I.V. INFUSION;500MG/100ML;;20'S	678.84
METRONIDAZOLE TABLETS;400MG;21'S	22.75
MINOXIDIL TABLETS 10MG; 100'S	428.27
MINOXIDIL TABLETS 5MG; 100'S	244.76
MITOMYCIN INJECTION; 10MG/VIAL; 1'S	485.40
MUPIROCIN 2% TOPICAL OINTMENT; 15G	26.23
MYCOPHENOLATE MOFETIL CAPSULES 250MG;100'S	410.32
MYCOPHENOLATE MOFETIL TABLETS 500MG;50'S	775.61
MYCOPHENOLATE SODIUM TABS 384.8MG (EQUIVALENT TO 360MG MYCOPHENOLIC ACID);120'S	1 243.45
MYCOPHENOLATE SODIUM TABS FILM-COATED;192.4MG (EQ TO 180MG MYCOPHENOLIC ACID);120'S	621.96
NATAMYCIN OPHTHALMIC SUSPENSION 50MG/ML;;15ML	1 288.31
NIFEDIPINE TABLETS 30MG;CONTROLLED RELEASE;28'S	16.92
NIMODIPINE 30MG TABLETS; 100S	663.27
NITROGLYCERIN AEROSOL 0,4MG/METERED DOSE; 200 DOSE UNIT	119.70
OESTRADIOL TABLETS 2MG; 28'S	95.77
OMEPRAZOLE CAPSULES 20MG; 28'S	15.44
OXYBUPROCAINE HCL OPHTHALMIC SOLUTION 0,4%(BENOXINATE HCL);0,5ML MINIMS;20'S	169.00
OXYBUTYNIN HYDROCHLORIDE TABLETS 5MG; 100'S	25.31
OXYMETAZOLINE HYDROCHLORIDE 0.025% EYE DROPS: 15ML	11.95
PANTOPRAZOLE POWDER FOR INJECTION 40MG;10ML	57.92
PARACETAMOL SOLUTION FOR INFUSION 1G/100ML;100ML VIAL	36.48
PARACETAMOL,CODEINE PHOSPH,MEPBROBAMATE,AND CAFFEIN 320MG;8MG;150MG AND 32MG TABLETS; 500'S	68.34
PENTOXIFYLLINE TABLETS :SLOW RELEASE 400MG; 100'S	172.00
PERINDOPRIL TERBUTYLAMINE TABLETS 4MG;28'S	14.36
PILOCARPINE HYDROCHLORIDE 2% EYE DROPS: 15ML	31.75
PILOCARPINE HYDROCHLORIDE OPHTHALMIC GEL 4%; 5G	54.71
PIPERACILLIN 4G AND TAZOBACTAM 500MG INJECTION;POWDER FOR RECONSTITUTION IN 50ML VIAL	102.19
PLASMINOGEN ACTIVATOR (RECOMBINANT HUMAN TISSUE TYPE); INJECTION 50MG/VIAL; 1'S	3 510.14
PRAZOSIN TABLETS 1MG;30	91.78
PRAZOSIN TABLETS 2MG; 30	157.64
PREDNISOLONE ACETATE 1% EYE DROPS; 5ML	39.63
PREDNISONE TABLETS 5MG;28'S	2.18
PROCHLORPERAZINE MESYLATE INJECTION 12,5MG/ML; 1ML	4.45
PROCHLORPERAZINE MESYLATE TABLETS 5MG; 250'S	18.80
PROPOXYPHENE HYDROCHLORIDE AND PARACETAMOL CAPSULES; 65MG AND 250MG; 100'S	33.09
PROPRANOLOL HYDROCHLORIDE TABLETS 40MG; 84'S	5.13
RANITIDINE HYDROCHLORIDE INJECTION 25MG/ML; 2ML	49.90
SHIELD, EYE;CARTELLA TYPE;LEFT OPULET; 1'S	14.90
SHIELD;EYE;CARTELLA TYPE;RIGHT OPULET; 1'S	3.98

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SIMVASTATIN TABLETS 10MG; 28'S	11.76
SIMVASTATIN TABLETS 20MG; 28'S	14.80
SODIUM CROMOGLYCATE 2% EYE DROPS: 10ML	134.53
SODIUM HYALURONATE 16MG/ML; OPHTHALMIC SOLUTION; 0.8ML	487.00
SODIUM VALPROATE INJECTION 400MG	123.63
SOTALOL HYDROCHLORIDE TABLETS 160MG; 100'S	46.34
SOTALOL HYDROCHLORIDE TABLETS 80MG; 100'S	30.75
SPIRONOLACTONE TABLETS;25MG;28'S	7.65
STREPTOKINASE FOR INJECTION 1 500 000IU/VIAL; 1'S	2 156.32
SULPHASALAZINE EC 500MG TABLETS 100S	235.11
TACROLIMUS CAPSULES 5MG;50'S	4 814.05
TELMISARTAN TABLETS 40MG;28'S	212.56
TELMISARTAN TABLETS 80MG;28'S	280.55
TESTOSTERONE PROPIONATE, TESTOST PHENYLPROPIONATE, TESTOS. ISOCAPROATE, TESTOST DECANOATE:30MG;60MG;60MG;100MG/ML; 1ML	135.66
THIAMINE HYDROCHLORIDE INJECTION VITAMIN B1 100MG/ML; 10ML	2.15
THYROXINE TABLETS 0,05MG; 100'S	7.63
THYROXINE TABLETS 0,1MG; 100'S	22.04
TIMOLOL MALEATE 0.5% EYE DROPS; 5ML	53.83
TOBRAMYCIN OPHTHALMIC SOLUTION USP: 3MG/ML; 5ML	102.61
TOTAL PHOSPHOLIPIDS; FOR INTRATRACHEAL USE; 200MG/8ML VIAL	2 435.11
TRAMADOL HYDROCHLORIDE CAPSULES 50MG; 100'S	67.68
TROPICAMIDE EYE DROPS 1%;0,5ML;20'S	169.00
VANCOMYCIN POWDER FOR INJECTION USP; 1000MG/VIAL	82.08
VENLAFAXINE TABLETS 75MG; 30'S	113.73
VERAPAMIL HYDROCHLORIDE INJECTION 2,5MG/ML; 2ML	0.89
VERAPAMIL HCL SUSTAINED RELEASE TABLETS 240MG; 30'S	480.64
VITAMIN TABLETS;25MG VIAL;28'S	1.16
VORICONAZOLE POWDER FOR INJECTION 200MG/;FOR INFUSION	340.50
WARFARIN 5MG TABLETS; 100S	221.02

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4 ETHICS CLEARANCE

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG
Division of the Deputy Registrar (Research)

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
R14/49 Ms Tryphine Ncube

CLEARANCE CERTIFICATE	**M10604**
PROJECT	Hospitalisation Rates, Length and Cost of Hospitalisation of Diabetic and Non-Diabetic Patients in a Tertiary Hospital in Johannesburg
INVESTIGATORS	Ms Tryphine Ncube.
DEPARTMENT	Pharmacy & Pharmacology
DATE CONSIDERED	26/06/2010
DECISION OF THE COMMITTEE*	Approved unconditionally

Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.

DATE 28/06/2010 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable
cc: Supervisor : Prof M Danckwerts

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES...

5. PROTOCOL APPROVAL

Faculty of Health Sciences
Medical School, 7 York Road, Parktown, 2193
Fax: (011) 717-2119
Tel: (011) 717-2745

Reference: Ms Tania Van Leeve
E-mail: tania.vanleeve@wits.ac.za
07 September 2010
Person No: 0701390E
PAG

Ms T Ncube
Flat 211 Howard Court
2-5 Nerwick Road
Gresswold
2192
South Africa

Dear Ms Ncube

Master of Science in Medicine (Pharmacotherapy): Approval of Title

We have pleasure in advising that your proposal entitled "*Hospitalisation rates, length and cost of hospitalisation of diabetic and non-diabetic patients in a tertiaary hospital in Johannesburg.*" has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences