

https://dspace.org/

Costing total hip arthroplasty in a South African State Tertiary Hospital

Sekeitto, Allan Roy

2019

https://hdl.handle.net/10539/29862

Sekeitto, Allan Roy, Costing total hip arthroplasty in a South African State Tertiary Hospital, University of the Witwatersrand, Johannesburg, <http://hdl.handle.net/10539/29862>

Downloaded from a DSpace repository. https://dspace.org/

Costing Total Hip Arthroplasty in a South African State Tertiary Hospital



Allan Roy Sekeitto

A research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Medicine

Johannesburg, 2019

Declaration

I *Allan Roy Sekeitto* declare that this Research Report is my own, unaided work. It is being submitted for the Degree of Master of Medicine in the branch of Orthopaedic Surgery at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other University.

……

29th day of October 2019 in Johannesburg

Dedication

This report is dedicated to my parents Dr Agnes Vera Ikatekit-Okonera and the late Dr Paul Sekeitto, who worked to pave the road of my success. My wife Boipelo “Kasana” Tselapedi - Sekeitto who has since the beginning of the journey been at my side. My family The Tselapedi’s, Clare Odongo, Melvyn Lubega, Ignatius Odongo, Anthea Opira, Alfonse Opira and the J’s who kept me focused on the bigger picture.

Abstract

Background: Most South Africans depend on the public sector for health services. There is an increased demand for arthroplasty in the public sector. There is a paucity academic data regarding the cost of primary hip arthroplasty. The aim of the study was to determine the cost of an uncomplicated primary hip arthroplasty. The objectives were the following: (i) to identify the factors that determine the cost and (ii) to make recommendations on cost optimisation.

Methodology: This was a cross-sectional study. Patients who met the inclusion criteria had their financial records reviewed from October 2015 to March 2017. There were six cost centres utilised namely; inpatient admission, anaesthesia and operative, ambulatory, prosthesis, physiotherapy and the blood bank cost centres. The data were statistically analysed.

Results: There were 55 patients who met the study inclusion criteria. Data were stratified into categories. Analysis of variance was used to test the data and significant differences were found in the prosthesis, inpatient admission and ambulatory cost centres at a 95% significance level. Least significance difference was used to test the analysis if variance results which paired significant categories. Neither cost centre showed significance over the other categories.

Discussion: The six cost centre data were compared to the current literature and industry best practice. Seven recommendations were made.

Conclusion: The study demonstrates that clinicians need to be aware of procedural costing in the current financial climate. There are still opportunities within the state sector to optimise cost containment.

Acknowledgements

I would like to thank my supervisor Prof A.A. Aden for his guidance through the journey of this research report and his mentorship. Special thanks to Dr Warren Meier and Ms Lucia Mabuto for their assistance in the acquisition of the data. Great thanks to Mr Stetson Haufiku for his insightful input on my data analysis section. Dr Maxwell Jingo and Dr Brenda Milner for their research support. Big thank you goes to the department of Orthopaedic Surgery for supporting this research project.

Table of contents

Declaration ..... **i**

Dedication ..... **ii**

Abstract ..... **iii**

Acknowledgements ..... **vi**

List of Figures ..... **x**

List of Tables ..... **xi**

Nomenclature ..... **xii**

List of Definitions ..... **xiii**

CHAPTER 1 ..... **1**

1 Introduction and literature review **1**

1.1 Background and literature review 1

1.2 Problem Statement 6

1.3 Study Justification 7

1.4 Study Aim and Objectives 7

CHAPTER 2 ..... **8**

2 Methodology **8**

2.1 Study Design 8

2.2 Study Site 8

2.3 Study Population 8

2.4 Selection Criteria 8

2.5 Data collection 9

Variables 9

Ethics....10

2.6 Data Analysis....10

CHAPTER 3....12

3 Results....12

3.1 Demographics....12

3.2 Inpatient admissions costs....13

3.3 Anaesthesia and operative costs....14

3.4 Ambulatory cost centre....14

3.5 Prosthesis cost centre....14

3.6 Physiotherapy cost centre....15

3.7 Blood bank cost centre....15

3.8 The total cost....16

4 Discussion....20

4.1 Recommendations....28

4.1.1 The prosthesis cost centre....28

4.1.2 Inpatient admission cost centre....28

4.1.3 The anaesthesia and operative cost centre....28

4.1.4 The ambulatory cost centre....29

4.1.5 The physiotherapy cost centre....29

4.1.6 The blood bank cost centre....29

4.1.7 General....29

CHAPTER 5....30

5 Conclusion....30

6 References 31

7 Appendices 34

7.1 Appendix A: Data collection sheet 34

7.2 Appendix B: Human Research Ethics Committee (Medical) Clearance Certificate 36

7.3 Appendix C – Hospital CEO permission Letter 37

List of Figures

Figure 3.1: Sex demographic of patients.....12

Figure 3.2: Side of total hip arthroplasty.....13

Figure 3.3: Cost centre contribution to the total cost 16

List of Tables

Table 3.1: Descriptive data of the respective cost centres.....13

Table 3.2: Quintiles of the cost centres.....17

Table 3.3: Categories according to frequency 17

Table 3.4: F-statistics of the cost centres 18

Table 3.5: Least squares means for the cost centres 19

Table 4.1: Model 2 Discovery Joint Arthroplasty Agreement 27

Nomenclature

ANOVA	Analysis of variance
CHBAH	Chris Hani Baragwanath Academic Hospital
DDH	Developmental dysplasia of the hip
ECG	Electrocardiogram
HJH	Helen Joseph Hospital
HPCSA	Health Professions Council of South Africa
HREC	Human Research Ethics Committee
LOS	Length of stay
LSD	Least significant difference
NHLS	National Health Laboratory Service
QALY	Quality adjusted life years
THA	Total hip arthroplasty
THAs	Total hip arthroplasties
TJA	Total joint arthroplasty
TKA	Total knee arthroplasty
USA	United States of America

List of Definitions

Arthroplasty	The operative formation or restoration of a joint.
Complication	Refers to any adverse effect, with or without reoperation.
Development of dysplasia of the hip	A disorder of abnormal development of the hip joint resulting in dysplasia and possible subluxation or dislocation of the hip.
Direct cost	A cost that can be completely attributed to the production of specific goods or services.
Economies of scale	A proportionate saving in costs gained by an increased level of production.
Indirect cost	A cost that is used by multiple activities, and which cannot therefore be assigned to specific goods or services.
Osteoarthritis	Arthritis that is characterised by degenerative changes in the bone and cartilage of joints and a progressive wearing down of opposing joint surfaces with consequent distortion of joint position.
Total Hip Arthroplasty	The operative restoration of the hip joint.

CHAPTER 1

1 Introduction and literature review

1.1 Background and literature review

Arthroplasty is an orthopaedic surgical procedure which is done to restore joint function. The modern era of total hip arthroplasty (THA) was pioneered by Sir John Charnley who lead the field of arthroplasty with his Charnley prosthesis in the 1970s (1). According to the South African National Joint Registry National Report 2015, 47.58% of all entries from December 2012-2015 were primary total hip arthroplasties (THAs) (2).

The aging population in South Africa has increased the demand for arthroplasty services; this is in keeping with the global trend (1, 3, 4). The public sector provides healthcare services to 84% of the South African population (5). The public sector has entered the media spotlight especially with regard to orthopaedic surgery backlogs, including arthroplasty waiting lists. The media reported at Chris Hani Baragwanath Academic Hospital (CHBAH), Johannesburg South Africa, that there is a seven year waiting list for patients in need of total joint arthroplasty (TJA). The ever growing burden on the public sector is evident with limited public funds particularly in developing countries of which South Africa is categorised within (6, 7).

This increased demand for arthroplasty services is in keeping with global healthcare trends, literature makes reference to the impending epidemic (8, 9). THA is among the most cost-effective interventions in medicine in terms of costs per quality adjusted life years (QALYs) gained (10). The literature demonstrates that TJA is a cost-effective medical intervention that alleviates pain with excellent function outcomes particularly in THA (1, 10). There is a substantial economic burden associated with arthroplasty in the current financial climate with healthcare budgetary constraints (1, 4, 11).

A study by Meyers et al. examined joint arthroplasty costs looking for potential measures to reduce costs by identifying cost drivers. Costs may vary due to several factors which include the frequency of the procedure, the varied inpatient services, the availability of medical supplies and other treatment modalities utilised, and the diversity of the population undergoing the procedure (12).

Adam et al. identified that the length of hospital stay and implant costs were the most important variable expense drivers. This study made use of seventeen cost centres based on availability of costs and charges. The anaesthetic service was comprised of operative and technical costs on a per case basis. The blood bank service was inclusive of blood typing and transfusion related costs. The electrocardiogram (ECG) service centre accounted for the cost of routine pre-operative ECG's. The hospital service room was inclusive of all hospital floor related costs during a patient's admission, nursing care, meals and dressing. The laboratory service centre

accounted for phlebotomy, processing and reporting costs. The operating room service centre accounted for staff and administrative associated expenses. The orthopaedic appliance centre included the abduction pillows. The pathology service accounted for all tissue specimens submitted for histology. The pharmacy accounted for all pre-, peri- and post-operative medications administered to the patient. Physical and occupational therapy were covered under a single cost centre. The recovery room cost centre accounted for the staff and administration expenses however, post-operative ventilator support and pulse oximetry were included in the respiratory therapy service centre. The hip implants and all supplies (medical and operatives) were costed together though, implant costs were not provided in the study as a result of purchase agreements with implant manufacturers and the respective hospitals. However, there were other numerous service centres which added to the overall data (8).

A study by Ashraf et al. determined that the hospital cost and length of stay (LOS) were associated with primary THA in patients with development of dysplasia of the hip (DDH). In this study, costing was divided into two parts; part A and part B. Part A consisted of hospital billed services and procedures to inpatients such as admission costs, radiology, physical therapy and supplies. Part B included items billed by physicians and auxiliary services such as laboratory, radiology and physical therapy. The costs were grouped into clinically relevant department rooms and boards, operating rooms, anaesthesia, implants, other supplies and physician costs. They used a starting point of one day prior to THA to calculate costs. Linear regressions were used to compare length of stay and medical costs. It is important to note that

they found length of hospital stay as an important cost driver and the results showed an increase in the cost of THA in the DDH as opposed to osteoarthritis (13).

The cost of in-hospital THA was investigated in Canada and the United States of America (USA) (14). The data collected in this study was extracted from their accounting records, which is a complete database with details namely; demographics, clinical resource utilisation and cost of treatment data for each patient admitted. The cost analysis was subsequently divided into direct and indirect costs. The direct costs came from departments that gave services directly to the patient. This direct element included salaries of employees and material costs e.g. pharmaceuticals. The overheads consisted of the hospital derived costs of admission and housekeeping; however, these costs were not adjusted for inflation. The outcome of this study showed that Canadian costs were less in comparison to the USA's despite having an increased length of hospital stay (14).

A study by Meyers et al. investigated the inpatient cost of primary total arthroplasty. The financial and medical records were utilised to determine the inpatient costs of surgery in patients of primary total hip and knee arthroplasty (12). Ten cost centres were identified as opposed to the seventeen cost centres used by Adam et al. (8). This study showed that 66% of costs were implants, anaesthesia/operating room and nursing/hospital room costs. The strongest correlation for total cost was hospital length of stay ($p < 0.0005$). However, it has been demonstrated that this cost cannot be further reduced without compromising the quality of care.

Meyers et al. aimed to determine the major cost components of TJA, the variability of the components and demographic factors (12). The data used was estimated using government stipulated hospital specific and cost to charge ratios instead of calculated costs. The costs were divided into direct and indirect. They found that the major cost centres were the prosthetic costs, anaesthesia/operating room and nursing/hospital costs. They concluded that standardisation of procedures alongside development of critical pathway to reduce case to case variation would result in a substantial decrease in costs.

The Gauteng Department of Health has developed initiatives to address the surgical backlogs, particularly in arthroplasty (15). The solution is a week-long blitz where patients on the waiting list will be admitted for arthroplasty procedures during a dedicated period in order to reduce the backlog (16). This week-long blitz named the “Move and Walk” week was launched at the Helen Joseph Hospital (HJH) in October 2015. The plan encompassed five to six operations per day over the course of the week. This planned week implemented for the first time, the standardisation of arthroplasty procedures along with the development of a critical pathway through a multidisciplinary approach towards the pre-, peri- and post-operative management of the patients (17).

Clinicians need to be aware of the costs involved in THA. There is ignorance amongst clinicians regarding costs associated with patient care. A South African non-randomised interventional study showed that by providing education and

information to the medical team on laboratory test costs, lead to both significantly reduced number and associated cost with tests requested. The demonstrated cost saving was 36% per day (18) . The treating clinical teams awareness of cost drivers in THA has shown to improve cost containment measures and length of stay by changes in clinical practices (19).

The arthroplasty burden in South Africa is growing as is evidenced by the extended waiting period for surgery (6). Meyers et al. reported that standardisation of procedures and development of a critical pathway and decrease in variation of implant costs would results in a decrease in associated costs (3, 12). The “Move and Walk” week is the first documented implementation of standardised procedures within arthroplasty in the public sector. Therefore, the aim of the proposed study is to determine the cost of THA in a public hospital and ascertain cost factors within the “Move and Walk” week at HJH.

1.2 Problem Statement

In South Africa 84% of the population depend on the public sector for health services (5). The current waiting lists in arthroplasty demonstrate an increased demand for specific services in the public sector such as THA. HJH in line with the Gauteng Department of Health has implemented standardised arthroplasty procedures within the “Move and Walk” week to address the arthroplasty backlogs.

1.3 Study Justification

There are no academic studies regarding the cost of primary hip replacement performed in the Public Sector in South Africa. This proposed study will calculate the cost of primary total uncomplicated hip arthroplasty within the confines of the “Move and Walk” weeks in the Orthopaedic Unit at HJH.

1.4 Study Aim and Objectives

The aim of this study was to determine the cost of an uncomplicated primary THA at HJH. To achieve this, the objectives of this study were:

- To identify the factors determining the cost of a THA procedure.
- To make recommendations on cost optimisation in uncomplicated primary THA.

CHAPTER 2

2 Methodology

2.1 Study Design

This was a cross-sectional study.

2.2 Study Site

The study took place at the Orthopaedic Surgery Department at HJH.

2.3 Study Population

The study population consisted of patients at HJH who underwent total primary hip arthroplasty during the “Move and Walk” weeks, of which all patients were adults over the age of 18. Patients recruited were from the inception phase of the “Move and Walk” week in October 2015 until March 2017.

2.4 Selection Criteria

Inclusion criterion:

- Patients who underwent primary THA within the “Move and Walk” week.

Exclusion criteria:

- Patients who underwent primary THA outside of the “Move and Walk” week.
- Patients who underwent revision THA.

2.5 Data collection

Data collection begun once ethical clearance was obtained. Permission from the hospital CEO to conduct research was granted (Appendix C). The Human Research Ethics Committee (HREC) (Medical), University of the Witwatersrand clearance was obtained (Certificate no: **M161147**, Appendix B). Data were collected from hospital records and the “Move and Walk” week’s financial records.

Variables

The costs associated with THA were divided into six cost centres. These centres were in part derived from the financial audit of the “Walk and Move” weeks held at HJH:

1. Inpatient admission cost centre

2. Anaesthesia and operative cost centre

3. Ambulatory cost centre

4. Prosthesis cost centre

5. Physiotherapy cost centre

6. Blood bank cost centre

Costs not Included were:

- Cost of chronic medication while admitted.

- Overhead costs i.e. facility utilities and cleaning services etc.

Ethics

An ethical clearance certificate was obtained as described in the data collection section (see Appendix B). Patient confidentiality was maintained during the data collection process. The data collection sheet did not contain any patient names or hospital numbers and only study numbers were used (see Appendix A).

2.6 Data Analysis

The data were analysed using descriptive statistics to describe the demographic data and cost variables. The data were analysed to quantitatively evaluate each cost centre in terms of South African Rand. The statistical analysis of the continuous variables was presented using means and standard deviations. Since the total cost is directly calculated from the cost centres, that is, total cost is the sum of all the cost centres, the quantiles were used to classify the cost centres into categories of high, medium and low for all the cost centres. The quantiles represent a statistical categorisation of continuous variables based on the representation from the sample. These categories were then used to evaluate whether there were significant differences between the patients within these cost centres.

Analysis of Variance (ANOVA) was used to test if there was any significant difference between the three levels. ANOVA is used if there is any statistically significant difference in the means of more than two independent groups. They were three categories high, medium and low. The results of the F-statistics and their corresponding 95% significance levels were displayed in the tables. The overall

model is significant and it was found that there are some significant differences with the categories of prosthesis cost, hospital costs and ambulatory cost at 95% significance level ($p < 0.05$).

If a significant difference was found, the Least Significant Difference (LSD), calculated from the results of the ANOVA, was used to test, at an overall 5% level of significance, which pairs of categories differ significantly. The LSD is an ANOVA test used to test which pairs of categories, in cases where the categories are more than two, are significantly different from each other. The F-test alone would in some cases reject the null hypothesis that there are no significant difference, however, the LSD can identify that some pairs are significantly different.

CHAPTER 3

3 Results

3.1 Demographics

In the study there were a total of 55 patients that met the inclusion criteria. The relationship between procedure and sex are presented in Figure 3.1. Male patients represented 25.6% (n = 14) of the study population, whereas female patients represented 74.6% (n = 41). The patients ranged from age 42 to 82 with a mean age of 62.9 years and all underwent THA at HJH during “Move and Walk” weeks during the period 01 October 2015 and 30 June 2017. The side of procedure left and right were 36.4% (n = 20) and 63.6% (n = 35), respectively as illustrated in Figure 3.2.

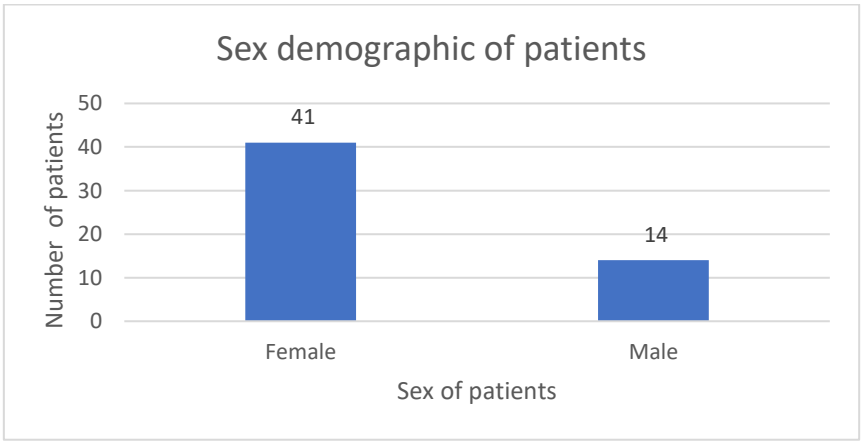


Figure 3.1: Sex demographic of patients

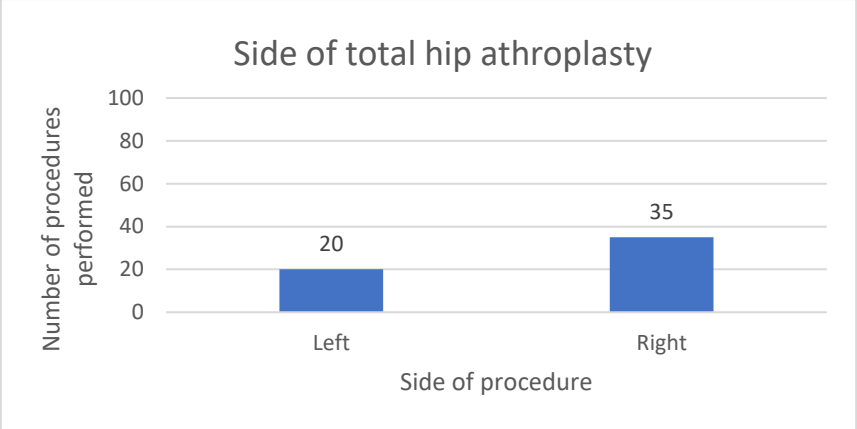


Figure 3.2: Side of total hip arthroplasty

3.2 Inpatient admissions costs

The inpatient admission cost centre was calculated by the daily admission rate billed by the hospital. This figure was R1 781.00 and R1 888.00 over the data collection period. This cost was driven by the total number of admission days. The mean length of stay for patients was 7.5 +/- 2.4 days. The pre-operative and post-operative length of stay for patients was 2.8 +/- 1.8 days and 4.8 +/- 2.0 days, respectively. Table 3.1 illustrates the mean of R13 721.24, standard deviation of R4 340.72 and a minimum and maximum of R7 124.00 and R28 496.00 respectively.

Table 3.1: Descriptive data of the respective cost centres

Variable	Mean	Standard Deviation	Minimum	Maximum
Prosthesis cost centre	R 40 305,16	R 9 501,11	R 30 000,00	R 72 761,22
Inpatient admission cost centre	R 13 721,24	R 4 340,72	R 7 124,00	R 28 496,00
Ambulatory cost centre	R 1 391,54	R 248,89	R 1 156,60	R 2 837,33
Anaesthesia and operative cost centre	R 17 243,00	R -	R 17 243,00	R 17 243,00
Physiotherapy cost centre	R 798,00	R 269,30	R 420,00	R 1 890,00
Blood Bank cost centre	R 726,32	R 1 164,85	R 320,31	R 7 396,35
OVERALL TOTAL COST	**R 74 185,25**	**R 10 792,83**	**R 60 414,04**	**R 110 598,62**

3.3 Anaesthesia and operative costs

The anaesthesia and operative cost centre was a predetermined amount of R17 243.00. This amount was calculated and provided by the HJH finance department. This amount was fixed to cover the expenditure incurred during the peri-operative period in theatre. This figure remained unchanged during the study period. No statistical analysis was performed on this cost centre.

3.4 Ambulatory cost centre

The ambulatory cost centre is inclusive of a chest x-ray, ECG, consulting, imaging of the joint, blood investigations and intravenous fluids. The HJH finance department calculated a fixed cost of R1 141.00 to cover the expenditure of the x-rays, consultation, ECG and intravenous fluids. The blood investigations were calculated by the National Health Laboratory Service (NHLS) invoice incurred by the patient during their admission for surgery. Table 3.1 illustrates the mean of R1 391.54, standard deviation R 248.89 and a minimum and maximum of R1 156.60 and R2 837.33, respectively.

3.5 Prosthesis cost centre

The prosthesis cost centre is the cost of the implants utilised. The amount was determined by the invoice submitted by the respective implant company to the hospital. The variation in costs is explained as certain companies had predetermined set pricing agreements with the hospital while others did not. Table 3.1 illustrates the

mean of R40 305.16, standard deviation of R9 501.11 and a minimum and maximum of R30 000.00 and R72 761.22, respectively.

3.6 Physiotherapy cost centre

The physiotherapy cost centre was calculated by the expenditure of the physiotherapy services. This was billed at a per session rate. The protocol at the hospital is pre-operatively the patients underwent a single of session of physiotherapy per day. The patients underwent no physiotherapy on the day of the procedure and from day one post-operatively the patients had two sessions of physiotherapy per day until discharge. The HJH finance department bill each session at a rate of R 105.00 per session. The total amount is dependent on the admission days pre- and post-operatively. Table 3.1 illustrates the mean of R798.00, standard deviation of R9 269.30 and a minimum and maximum of R420.00 and R1 890.00, respectively.

3.7 Blood bank cost centre

The blood bank service cost centre was derived by the invoice incurred by patient during their admission. The invoice is composed of the following costs; type and screening fee, after-hours levy and blood products if issued. The after-hours levy was incurred if the blood specimen for type and screen was submitted after 16h00. Table 3.1 illustrates the mean of R726.32, standard deviation of R1 164.85 and a minimum and maximum of R 320.31 and R7 396.35, respectively.

3.8 The total cost

The total cost for primary THA was calculated by the sum of all the cost centres. Table 3.1 illustrates the mean of R74 185.25, standard deviation of R10 792.83 and a minimum and maximum of R 60 414.04 and R110 598.62, respectively. Figure 3.3 illustrates the percentage of each cost centre to the average total cost. This represents proportionality contribution to the total cost but not a measure of statistical significance.

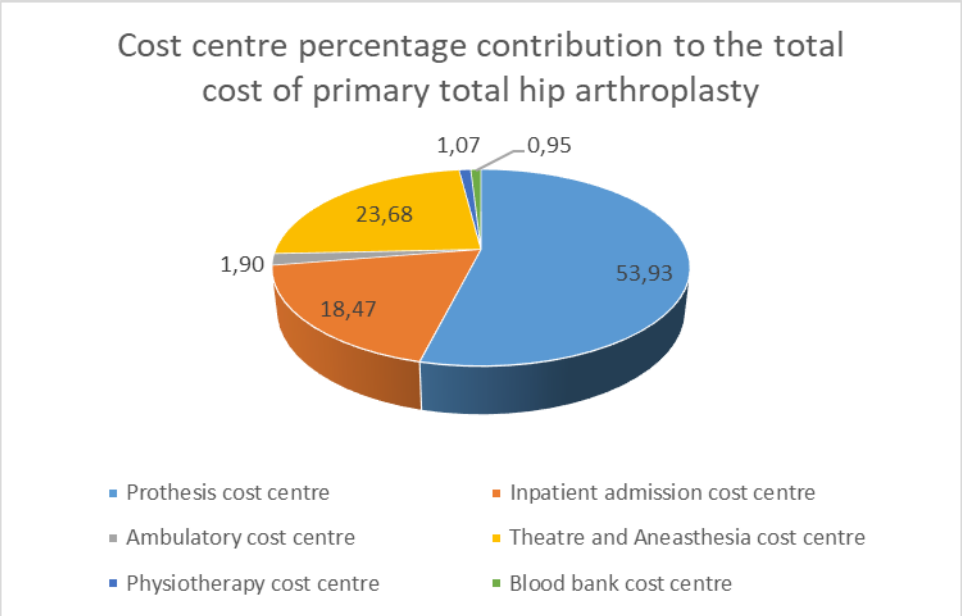


Figure 3.3: Cost centre contribution to the total cost

The cost centres were presented in quintiles as shown in Table 3.2. The quantiles were used to classify the cost centres into categories of high, medium and low for all the cost centres as shown in Table 3.3. These categories are then used to evaluate whether there were significant differences between the patients within these cost centres.

Table 3.2: Quantiles of the cost centres

Variable	Maximum	Q3	Q1	Minimum
Prothesis cost centre	R 72 761,20	R 42 829,80	R 34 000,00	R 30 000,00
Inpatient admission cost centre	R 28 496,00	R 15 104,00	R 11 328,00	R 7 124,00
Ambulatory cost centre	R 2 837,33	R 1 373,96	R 1 297,14	R 1 156,60
Physiotherapy cost centre	R 1 890,00	R 840,00	R 630,00	R 420,00
Blood Bank cost centre	R 7 396,35	R 709,01	R 320,31	R 320,31

Table 3.3: Categories according to frequency

Variable	High		Medium		Low	
	Frequency	Percent	Frequency	Percent	Frequency	Percent
Prosthesis cost centre	14	25,45	27	49,09	14	25,45
Inpatient cost centre	14	25,45	21	38,18	20	36,36
Ambulatory cost centre	14	25,45	27	49,09	14	25,45
Physiotherapy cost centre	17	30,91	19	34,55	19	34,55
Blood bank cost centre	14	25,45	27	49,09	14	25,45

ANOVA was used to test if there was any significant difference between the three levels. The results of the F-statistics and their corresponding 95% significance levels are displayed in the Table 3.4. Type I SS is the sum of square associated with rejecting a true null hypothesis. The null hypothesis is that there is no significant difference between the categories of the cost centres. The overall model is significant and it was found that there are some significant differences with the categories of prothesis cost centre, inpatient admission cost centre and the ambulatory cost centre at 95% significance level ($p < 0.05$).

Table 3.4: F-statistics of the cost centres

Cost centre	DF	Type I SS	Mean Square	F Value	Pr > F
Prosthesis cost centre	2	3887318824	1943659412	86,93	0,0001
Inpatient admission cost centre	2	1232716448	616358224	27,57	0,0001
Ambulatory cost centre	2	153004074	76502037	3,42	0,0416
Physiotherapy cost centre	2	5674515	2837258	0,13	0,8812
Blood bank cost centre	2	27654007	13827004	0,62	0,5434

The Least Significant Difference (LSD) presented in Table 3.5, calculated from the results of the ANOVA, was used to test, at an overall 5% level of significance, which paired categories that differ significantly. The prosthesis cost centre, demonstrates there is a significant difference between high and low, and between high and medium categories, and no significant difference between low and medium categories. The inpatient admission cost centre, demonstrates there is a significant difference between high and low, and between high and medium categories, and no significant difference between low and medium categories. The ambulatory cost centre demonstrated no significant differences between the respective categories. The physiotherapy cost centre demonstrates there is a significant difference between high and low, and between high and medium categories, and no significant difference between low and medium categories. The blood bank cost centre demonstrates that there is a significant difference between high and low categories, and no significant differences between the low and medium, and high and medium categories.

Table 3.5: Least squares means for the cost centres

Least Squares Means for prosthesis cost centre					
Category Combination		Difference Between Means	95% Confidence Limits for LSMean(i)-LSMean(j)		Pr > |t| for H0: LSMean(i)=LSMean(j)
High	Low	19974	14818	25130	0,0001
High	Medium	18911	14418	23403	0,0001
Low	Medium	-1063,413968	-5555,846272	3429	0,6368

Least Squares Means for inpatient admission cost centre					
Category Combination		Difference Between Means	95% Confidence Limits for LSMean(i)-LSMean(j)		Pr > |t| for H0: LSMean(i)=LSMean(j)
High	Low	13457	6769,492089	20145	0,0002
High	Medium	9719,479048	3097,653853	16341	0,0048
Low	Medium	-3737,728667	-9734,046412	2258,6	0,2166

Least Squares Means for ambulatory cost centre					
Category Combination		Difference Between Means	95% Confidence Limits for LSMean(i)-LSMean(j)		Pr > |t| for H0: LSMean(i)=LSMean(j)
High	Low	8107,377857	157,682782	16057	0,0458
High	Medium	6972,997196	45,991906	13900	0,0486
Low	Medium	-1134,380661	-8061,385951	5792,6	0,7438

Least Squares Means for physiotherapy cost centre					
Category Combination		Difference Between Means	95% Confidence Limits for LSMean(i)-LSMean(j)		Pr > |t| for H0: LSMean(i)=LSMean(j)
High	Low	11557	4989,587194	18124	0,0009
High	Medium	8858,847678	2291,626668	15426	0,0092
Low	Medium	-2697,960526	-9080,152158	3684,2	0,4002

Least Squares Means for blood bank cost centre					
Category Combination		Difference Between Means	95% Confidence Limits for LSMean(i)-LSMean(j)		Pr > |t| for H0: LSMean(i)=LSMean(j)
High	Low	8941,309286	980,150623	16902	0,0285
High	Medium	4757,814233	-2179,17991	11695	0,1746
Low	Medium	-4183,495053	-11120	2753,5	0,2317

CHAPTER 4

4 Discussion

The mean age for THA was 62.9 +/- 10.7 years in the study. The age demographics were similar to the age demographics in a comparative study which compared the American and Canadian THA patients. American patients were a mean of 4.6 years older than the Canadian patients (mean, 67.8 ± 12.4 years compared with 63.2 ± 14.9 years, respectively) (14).

The mean length of stay for patients was 7.5 +/- 2.4 days. The pre-operative and post-operative length of stay for patients was 2.8 +/- 1.8 days and 4.8 +/- 2.0 days, respectively. The overall length of stay is similar to other studies however the pre-operative length of stay was important for a patient population that was pre operatively worked up as an outpatient. The Canadian patients had a significantly longer length of stay (7.2 ± 4.7 days compared with 4.2 ± 2.0 days; $p < 0.0001$) (14). This time period spent awaiting surgery presents an opportunity for cost containment measures either by admission on the day of surgery or the day before.

The inpatient admission cost is the sum of daily inpatient costs charged by the hospital which is directly related to the days of admission of the patient, and this cost

centre was found to be statistically significant. The length of stay is a key determinant in resource utilisation which was also shown in a study by Batsis et al. (20). In their study of 5 534 patients who underwent total knee arthroplasty (TKA), they found that hospitals streamlined the patients post-operatively as a measure of resource utilisation (20). The USA has managed to reduce the LOS in the past two decades from an average of three weeks to three - five days (9).

There has been pressure on orthopaedics to reduce the THA LOS which resulted in the outpatient THA (21). The initial pilot studies demonstrated the financial benefits of this model when supported by clear pre- and post-operative protocols (22). More recent studies have shown that outpatient THA is a proven efficient intervention in cost containment with THA in appropriately selected patients with no increase in readmission or complications (21, 23, 24). We are of the opinion that the South African public health system and patient population are currently not appropriate for outpatient THA.

The average cost of the prosthesis is R40, 305.20. The prosthesis cost centre was determined by the invoice received from the implant company as per procedure. The prosthesis costs varied due to pre-bargaining on pricing with certain companies. Surgeons operating within the “Move and Walk” week made use of their preferred prosthesis company, some of which had no pre-set pricing with the state. The Gauteng province Orthopaedic tendering came into effect in 2017. The price of a total hip prosthesis has risen by 212% in the United States in the last decade, and a

large variation has been reported in the cost of total hip prostheses, with identical implants from a single manufacturer varying as much as 700% (11, 14). Nitin stated that the prosthesis cost should follow the principle of economies of scale. With an increased number of arthroplasty procedures the cost of the prosthesis should be on the decline, however, this has not been the market trend to date as the literature demonstrates the escalation of prosthesis costs since the 1980's (25, 26). A study by Barber showed in 1990 the prosthesis amount to 24% of the total inpatient cost in comparison to our study of 53.93% (25). A study by Robinson et al. identified the prosthesis cost as the main contributor to overall cost with its pricing fluidity being responsible for the overall variability in total cost of THA (3). The standardisation has been recommended in previous studies as part of cost reduction measures (8, 25, 26). We recommend collective bargaining with implant companies, price and product comparisons.

The inpatient admissions cost centre was determined by the hospital admission daily rate as published by the hospital financial department multiplied by the number of admission days. The daily rate is inclusive of all hospital overhead costs associated with the admission. The pre-operative admission days were 2.8 +/- 1.8 days. The patients were all worked up for surgery as outpatients; the lag from admission to the day of the procedure can be explained by the logistical constraints of the state sector. The burden of trauma translates into empty beds being utilised for trauma and emergency admissions. In order to ensure the availability of the respective beds the patients need to be admitted to be guaranteed a bed.

The average number of post-operative days was 4.8 +/- 2.0. There is no established post-operative protocol for time of surgery to discharge as this is determined by the treating physician and the physiotherapist. In a comparative study by Antoniou et al., the authors found that American hospitals had a significant shorter patient stay than Canadian hospitals. However, this did not result in a reduction of in-patient hospital costs as these were still higher than the group of Canadian hospitals. The American health system is split along both private and public sectors whereas the Canadian health system is predominately public which is insured, budgeted and regulated by the state (14). We recommend dedicated elective procedure beds with rolling scheduled admissions for elective procedures. Studies have indicated the development of a post-operative protocol to standardise the LOS and activities to discharge (8, 11, 12).

The anaesthesia and theatre cost centre was determined by a fee per procedure as determined by the hospital finance department. The fee is inclusive of all costs incurred in and around the operating theatre during the procedure. In a study by Meyers et al. found that the major cost centres were the prosthetic costs, anaesthesia/operating room and nursing/hospital (12). The anaesthesia/operating room cost centre is equivalent to our anaesthesia and theatre cost centre. Our cost centre set amount was uncharged during the duration of this study and excluded from the statistical analysis. We recommend that this cost be subdivided into variables and analysed to obtain an accurate amount.

The ambulatory cost centre was determined by two components. The first component was a set fee determined by the finance department of R1, 141.00 which covers pre- and post-operative imaging, ECG and intravenous fluids. The second component consisted of the NHLS laboratory tests performed during the patient admission. Our recommendation is not to advise any cost-containment measures to allow physician clinical autonomy regarding investigations performed.

The physiotherapy costs centre was determined by the number of physiotherapy sessions multiplied by the prevailing session rate. The physiotherapy protocol at HJH is as follows: pre-operatively the patients undergo a single session per day and excludes the day of surgery. Post-operatively the patients undergo two sessions per day until discharge. This cost centre was not shown to be statistically significant. We offer no cost containment recommendation regarding this cost centre.

The blood bank cost centre was determined by the invoice incurred by the patient during the admission. This consisted of type and screen, blood products and after-hours levy. The after-hours levy was charged when a type and screen was received at the blood bank office outside of business hours. In our study 25% (n = 14) of the patients incurred an after-hours levy. An observational study in the USA of 2,087,423 patients has demonstrated an increased rate of allogenic blood transfusions post THA. This rate between 2000 and 2009 increased from 11.8% to 19.0%, respectively (27). In our study, 9% (n = 5) of the patients received blood products which is below the values stated in the allogenic blood transfusions has been identified as a

statistically significant contributor towards total cost of THA. However, this was not the case in our study (27). We recommend blood type and screens be done the day before, or the morning, of the procedure to avoid incurring an after-hours levy.

In 2017, the private sector in South Africa implemented fixed global fee products to remunerate participating entities within TJA. This saw a single payment being made to the facility or third party. Professional societies are opposed to this implementation as this leads to unethical conduct, power imbalance driven by funders and facilities, hence, the contravention of Health Professions Council of South Africa (HPCSA) rules 7, 8 and 18 which govern the health practice in South Africa. The greatest risk to patients are underservicing and additional costs due to co-payments (28).

The total cost for primary THA was calculated by the sum of all the cost centres .The mean was R74 185.25, standard deviation of R10 792.83 and a minimum and maximum of R 60 414.04 and R110 598.62 respectively. In the private sector Discovery Health joint arthroplasty network funds elective unilateral hip or knee joint arthroplasty with orthopaedic surgeons and hospitals signed up to the network (29). The participating medical schemes are Discovery Health Medical Scheme, LA Health, Quantum Medical Aid Society, Retail Medical Scheme and Tsogo Sun Group Medical Scheme. The agreement is either a bundle fee totalling (model 1) or a fixed fee (model 2) amount of R 133 262.00 in 2018 (30). Model 2 is represented in Table 4.1 indicating the agreed fixed fee amount for the hospital representative, prosthesis, orthopaedic surgeon, anaesthetist and physiotherapist.

The hospitals representative fee would be equivalent to the inpatient admission, ambulatory, anaesthesia and operative and the blood bank cost centres with the inclusion of any other inpatient hospital expenditure not calculated in our study (30). The prosthesis being limited to R 35 000.00 is in keeping with bargaining with the respective implant companies which was not the established protocol in our study as represented in Table 3.1. This demonstrates its effects on cost containment in the private sector which is ahead of public sector in curbing costs. Our study did not calculate the cost for the surgical team and the anaesthetist. The private sector allocation to physiotherapist is just above the maximum cost of the physiotherapist in our study. The models presented in the private sector indicate the need for cost containment in THA. The public sector can learn from the private sector in its approach to THA costing.

The aging population in South Africa has increased the demand for THA. This is in keeping with the global trend. The cost of healthcare services has come under scrutiny due to constrained health budgets in the current financial climate. The private sector has been the forerunner in the attempt for cost containment, however, controversial. Our study reviews the literature and industry practice. We analysed the cost in the public sector (55 patients) according to six cost centres and compared our results to the literature. Furthermore, this study makes recommendations on cost containment measures on THA performed in the public sector.

Table 4.1: Model 2 Discovery Joint Arthroplasty Agreement

Model 2 – Fixed fee per team (Event total not to exceed R 133,262)						
Hospital Name						
Title/Role		Agreed fixed fee amount	Name	Pr Number	Signature	Date signed
Hospital representative	Surgicals, ethicals & hospital costs	R 57,212.00				
Prosthesis	Hospital/Doctor	R 35,000.00				
Orthopaedic Surgeon	Incl. assistant	R 28,350.00				
Anaesthetist		R10,000.00				
Physiotherapist	IH only	R 2,700.00				
	IH only					
	IH only					

Limitations

The study was dependent on the availability, adequacy and quality of the financial data linked to patients undergoing THA. Within the studies reviewed some figures were adjusted for inflation while others were not (7, 8). Our study collection ran over three years regarding the collected costs no declaration was made about any inflationary adjustment. Our study did not explore the relationship of the indication of THA and impact on cost as has been documented in another study as a cost factor (12). Our study is limited by the small sample size of the patient cohort in comparison to other studies.

4.1 Recommendations

4.1.1 The prosthesis cost centre

- We recommend collective bargaining with implant companies, price and product comparisons.

4.1.2 Inpatient admission cost centre

- We recommend dedicated elective procedures beds with rolling scheduled admissions for elective procedures. The development of a post-operative protocol post-surgery, this is in line with earlier studies which advocated for standardisation (8, 11, 12).

4.1.3 The anaesthesia and operative cost centre

- We recommend that this cost be subdivided into variables and analysed to obtain an accurate figure.

4.1.4 The ambulatory cost centre

- We recommend that although cost containment measures are important allowing physician clinical autonomy regarding investigations performed in assessment of the patient is of paramount importance to safe guard clinically safety.

4.1.5 The physiotherapy cost centre

- This cost centre was not shown to be statistically significant. We offer no cost containment recommendation regarding this cost centre.

4.1.6 The blood bank cost centre

- We recommend type and screens to be either taken the day before or on the morning of the procedure as a cost containment measure to avoid incurring after-hours levy.

4.1.7 General

- We recommend costing of all cost-driven procedures within orthopaedics. Orthopaedics has been identified as a major contributor to the healthcare burden cost (26). This needs to be driven by the private and public policy makers and purchaser.

- We recommend a pro-rata estimation of the cost of the time spent by the surgeon and anaesthetist during the procedure to obtain a comprehensive costing of THA in the public sector.

CHAPTER 5

5 Conclusion

The aging population in South Africa has increased the demand for THA. This is in keeping with the global trend. The cost of healthcare services has come under scrutiny due to constrained health budgets in the current financial climate. The private sector has been the forerunner in the attempt for cost containment and claim to have had success, however, controversial. Our study reviews the literature and studies a cohort of arthroplasty patients in a local setting as well as the prevailing local industry practice. We analysed the six cost centres and discussed seven recommendations on cost containment measures on THA performed in the public sector.

References

1. Pivec R, Johnson AJ, Mears SC, Mont MA. Hip arthroplasty. The Lancet. 2012;380(9855):1768-77.

2. First Annual Report Dec 2012 - Dec 2015 [Internet]. South African National Joint Registry. 2016. Available from: http://www.sanjr.co.za/downloads/National%20Report_2015.pdf [Last accessed: 12 May 2016].

3. Robinson J, Pozen A, Tseng S, Bozic K. Variability in costs associated with total hip and knee replacement implants. The Journal of Bone and Joint Surgery. 2012;94(18):1693-8.

4. Peel TN, Cheng AC, Liew D, Buising KL, Lisik J, Carroll KA, et al. Direct hospital cost determinants following hip and knee arthroplasty. Arthritis Care Res (Hoboken). 2015;67(6):782-90.

5. Motsoaledi A, editor PRESENTATION TO THE STAKEHOLDER CONSULTATIVE MEETING: NATIONAL HEALTH INSURANCE (NHI)2018; CSIR International Convention Centre: Department of Health.

6. Rahlaga M. First on EWN: Patient placed on 7 year waiting list for surgery: Eye Witness News 2015. Available from: http://ewn.co.za/2015/03/04/FIRST-ON-EWN-Surgery-candidate-placed-on-7-year-waiting-list [Last accessed: 19 May 2016].

7. Flessa S, Dung NT. Costing of services of Vietnamese hospitals: identifying costs in one central, two provincial and two district hospitals using a standard methodology. Int J Health Plann Manage. 2004;19(1):63-77.

8. Adam J, William L. Hospital Economics of Primary THA Decreasing Reimbursement and Increasing Cost 1990 to 2008. Clinical Orthopaedics and Related Research. 2011;469(2):355 - 61.

9. Molloy I, Martain B, Moschetti W, Jevsevar D. Effects of the Length of Stay on the Cost of Total Knee and Total Hip Arthroplasty from 2002 to 2013. The Journal of Bone and Joint Surgery. 2017;99(5):402 - 7.

10. Daigle M, Weinstein A, Katz J, Losina E. The cost-effectiveness of total joint arthroplasty: a systematic review of published literature. Best Practice & Research: Clinical Rheumatology. 2012;26(5):649 - 58.

11. Gray C, Bozic K. Epidemiology, cost, and health policy related to total knee arthroplasty. Current Orthopaedic Practice. 2015;26(3):212 - 6.

12. Meyers S, JD R, Cox D, Watson M. Inpatient Cost of Primary Total Joint Arthroplasty. The Journal of Arthroplasty. 1996;11(3):281- 5.

13. Ashraf A, Larson N, Maradit-Kremers H, Kremers W, Lewallen D. Hospital Costs of Total Hip Arthroplasty for Developmental Dysplasia of the Hip. Clinical Orthopaedics and Related Research. 2014;472(7):2237–44.

14. Antoniou J, Martineau P, Filion K, Haider S, Zukor D, Huk O, et al. In- Hospital cost of total hip arthroplasty in Canada and the United States. The Journal of Bone and Joint Surgery. 2004;86(11):2435 - 9.

15. Health G. 02014/15 Gauteng Health Budget Vote Speech Tabled by the MEC for Health Ms Qedani Mahlangu at Gauteng Provincial Legislature 2015. Available from: http://www.gov.za/201415-gauteng-health-budget-vote-speech-tabled-mec-health-ms-qedani-mahlangu-gauteng-provincial [Last accessed: 15 June 2016].

16. Health G. Gauteng Health conducts arthroplasty and cataract procedure blitz 5 to 9 Oct 2015. Available from: http://www.gov.za/speeches/gauteng-health-address-surgical-backlogs-week-long-blitz-2-oct-2015-0000 [Last accessed: 17 June 2016].

17. Gmaster34. Week long operations blitz to address surgical backlogs: Westside Eldos; 2015. Available from: http://westside-eldos.co.za/20802/week-long-operations-blitz-to-address-surgical-backlogs/ [Last accesed: 18 February 2018].

18. Ellemdin S, Rheeder P, Soma P. Providing clinicians with information on laboratory test costs leads to reduction in hospital expenditure. South African Medical Journal. 2011;101(10):746 - 8.

19. Sommer LS, DJ, Jamison J, Woolson S, Robinson B, Silverman J. Clinician-directed hospital cost management for total hip arthroplasty patients. Clinical Orthopaedics and Related Research. 1990;258:168- 75.

20. Batsis JA, Naessens JM, Keegan MT, Huddleston PM, Wagie AE, Huddleston JM. Resource utilization of total knee arthroplasty patients cared for on specialty orthopedic surgery units. J Hosp Med. 2008;3(3):218-27.

21. Ayanardi M, Post Z, Orozeo F, Sukin DC. Outpatient Surgery as a Means of Cost Reduction in Total Hip Arthroplasty: A Case-Control Study. HSS Journal. 2014;10:252-5.

22. Bertin KC. Minimally Invasive Outpatient Total Hip Arthroplasty. Clinical Orthopaedics and Related Research. 2005;&NA;(435):154-63.

23. Dorr LD, Thomas DJ, Zhu J, Dastane M, Chao L, Long WT. Outpatient total hip arthroplasty. J Arthroplasty. 2010;25(4):501-6.

24. Klein GR, Posner JM, Levine HB, Hartzband MA. Same Day Total Hip Arthroplasty Performed at an Ambulatory Surgical Center: 90-Day Complication Rate on 549 Patients. J Arthroplasty. 2017;32(4):1103-6.

25. Barber T, Healy W. The hospital cost of total hip arthroplasty. A comparison between 1981 and 1990. The American Journal of Bone and Joint Surgery. 1993;75(3):321-5.

26. Nitin J. Joint Replacement Costs in the Era of Healthcare Reform. The American Journal of Bone and Joint Surgery [Internet]. 2012; 94(18).

27. Saleh A, Small T, Chandran Pillai AL, Schiltz NK, Klika AK, Barsoum WK. Allogenic blood transfusion following total hip arthroplasty: results from the nationwide inpatient sample, 2000 to 2009. J Bone Joint Surg Am. 2014;96(18):e155.

28. Advisory on Global Fee Arrangment Participation [press release]. 2016.

29. Elective Hip and Knee Network Agreement, (2017).

30. Discovery Joint Arthroplasty Agreement 2018, (2017).

Appendices

5.1 Appendix A: Data collection sheet

Part 1

Study Number	Age	Sex	Pre op days	Post op days	Company	Prothesis cost	Procedure side	Theatre Date

Part 2

DOA	DOD	Total admission days	In Patient Cost p/day	Total Cost (LOS)	Imaging and fluids

Part 3

Theatre and aneasthesia costs	Physio Pre op Costs	Physio post op costs	Physio Costs	Laboratory Invoices

Part 4

Bank Bank Invoice	Type and Screen	Usuages SANBS	Levy	OVERALL TOTAL COST	Ambulatory Cost

Appendix B: Human Research Ethics Committee (Medical) Clearance Certificate

R14/49 Dr Allan Roy Sekeitto

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M161147

NAME: (Principal Investigator)	Dr Allan Roy Sekeitto
DEPARTMENT:	Orthopaedic Surgery Helen Joseph Hospital
PROJECT TITLE:	Costing Total Hip Arthroplasty in South African State Tertiary Hospital
DATE CONSIDERED:	25/11/2016
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Prof Abdirashid A. Aden
APPROVED BY:	Professor P Cleaton-Jones, Chairperson, HREC (Medical)
DATE OF APPROVAL:	03/02/2017

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

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 301, Third Floor, Faculty of Health Sciences, Phillip Tobias Building, 29 Princess of Wales Terrace, Parktown, 2193, University of the Witwatersrand. I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated, from the research protocol as approved, I/we undertake to resubmit the application to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. In this case, the study was initially reviewed in November and will therefore be due in the month of November each year. Unreported changes to the application may invalidate the clearance given by the HREC (Medical).

Principal Investigator Signature

Date 7/03/2017

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

5.2 Appendix C – Hospital CEO permission Letter

GAUTENG PROVINCE
HEALTH
REPUBLIC OF SOUTH AFRICA

Gauteng Department of Health
Helen Joseph Hospital
Enquiries: Dr. F.G Benson
Acting Chief Executive Officer
Tel :(011) 489-0306/1087
Fax :(011) 726-5425
E mail:Frew.Benson@gauteng.gov.za
Date: 24 June 2019

Dr. F.G. Benson
Acting Chief Executive Officer
Helen Joseph Hospital

Dear Dr. F. G. Benson

STUDY: Costing total Hip Arthroplasty in South African state tertiary Hospital.

RESEARCHERS: Dr Allan Roy Sekeitto

Ethics: M161147

Above the study was discussed at the Research Committee meeting. We recommend that permission be granted for Helen Joseph Hospital to be used as a site for the above research, However , since this is individual /Patients.

Upon completion of the study, copy thereof should be submitted to Helen Joseph Hospital. It is duty of the researcher to collect the data to the relevant department after the Research Committee approved the study.

Thank you

Dr. Murimisi Mukansi
CHAIRPERSON
DATE:

Approved

Dr. F.G.Benson
Acting CHIEF EXECUTIVE OFFICER
DATE: 2019/6/26