The cost effectiveness of treating paediatric cancer in South Africa: A review of treatment cost for Burkitt Lymphoma

By

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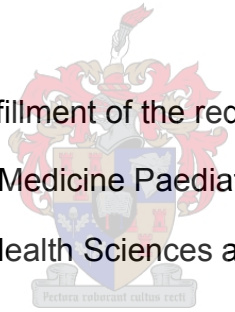

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Declaration

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December 2016

Abstract

Background

In middle and low income countries, childhood cancer is rare when compared to trauma and infectious diseases. There is a paucity of literature regarding the cost and cost-effectiveness of treatment for paediatric cancers to guide decisions on resource allocation. Burkitt Lymphoma (BL) is a fairly common paediatric cancer in South-Africa. Optimal treatment and supportive care of BL translates in high cure rates.

Study aim

To determine the cost to avert 1 Disability Adjusted Life Year (DALY) in treating children with Burkitt Lymphoma in Tygerberg Children's Hospital and whether this meets the WHO-CHOICE threshold of cost-effectiveness.

Methodology

The study is a retrospective, longitudinal descriptive audit and cost-effectiveness analysis. Data was collected from all available records at Tygerberg Children's Hospital and total direct cost for treatment and follow up was calculated. Using the WHO's 'Choosing Interventions that are Cost-Effective' guidelines, the disability adjusted years of life lost averted by treatment were calculated and divided by the total cost of treatment. The result was compared to the South-African Gross Domestic Product (GDP) per capita.

Results

Ten patients treated for Burkitt Lymphoma between 2005 and 2010 were included in the study. The average direct cost was US$12829 per patient. A trend was found for treatment of late stage disease to be more expensive than early stage disease, as well as a less favourable prognosis of late stage disease, as expected. A trend was also noted for the treatment of HIV infected children with Burkitt Lymphoma to fall well within the very cost-effective threshold.

Cost related to general supportive care, was by far the largest contributing factor with hospitalisation contributing 49% of the total cost.

The average cost to avert 1 DALY, was US$610.52, thus the average ratio to GDP per capita was 0.1:1, which indicates that the treatment of BL in South-Africa is well within the limits of being very cost effective (1:1).

Conclusion

The treatment of children with Burkitt Lymphoma in Tygerberg Children's Hospital, South Africa is very cost effective, as it is well below the WHO-CHOICE threshold of very cost-effectiveness. It is also very cost-effective to treat children with Burkitt Lymphoma who present with advanced disease as well as children with associated HIV infection.

Cost constraints should therefore not be a limitation to treating children with Burkitt Lymphoma, even if they present with advanced stage disease or HIV infection.

Similar cost-effective studies in another type of paediatric cancer, private health sector or low-income countries, should be done to verify that the treatment of childhood cancers is very cost-effective.

Opsomming

Inleiding

In lande met middel tot laer inkomste is die aantal pediatriese kankergevalle skaars in vergelyking met trauma en infeksie-siektes. Daar is ‘n gebrek aan inligting in die literatuur oor die koste en koste-effektiwiteit van pediatriese kankerbehandeling, wat kan help met besluitneming oor die rasionele besteding van bronne. Burkitt Limfoom (BL) is ‘n redelik algemene pediatriese kanker in Suid-Afrika. Optimale behandeling en ondersteunende sorg van kinders met BL lei tot hoë genesingsyfers.

Studie mikpunte

Berekening van die koste om die verlies van een Ongeskiktheids-Aangepaste Lewensjaar (DALY) te voorkom deur die behandeling van kinders met BL in Tygerberg Kinderhospitaal en te bepaal of dit onder die drempel van koste-effektiwiteit val.

Metodes

Die studie is ‘n longitudinale, beskrywende oudit en koste-effektiwiteits analise. Data is ingesamel uit alle moontlike rekords van Tygerberg Kinderhospitaal en die totale direkte koste van behandeling en opvolg is bereken. Deur die Wêreld Gesondheids Organisasie se ‘Choosing Interventions that are Cost-Effective’ riglyne te gebruik, is die verlies aan ongeskiktheids-aangepaste lewensjare wat voorkom is deur behandeling bereken en gedeel deur die totale koste van behandeling. Die resultaat is dan vergelyk met die Suid-Afrikaanse bruto binnelandse produk per kapita.

Resultate

Tien pasiënte wat behandel is vir BL tussen 2005 en 2010 is ingesluit in die studie. Die gemiddelde direkte koste was US$12829 per pasiënt. ‘n Neiging is gevind dat die behandeling van vroeë stadium siekte minder koste beloop as laat stadium siekte, sowel as ‘n swakker prognose geassosieer met laat stadium siekte, soos verwag.

Die onkoste van algemene ondersteunende sorg, was by verre die grootste bydraende faktor en hospitalisasie alleen het 49% van die totale koste beloop.

Die gemiddelde koste om 1 DALY te voorkom, was US$610.52 en die gemiddelde verhouding tot Bruto Binnelandse Produk was 0.1:1, wat aandui dat die behandeling van BL in Suid-Afirka gemaklik onder die bo-grens van hoë koste-effektiwiteit, wat 1:1 beloop, val.

Gevolgtrekkings

Die behandeling van Burkitt Limfoom in Tygerberg Kinderhospitaal, Suid-Afrika is hoogs koste-effektief, omdat dit ver onder die WGO-CHOICE riglyne se drempel van koste-effektiwiteit val. Dit bly ook koste-effektief, ongeag gevorderde stadium van siekte by presentering of ‘n positiewe HIV-status.

Koste beperkings behoort dus nie behandeling van kinders met Burkitt Limfoom te ondermyn nie, al presenteer hulle met laat-stadium siekte of ‘n positiewe HIV-status.

Soortgelyke studies wat koste-effektiwiteit analiseer, behoort uitgevoer te word in ander tipes pediatriese kankers, die privaat sektor en in lande met lae-inkomste om te bevestig dat behandeling van kinders met kanker koste-effektief is.

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I would also like to mention the children included in this study and other oncology patients I encountered during my time in Tygerberg Hospital. Their brave fight inspires me.

Lastly, thank to my husband and supportive family, you are my rock.

List of abbreviations:

AIDS: Acquired Immunodeficiency Disorder

ALL: Acute Lymphocytic Leukemia

ART: Antiretroviral therapy

BL: Burkitt Lymphoma

BM: Bone marrow

CNS: Central Nervous System

CT: Computerised Tomography

DALY: Disability Adjusted Life Years

DW: Disability Weight

EBV: Ebstein Barr Virus

GDP: Gross Domestic Product

HIV: Human Immunodeficiency Virus

HL: Hodgkin Lymphoma

HREC: Health Research Ethics Committee

LMB: Mature B-Cell Lymphoma

MRI: Magnetic Resonance imaging

N: Number of patients

NHL: Non-Hodgkin Lymphoma

NHLS: National Health Laboratory Service

PICU: Paediatric Intensive Care Unit

POU: Paediatric oncology unit

PPP: Purchasing Power Parity

QALY: Quality Adjusted Life Year

RSA: South Africa

SACCSG: South African Children's Cancer Study Group

TBH: Tygerberg Hospital

UPFS: Uniform Patient Fee Schedule

USA: United States of America

US$: United States of America Dollar

WHO: World Health Organisation

WHO-CHOICE: World Health Organisation Choosing Interventions that are Cost-Effective

YLD: Years of Life with Disability

YLL: Years of Life Lost

ZAR: South African Rand

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Appendix 2

UPFS Fee Schedule for H3 patients: 1 APRIL 2014

CODE	DESCRIPTION	BASIS	Professional Fee R	FACILITY FEE		
				LEVEL 1	LEVEL 2	LEVEL 3
				R c	R c	R c
01	***Anaesthetics***					
0111	Anaesthetics Cat A – General medical practitioner	Procedure	122			
0112	Anaesthetics Cat A – Specialist medical practitioner	Procedure	183			
0121	Anaesthetics Cat B – General medical practitioner	Procedure	208			
0122	Anaesthetics Cat B – Specialist medical practitioner	Procedure	313			
0131	Anaesthetics Cat C – General medical practitioner	Procedure	730			
0132	Anaesthetics Cat C – Specialist medical practitioner	Procedure	1096			
02	***Confinement***					
0210	Natural Birth – Facility Fee	Incident	Free Services			
0211	Natural Birth – General medical practitioner	Incident				
0212	Natural Birth – Specialist medical practitioner	Incident				
0213	Natural Birth – Nursing practitioner	Incident				
0220	Caesarean Section – Facility Fee	Incident				
0221	Caesarean Section – General medical practitioner	Incident				
0222	Caesarean Section – Specialist medical practitioner	Incident				
03	***Dialysis***					
0310	Haemo – Facility Fee	Day		809	809	926
0311	Haemo-dialysis – General medical practitioner	Day	154			
0312	Haemo-dialysis – Specialist medical practitioner	Day	192			
0320	Peritoneal Dialysis – Facility Fee	Session		124	124	142
0321	Peritoneal Dialysis – General medical practitioner	Session	24			
0322	Peritoneal Dialysis – Specialist medical practitioner	Session	30			
0330	Plasmapheresis – Facility Fee	Day		809	809	926
0331	Plasmapheresis – General medical practitioner	Day	152			
0332	Plasmapheresis – Specialist medical practitioner	Day	191			
04	***Medical Reports***					
0410	Medical Report – Facility Fee	Report				
0411	Medical Report – General medical practitioner	Report		328	328	353
0412	Medical Report – Specialist medical practitioner	Report		443	443	468
0420	Copies Medical Report – Facility Fee	Copy				
0421	Copies of Medical Reports, records, X-Rays reports, completion of certificates / forms - General medical practitioner	Copy		221	221	246
0422	Copies of Medical Reports, records, X-Rays reports, completion of certificates / forms - Specialist medical practitioner	Copy		279	279	304
0425	Copies of X-Rays films, Ultrasounds etc.	Copy		221	221	246

05	***Imaging***					
0510	Radiology, Cat A – Facility Fee	Procedure		41	41	46
0511	Radiology, Cat A – General medical practitioner	Procedure	40			
0512	Radiology, Cat A – Specialist medical practitioner	Procedure	76			
0514	Radiology, Cat A – Allied health practitioner	Procedure	39			
0520	Radiology, Cat B – Facility Fee	Procedure		112	112	129
0521	Radiology, Cat B – General medical practitioner	Procedure	108			
0522	Radiology, Cat B – Specialist medical practitioner	Procedure	211			
0524	Radiology, Cat B – Allied health practitioner	Procedure	106			
0530	Radiology, Cat C – Facility Fee	Procedure		276	276	315
0531	Radiology, Cat C – General medical practitioner	Procedure	177			
0532	Radiology, Cat C – Specialist medical practitioner	Procedure	544			
0540	Radiology, Cat D – Facility Fee	Procedure		523	523	597
0541	Radiology, Cat D – General medical practitioner	Procedure	335			
0542	Radiology, Cat D – Specialist medical practitioner	Procedure	1 031			
0550	Radiology, Cat E – Facility Fee	Procedure		1 332	1 332	1 522
0551	Radiology, Cat E – General medical practitioner	Procedure	1 233			
0552	Radiology, Cat E – Specialist	Procedure	2 574			
06	***Inpatients***					
0620	Inpatient High care – Facility Fee	12 hours		642	803	1 151
0621	Inpatient High Care – General medical practitioner	12 hours	45			
0622	Inpatient High Care – Specialist medical practitioner	12 hours	85			
0630	Inpatient Intensive care – Facility Fee	12 hours		2 110	2 110	2 523
0631	Inpatient Intensive Care – General medical practitioner	12 hours	50			
0632	Inpatient Intensive Care– Specialist medical practitioner	12 hours	95			
0650	Day patient – Facility Fee	Day		345	435	638
0651	Day patient – General medical practitioner	Day	86			
0652	Day patient – Specialist medical practitioner	Day	150			
0653	Day patient – Nursing practitioner	Day	50			
0660	Inpatient Boarder – Facility Fee	12 hours		100	100	100
0663	Inpatient Boarder/Patient Companion – Nursing practitioner	12 hours	9			
0670	Inpatient General ward – Facility Fee	12 hours		208	265	499
0671	Inpatient General Ward – General medical practitioner	12 hours	43			
0672	Inpatient General Ward – Specialist medical practitioner	12 hours	75			
0673	Inpatient General Ward – Nursing medical practitioner (MOU)	12 hours	28			
0680	Inpatient Chronic care – Facility Fee	12 hours		122	122	122
0681	Inpatient Chronic care – General medical practitioner	12 hours	14			
0682	Inpatient Chronic care – Specialist medical practitioner	12 hours	32			
0683	Inpatient Chronic care – Nursing practitioner	12 hours	9			
07	***Mortuary***					
0710	Mortuary – Facility Fee	Day		106	106	120
0720	Cremation Certificate – Facility Fee	Certificate		106	106	120
08	***Pharmaceutical***					
0810	Medication Fee – Facility Fee	Prescription		19	19	22
0815	Item Fee	Item	Varies			
0816	Pharmaceutical - TTO	Item	Varies			
0817	Pharmaceutical - Chronic	Item	Varies			

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1 Introduction

In a difficult economic climate, I became aware of an increasing trend to guide resource allocations based on cost-effective decision making. Low to middle income countries are under pressure to allocate limited healthcare resources. Childhood deaths due to infectious diseases are common in these countries and often preventable with the correct treatment. (1) In comparison, childhood deaths due to cancer are infrequent. There may be a public perception that the treatment of childhood cancer is expensive and that it carries a guarded prognosis despite treatment.

South Africa is a Middle-income country(2), with the infrastructure and expertise capable of providing a high standard of care – which is likely to be expensive – but burdened with a high number of childhood deaths related to infectious diseases(1) and also faces this conundrum.

A utilitarian approach may prompt decision makers in such countries to divert resources away from cancer treatment, to more common, less costly diseases. However, looking at the absolute cost of treatment is only a part of the answer and the WHO-CHOICE framework advises making decisions based on cost-effectiveness and suggests calculating the cost to avert one DALY and comparing it to the GDP per capita as an option. There is inadequate information available on the cost or the cost-effectiveness of treatment of diseases or disorders, which is why I decided to contribute to this field of study.

Tygerberg Children's Hospital is a central referral facility with an Oncology Unit that uses standardised treatment protocols. It keeps records of all treated children with the Tygerberg Hospital Children's tumour registry which made it ideal for my study. Burkitt Lymphoma is one of the most common paediatric cancers in SA and has a successful cure which made it a good subject for investigation.

2 Literature review

2.1 Topics and Objectives of literature review

- To describe the epidemiology of paediatric Burkitt Lymphoma (BL), including:

  a) The burden of disease globally and locally.

  b) Peak age and stage of presentation, natural history and most common complications.

- Research the current treatment protocols, the success rates and the most likely serious adverse events.
- To determine the average life expectancy in South Africa and gross domestic product per capita.
- Determine the standard framework to evaluate cost effective treatment and the disability weight allocated to BL.
- Search literature for similar cost-effectiveness studies in childhood cancer, BL in particular, as well as childhood infectious diseases, for comparison. We would take particular care to find studies performed in other middle- to low income countries.

2.2 Population Statistics

We found official reports of governments and United Nations through the internet search engine Google and yielded the required statistics.

In South Africa, life expectancy at birth, according to the 2014 midyear analysis is 61 years - 59.1 for males and 63.1 years for females(3). The per capita Gross Domestic Product (GDP) for 2014 is US$5916.46 and the per capita GDP purchasing power parity (PPP) adjusted is US$12105.55(2).

According to the Child Healthcare Problem identification programme, cancer is only the 31st most common cause of death in South African children causing 0.7% of deaths(1), similar to other African countries. This is in contrast to first world countries where it is the 2nd to 4th most common, causing 3% of deaths in USA and 15% in Scandinavian countries.(4–7) The true incidence of paediatric cancers in African countries however, may be underestimated due to under-diagnosis, under-reporting and lack of cancer registries.

2.3 Overview of Epidemiology, Staging, Treatment and Outcome

Burkitt lymphoma is an aggressive form of Non-Hodgkin's B-Cell Lymphoma (NHL). It usually presents primarily in the abdomen (60-80%) or head and neck region.(11,12) With a replication index of nearly 100%, it is the fastest growing human tumour and if left untreated, will result in 100% mortality, usually within 4-6 months.(8) There are three clinical variants.

Endemic BL occurs in children from equatorial Africa, Papua New Guinea and Brazil where malaria is common. It is strongly associated with Epstein Barr Virus (EBV) and

malarial infections. In endemic areas, BL comprises roughly 50% of childhood cancers. (9,10)

Sporadic BL occurs outside these areas, is rarely associated with EBV and forms 30-40% of paediatric lymphomas. (9,10)

Immunodeficiency-related BL is mostly associated with HIV infection. In Africa, the high prevalence of HIV has only caused a gradual increased incidence of paediatric BL, possibly attributable to the poor survival rate of African children born with HIV. (9,10)

This lymphoma is most common in children aged 3–12 years, the incidence peaks at 6–8 years and is more common in boys than in girls. In African countries, 60-70% of patients present with stage 3 disease.(11,12)

The St. Jude staging system for NHL guides prognosis and treatment decisions. Stage I and II disease are fairly well localised lesions that do not involve the central nervous system (CNS), bone marrow or thoracic cavity. Stage III is non-resectable disease with extensive spread or thoracic cavity involvement, while stage IV indicates CNS or bone-marrow involvement greater than 25%.(13)

Investigations required for diagnosis and staging include biopsy for histology and immunocytological analysis, full blood count and film, as well as liver function tests and urinalysis, computerised tomography (CT) scans of chest and abdomen, bone marrow aspirates and cerebrospinal fluid evaluation. In low-resource settings with a high incidence, fine needle aspirate with cytology, chest X-ray and abdominal ultrasound may have to suffice in the place of superior investigations.

The long term cure and survival rate for BL varies between 30-50% in low-income African countries, using single or low dose chemotherapy agents and roughly 90% in the first world setting, using high dose chemotherapy and providing optimal supportive care. Survival is negatively impacted by advanced disease at diagnosis (Stage III-IV) and HIV co-infection.(14–16)

Complications often arise and can either be a result from the tumor, associated co-morbidities, surgery or chemotherapy. Important tumor- related complications include respiratory obstruction or paraplegia from para-spinal tumor compression, while mucositis, infections, cytopenias, electrolyte disturbances and tumor lysis syndrome often occur during treatment.

The chance of relapse after 1 year event free survival is less than 5%, while relapse after 5 years is extremely rare.(17)

The incidence rate of BL in South-African children (<15 years), is approximately 0.1 per 100 000 per year. The sporadic form of BL is the most common type seen at Tygerberg Hospital Oncology unit. (18–20) Burkitt Lymphoma is one of the most common paediatric cancers in South Africa, comprising roughly 40% of lymphomas, which is ranked the second most common cancer, behind leukemia.(4,16,18)

The LMB 96 protocol is the treatment regimen of choice in South Africa and a recent study showed a 77% cure rate in HIV-uninfected children, but only 27% in HIV-infected children (60% overall). (14) The higher mortality rate in the HIV-infected group was attributed to poor general health, low CD4 counts and frequent tuberculosis (TB) co-infection. Stage of disease and site of presentation were independent predictors of poor outcome. The study did note a trend that HIV-positive children were more likely to have CNS involvement. (14) A similar study conducted in Uganda (which is an endemic area where less aggressive chemotherapy is used) also reported a much higher mortality rate among HIV-positive children than HIV-negative children, in spite of similar objective tumour responses. (15) This study did find HIV-positive patients to present with more advanced disease and more CNS involvement, but did not mention co-infection or CD4 count.(15)

The LMB 96 treatment regimen groups patients into 3 categories(21,22):

Group A comprises of Stage I and abdominal Stage II disease that is completely resectable. After resection, this group receives two cycles of chemotherapy (COPAD).

Group B consists of patients with non-resectable disease in any stage, but with no CNS involvement and less than 25% bone marrow (BM) involvement. These patients receive an initial cycle (COP), followed by two induction cycles (COPADM) and two consolidation cycles (CYM), but would be transferred to group C if they still have residual disease after the first consolidation cycle.

Group C consists of patients with CNS disease and/or BM involvement of greater than 25%.(21,22) They receive initiation and induction cycles as above, with consolidation cycles (CYVE) and four maintenance cycles. Patients with CNS involvement also receive intra-thecal therapy, as well as added methotrexate between consolidation treatments.

Side effects associated with treatment of BL may lead to prolonged hospital admissions, added investigations and medication, which increases the cost of treatment. (19,20) Neutropenic sepsis, mucositis, gastro-enteritis and tumor lysis syndrome are the most common associated side effects seen at Cape Town pediatric oncology units. (19,20)

2.4 Cost-effective analysis

Guidelines to determine the cost and evaluate the cost-effectiveness of treatment is stipulated in the WHO's 'Guide to cost - effectiveness analysis and 'Burden of Disease reports.(23,24) They suggested the detailed calculation of all expenses related to treatment and to measure these costs against Years of Life Lost (YLL), Disability Adjusted Life Years (DALYs) and the per capita Gross Domestic Product (GDP) of the country to help guide important decisions regarding the optimal application of resources. The per capita GDP serves as an indication of what a country can afford per citizen and of the earning potential gained averting DALYs. The Global Burden of Disease working group has set the Disability Weight for Non-Hodgkin's Lymphoma at 0.09.(23,24)

Finding similar studies relating to the cost effectiveness of treating cancer proved challenging due to a variety of key phrases being used in the titles and headings. Key words used in the PubMed and the SUNLIS searches included: 'Burkitt's or Burkitt

Lymphoma', Non Hodgkin lymphoma, 'cancer', 'treatment', 'children', 'cost effective', 'cost analysis', 'South-Africa', 'developing countries'. I also scrutinised the references of closely related publications.

Russel et al. (2013) conducted a systematic review aimed at identifying areas to improve resource efficiency in treating various types of pediatric cancer, specifically in developed countries. The average cost for the in-patient care of a pediatric cancer patient (primary episode) in the United States of America (USA) was estimated at $40 400 and rising sharply. For children with leukemia or CNS tumours the average direct treatment-related cost was US$89 000 for survivors and US$236 000 for those that died. The authors estimated indirect cost to the family of a patient at US$3725 to US$4648 – and considered it a minor relative cost, at less than 10% of total expenditure. The literature revealed a large heterogeneity in the quality of the studies and was mostly aimed at establishing the cost to benefit ratio of single additional interventions.(25,26)

Norum et al. (1996) did a cost-effectiveness study of Hodgkin's Lymphoma (HL) treatment in adults in Norway. They calculated the average healthcare cost (including indirect costs) at US$18 768 in 1994. The Quality Adjusted Life Years (QALY) gained were determined on an individual patient basis by a panel of experts that estimated their life expectancy and quality of life. The subsequent cost of one QALY was US$1990.(27)

Stefan and Stones (2009) conducted a calculation of the cost of primary treatment and two-year follow-up of Hodgkin Lymphoma at two pediatric oncology centres in South Africa. They included the cost of all investigations and medication, but excluded costs related to hospitalisation, staff salaries and disposables. They reported the treatment cost of stage II HL as US$6647.(28)

Bhakta et al. (2011) aimed to create a framework to determine cost-effectiveness thresholds for pediatric cancer using WHO and Global Burden Study of Disease guidelines. Using information from 2 treatment outcome studies that also provided information regarding cost of treatment – Howard et al. (2004) and Hesseling et al. (2009) - they conducted cost-effectiveness analysis of Acute Lymphocytic Leukaemia(ALL) in Brazil (middle-income country) and BL in Malawi (low-income) as examples. In Brazil the average direct cost of staging, treatment and 1 year follow-up for each child with ALL was calculated as US$16 700. They did not mention whether this included cost related to the initial workup and diagnosis at presentation. The cost per DALY gained was US$447. In Malawi, they only included the cost of medication used in the less intensive chemotherapy regimen – which was less than US$50 per patient, but in all likelihood represented only a fraction of the total cost of care. The cost for DALYs gained was compared to the per capita GDP for each respective country and found to be much lower than the 1:1 threshold, which defined the treatment as very cost effective. The amounts used for the GDP per capita was Purchasing Power Parity adjusted, although they refer to it as per capita GDP.(29–31)

Comparatively, cost analysis studies of infectious diseases have shown much lower costs per case, as expected. The total direct cost of treating community acquired pneumonia in pediatric patients in the South African public sector was calculated by Kitchin et al. (2011)

at US$639.06 for HIV infected children and US$399.45 for HIV negative children.(32) The cost of tuberculosis treatment per patient is estimated at US$100-500 in high-burden countries and US$2000 in developed countries.(33,34)

2.5 Discussion of literature review

The incidence of childhood cancer is rare (5), but is proportionally still a major cause of mortality in developed countries.(4–7) However, it is overshadowed by trauma and infectious diseases in middle and low-income countries. (1) The burden of childhood cancers is possibly underestimated due to the lack of cancer registries or active reporting.

Burkitt Lymphoma (BL) is a common paediatric cancer in South Africa. (4,16,18) Optimal treatment and supportive care of BL (as seen in developed countries) can lead to high cure rates and low relapse rates. (14–16)

Literature suggests that cost of treating childhood cancer is markedly higher in developed countries compared to developing countries. (29–31) This difference may be due to increased costs associated with in-hospital care and less restricted use of investigations and interventions. Even in developing countries, the cost of treatment of cancer is still very expensive when compared to the treatment of infectious diseases.(33,34) This highlights the importance of informed decision making regarding the allocation of healthcare resources in middle- and low income countries.

There are only limited research studies with uniform designs to determine the cost or cost-effectiveness of cancer treatment, especially in limited resource settings. Following a comprehensive literature search, we found no published cost analysis studies assessing the total direct cost of treating Burkitt Lymphoma, or cost-effectiveness analyses of cancer treatment in South Africa.

3. Research Justification

I chose a relatively common paediatric cancer for a pilot study, with a standardised treatment regimen that is well described in literature.

3.1 Research question

Is the treatment of children diagnosed with Burkitt Lymphoma cost effective in a middle-income country, such as South Africa?

3.2 Hypothesis

Treating Burkitt Lymphoma in South Africa (a middle-income country) is very cost-effective and the null-hypothesis is that it is not cost-effective to treat Burkitt Lymphoma in South Africa.

3.3 Objectives

- Calculate the cost per patient treated for Burkitt Lymphoma at Tygerberg Children's Hospital.
- Determine the average disability adjusted life years gained by treating a patient with Burkitt Lymphoma.

- Calculate the cost per DALY gained.
- Determine the ratio of cost per DALY to the gross domestic product per capita in South Africa.
- Compare the cost per DALY to GDP per capita ratio to the World Health Organisation's Choosing Interventions that are Cost Effective (WHO-CHOICE) threshold of cost effectiveness.

4. Methods

4.1 Setting

Tygerberg Children's Hospital is a 308 bed academic hospital in Cape Town, South Africa. It includes a dedicated Paediatric Oncology Unit and receives paediatric referrals from the Western Cape for the diagnosis and treatment of cancer.

4.2 Literature review

I performed a Boolean search of Pubmed Library and Stellenbosch University Library and Information Services (SUNLIS) using keywords: "burkitt's lymphoma", "burkitt lymphoma" AND "children" in combination with "epidemiology", "staging", "treatment outcome" and limited results to the last 10 years. This yielded four large reviews of recent BL-related literature, of which three included African data. The reviews were published in The Lancet(2012)(8), African Health Sciences(2007)(9) and the British Journal of Haematology(10) respectively and aimed to provide an overview of the disease and unravel the link between the epidemiology and the etiology of BL. They also provided an overview of staging, prognosis, treatment options and outcome. These reviews were thoroughly researched and supported each other's findings. As such, they form the basis of this section. However, I performed additional sub-themed searches and studied some of their listed references to provide confirmation or more clarity on individual subjects and for information specific to South Africa (SA) and Tygerberg Hospital (TBH).

4.3 Study Design

The study is a retrospective, longitudinal descriptive audit and cost-effectiveness analysis.

4.4 Inclusion and exclusion

Paediatric patients (age ≤15years), who were diagnosed and treated for Burkitt Lymphoma at Tygerberg Hospital (TBH) between 2005 and 2010 were identified through the Tygerberg Hospital Children's Tumour Registry. The timeframe for the search was established to optimise the eligible patient numbers and availability of financial records (which are destroyed after 10 years), while keeping the change in treatment protocols and item prices relatively small. It also allowed for completion of the full course of treatment and a 2 year follow-up period, to establish whether successful cure was accomplished. Relapse of BL is highly unlikely beyond 2 years from remission. (17)

4.5 Data collection

We retrieved patients' treatment folders from the oncology ward. Additional clinical records, containing nursing notes, prescription charts, microfilms and other clinical data, were obtained from the department of medical records. We also collected data from

hospital-based laboratory and radiology records. This was done to ensure completeness of collected data.

Data collected included:

- Patient details (age, sex, weight, date of diagnosis).
- Disease group of each patient (assigned to each patient as per the LMB 96 protocol into Group A, B or C). (See Appendix 1)
- The number of admission days, as well as the specific ward of admission. In TBH, different wards have different levels of care, implying different cost of admission.
- The number of outpatient visits.
- Chemotherapy received was recorded on a separate chemotherapy documentation sheet.
- Surgical procedures performed, as documented in clinical records.
- Minor surgical procedures, as documented in clinical records, consisting mainly of central line insertions or biopsies, as categorised in UPFS.
- Imaging studies performed and the results thereof; obtained from patient folders. Studies from 2007 were reconciled with the I-site Digital Imaging Database. Prior to 2007, no reconciliation was possible since digital imaging was only implemented at TBH at that stage and no hard copies were kept for more than 5 years.
- Laboratory investigations performed and the associated results: obtained from the clinical records and reconciled with data from the National Health Laboratory Service (NHLS) database. Results may have cost implications in some cases – for instance, a positive blood culture is more expensive than a negative culture, due to drug sensitivity testing.
- We identified medication, fluids, blood products and supplementation received from treatment charts and included all routes of administration. Both inpatient and outpatient scripts were taken into consideration.
- Auxiliary services rendered, i.e. physiotherapy were not recorded, as it did not affect the cost of admission or outpatient appointments. During an outpatient visit or hospital admission the patient is charged the highest rate, which in all cases would have been the charge for the paediatric specialist.
- Disposables, for example syringes, needles, etc. were not collected as it is incorporated into the cost of an admission, outpatient visit or procedure.

4.6 Data capturing

Data were collected on a case recording form. We allocated a case number to each patient. Data was subsequently transcribed to an Excel spreadsheet and cost calculations done.

4.7 Price calculation

Patients are charged different rates according to their income category in South African public sector hospitals. Children under the age of 5 years receive free medical care. A significant percentage of patients with Burkitt Lymphoma are under the age of 5 years, or their caregivers fall in lower income categories, and are then only charged a small portion of actual costs. Each patient was assigned to the full paying category, to estimate the true cost accrued to treat children with Burkitt Lymphoma. (See Appendix 3)

The collected data was tabled and the combined costs calculated from the price catalogues, as it were on 1 April 2014:

- The Uniform Patient Fee Schedule, procedure code and radiology code for the provincial health system. From the codes on the procedure code forms, the costs of procedures, admissions and radiological investigations were determined.
- The TBH pharmacy price list.
- The TBH NHLS tariff rates for state patients.
- The TBH department of Human Nutrition's price list of supplemental feeds.
- The Western Province Blood Transfusion Service's price list for state patients.

The direct non-medical costs (transport costs, meals of caregivers in hospital, etc.) and cost associated with loss of productivity of parents was not included. These costs were not included as this is a retrospective study and no data regarding the above was available. The total direct cost related to treating children with BL were then calculated per patient in South African Rand (ZAR) before conversion to US Dollars (US$), using the average conversion rate for 2014.(35)

4.8 Cost-effectiveness calculation

To calculate the DALYs gained by treatment per cured patient, we subtracted the age at diagnosis from the life expectancy of the applicable gender to determine the total years of life lost (YLL) averted. Then we calculated Years of life with disability (YLD) during- and after treatment by multiplying the appropriate disability weight (DW) with the duration (in years) of disability. In BL the duration of treatment was used as the duration of disability. For permanent disabilities, it is calculated as the period from diagnosis until end of estimated life expectancy. Disability weight is a set severity weight that measures the valuation of the loss of healthy life for each clinical condition, as determined by the Global Burden of Disease working group.(23,24) When more than one disability co-existed, the combined disability weight is calculated using the formula: DWcombined = 1 - (1 - DWa) (1 - DWb). Since cancer in the presence of HIV positivity is an acquired immune deficiency syndrome(AIDS)-defining disease and all children were started on anti-retroviral therapy(ART) during treatment, the DW used were the 'AIDS on ARTs' average as obtained from the WHO guidelines.(23,24) The DALYs gained is the difference between the YLL averted and the YLD. A patient that died due to BL had no DALYs gained, therefore to determine the average DALYs gained per patient, the sum of the DALYs of patients that survived, were divided by the total number of patients in the study. The ratio between the average cost to avert 1 DALY and the RSA GDP per Capita is then calculated.

We obtained the following variables used from literature:

- RSA life expectancy (male) (3): 59.1yrs
- RSA life expectancy (Female) (3): 63.1yrs
- Disability weight (BL) (24): 0.09
- Disability weight (AIDS on ARV's) (24): 0.167
- Disability weight (paraplegia) (24): 0.57
- RSA Per Capita GDP (2014) (2): US$5916.46

- 2014 average South African Rand ratio US$ = 1:0.0923(35)

4.9 Statistical Analysis

This was a novel, retrospective, descriptive study regarding a rare condition and was not powered for in depth statistical analysis. Where appropriate, the means, medians and ranges were used to summarise and describe the results. Statistics and graph preparation were performed using Statistica 12 and Microsoft Excel 2010.

4.10 Ethical considerations

Ethical clearance was obtained from the University of Stellenbosch Health Research Ethics Committee (HREC 2; Ethics Reference: S13/10/186). This was a retrospective study with influence the care of the participants, and a waiver of consent was granted, with the provision of identity protection. I also obtained approval from the TBH Senior medical superintendent to conduct the study.

5. Results

5.1 Patient Demographics

Eleven children were treated for BL at Tygerberg Children's Hospital Oncology Unit between 2005 and 2010. One patient was excluded due to missing hospital records and clinical notes. Nine patients were male and one female. The youngest was 2 years and 3 months, while the oldest was 10 years and 6 months at the time of diagnosis. The median age was 6 years. Five out of the 10 patients included were HIV positive. None of the HIV positive children was on antiretroviral therapy, or virally suppressed at diagnosis.

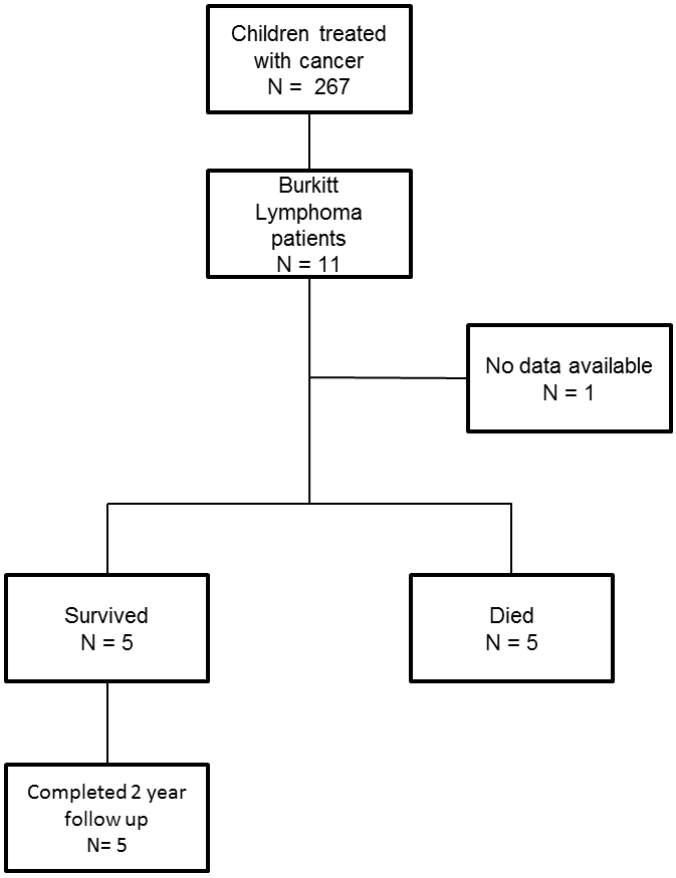

Figure 1: Breakdown of retrospective recruitment and follow-up of patients diagnosed with Burkitt Lymphoma between 2005 and 2010 at Tygerberg Children's Hospital in South Africa.

5.2 Treatment and Outcome

Five of the patients treated for Burkitt Lymphoma died and five patients were cured. All five patients that survived completed 2 year follow up period at Tygerberg Hospital and there were no relapses documented.

5.2.1 Patients in disease group A

After diagnostic and staging investigations, two patients were diagnosed with resectable abdominal disease (Stage II) and assigned to LMB 96 treatment protocol Group A. For these patients treatment included surgical resection via laparotomy and 2 cycles of

chemotherapy, consisting of vincristine, cyclophosphamide, prednisolone and doxorubicin (referred to as COPAD in the LMB 96 protocol). (See Appendix 2)

The first patient was a 2-year-old boy. He was diagnosed as HIV positive, with a CD4 count of 12.7% (absolute count 778 cells/mm^3) and a viral load of log 5.87 (740654 copies/ml). He suffered tumor lysis syndrome, liver failure and febrile neutropenia as complications during therapy. He required 35 days of admission to a tertiary care ward and attended eight outpatient visits.

The second was a 10 year old, HIV-negative boy. He suffered no complications during treatment, required 27 days of tertiary inpatient care and attended 12 outpatient visits.

5.2.2 Patients in disease group B

Four patients had non-resectable disease, which spared the central nervous system (stage III) and bone marrow, and were assigned to treatment protocol Group B. Two of these children died due to septicaemia. Both were HIV negative.

The first patient, a 2-year-old boy, developed bowel perforation due to an abdominal tumour and subsequent gram-negative septicaemia. He was taken to theatre for a laparotomy and received broad-spectrum antibiotics, but died on the 12^{th} day in hospital (2 days in secondary level ward, 9 days in a tertiary ward and 1 day in the paediatric intensive care unit (PICU).

The second patient was a 7-year-old boy who died during chemotherapy, after 35 days in the tertiary care ward and 3 days in the PICU. He suffered repeated episodes of febrile neutropenia and sepsis. Treatment for this patient included a laparotomy and numerous blood transfusions to the value of US$11232.

The two surviving patients from this group successfully completed five cycles of chemotherapy (1 initiation- , 2 induction- and 2 consolidation cycles) and were cured. The first was an HIV negative 6-year-old boy. He suffered from treatment-related complications, which included febrile neutropenia, tumor lysis syndrome, mucositis and reversible renal failure. He spent a total of 39 days in a tertiary care ward and had 14 outpatient visits.

The fourth patient was a 7 year old HIV positive boy, with a CD4 count of 28% (469 cells/mm^3) and a viral load of log 4.4 (25000 copies/ml). He spent 48 days in the tertiary care ward and had 10 outpatient visits. He had reversible renal failure and mucositis as complications.

5.2.3 Patients in disease group C

Four patients had disease involving the central nervous system and bone marrow and required treatment as per the Group C treatment plan. Only 1 Group C patient was successfully cured: a 10-year-old HIV positive boy who presented with lower limb paraplegia (L5/S1level). He had a CD4 count of 24% (304 cells/mm^3) and a viral load of log 4.6 (40000 copies/ml). He spent a total of 100 days in hospital (88 days in the tertiary care ward and 12 in a secondary care ward); he also had 15 outpatient visits. The lower limb paralysis remained despite successful treatment.

Of the Group C patients with unsuccessful treatment outcomes, the first was a 2-year-old girl who demised after only 4 days in the tertiary care ward. She was HIV positive and presented with disseminated BL. Her CD4 count was 27.7% at diagnosis (absolute count 778 cells/mm^3), but no viral load was requested at that time. She died in the theatre recovery room after thoracic biopsies in theatre; the diagnosis of Burkitt Lymphoma was made after she succumbed, on these biopsies. Post-mortem examination cited cardiac failure as the most likely cause of death.

The other two patients in Group C were boys and presented with extensive disease, which included neurological manifestations. Both suffered from tumor lysis syndrome, febrile neutropenia and sepsis during treatment and required intensive treatment and care. One was 5 years old and HIV positive with a CD4 count of 10% (318 cells/mm^3) at diagnosis, but no viral load was performed. He died after 57 days (2 days in the secondary care ward, 53 days in the tertiary care ward and 2 days in PICU), while the other boy was 6 years old, HIV negative and demised after 21 days (19 days in the tertiary care ward and 2 days in PICU).

In summary: both patients with Group A disease were cured, while 2 out of 4 patients assigned to Group B and 3 out of 4 assigned to Group C succumbed before completion of treatment. The only cured Group C patient was paraplegic because of spinal involvement. This was the only disease-related permanent disability that occurred in the 5 survivors. However, multiple reversible complications were documented.

Disease group	Outcome	Age at diagnosis (years)	HIV status	Days in hospital	Cost of hospital admissions (US$)	Blood products (US$)	Total cost(US$)
A	Cure	10.5	Negative	27	4184.73	0	6687
A	Cure	2.58	Positive	35	5424.65	0	8335
B	Cure	5.58	Negative	39	6044.61	186	10976
B	Cure	6.92	Positive	48	7439.52	0	11609
B	Death	2.25	Negative	12	2285.73	1887	4856
B	Death	7.58	Negative	35	7546.91	0	23793
C	Cure	10.16	Positive	100	14739.56	465	25817
C	Death	6.25	Negative	21	4359.65	11196	10764
C	Death	2.92	Positive	4	619.96	2985	1839
C	Death	5.75	Positive	57	9810.87	0	23616
Mean		6.05		37.8	6245.62	1671.9	12829

Table 1: Summary of demographics and the two most significant components of cost calculation per patient.

5.3 Cost calculation

Of the total direct cost to treat these 10 patients, admission costs, which represented the cost of clinical care, staff salaries and equipment maintenance, were by far the largest proportion, with each patient spending an average of 38 days as an inpatient. This amounted to US$6245.81 per patient and effectively contributed 49% of the total cost (figure 2). The second largest contributor was the cost of blood product transfusions, which contributed 16% and amounted to an average of US$2115.79 per patient. The cost of blood products was inflated by the fact that leucocyte depleted blood was indicated.

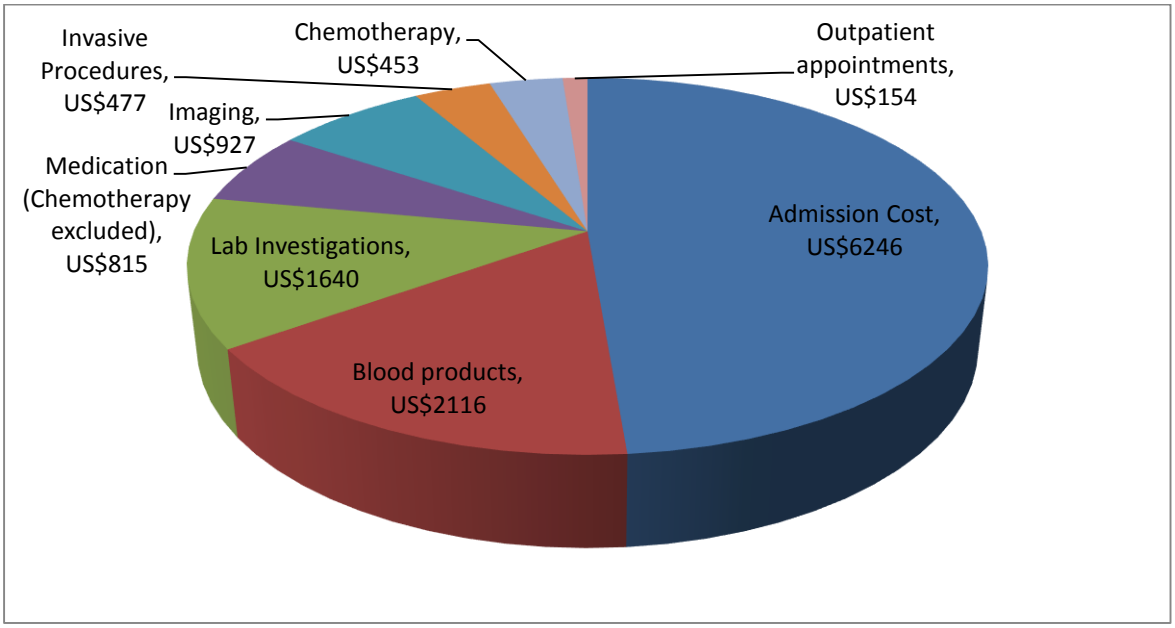

Figure 2: Average cost (US$) of each contributing component per patient.

Laboratory investigations comprised 13% of costs. The most costly laboratory investigation was a full blood count (with and without a differential cell count). A total of 320 counts were requested and amounted to US$1917. This was followed by serum calcium-, magnesium- and phosphate levels with 165 tests, costing US$1799.

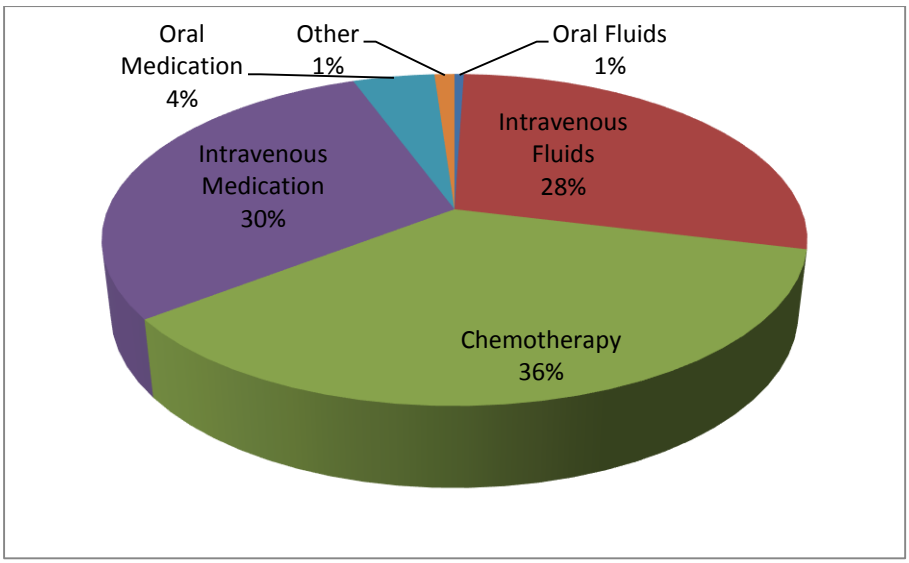

Figure 3: Medication cost breakdown.

Medication (on average US$1268.20 per patient) was responsible for a proportion of 13% of the total cost (figure 3). Chemotherapy (36%) contributed most to the bulk of medication- related cost, followed by intravenous (IV) fluids (28%) (Figure 3). Intravenous fluids included the following: crystalloids and total parenteral nutrition (blood products excluded). Oral rehydration solution and nutritional supplements (Pediasure, Ensure, Nutren Junior, Nutren Active and Peptomen Junior) were classified as oral fluids. Oral nutritional supplements made up the bulk of the cost of oral fluids and more than half the cost of IV fluids was due to total parenteral nutrition. Oral medication included anti-retroviral therapy. 'Other' consisted of topical, otological, optical and rectally administered medication.

Computed tomography (CT) and Magnetic resonance imaging (MRI) scans required for diagnosis and staging were the most expensive imaging investigations. Imaging investigations contributed 7% of the total cost (figure 2). Surgical procedures included four laparotomies and made up only 4% of the total expenses. Outpatient follow up visits were inexpensive and only contributed 1%.

The total direct cost related to treatment ranged from US$1838.60 to US$25817.21. This amounted to an average total direct cost of US$12829.07 per patient. The rapid course of one patient's extensive disease resulted in the lowest cost of treatment in this cohort at US$1839, as this patient died within 4 days of presentation. The patient that amassed the highest cost in the cohort (at US$25817) spent a total of 100 days in hospital. He survived, but had permanent lower limb paralysis due to disease sequelae.

Patient	1	2	3	4	5	6	7	8	9	10	Total US$
Group	B	C	B	B	C	C	A	B	C	A	
Outcome	Survived	Died	Survived	Died	Survived	Died	Survived	Died	Died	Survived	
Admission	6064	622	7464	2293	14787	9845	5442	7571	4374	4198	62661
Transfusion	0	0	466	0	1894	4454	186	11232	2995	0	21227
Lab tests	2697	341	1774	1354	2525	2579	1237	2038	1310	602	16457
Radiology	518	519	546	518	2942	1818	418	784	364	878	9305
Procedure	173	304	86	593	657	917	571	674	244	571	4790
Chemo	553	0	561	23	1534	1003	153	341	302	75	4545
IV Meds	270	47	211	71	574	1291	72	726	514	25	4509
IV Fluids	1	0	1	0	14	10	4	25	10	0	3604
Follow up	332	6	212	17	265	1668	48	366	665	25	1545
PO Fluids	367	0	262	0	393	0	210	0	0	314	65
PO Meds	19	6	30	2	287	90	11	88	22	17	570
Other meds	18	0	34	1	30	20	8	25	0	4	140
Total US$	11011	1845	11647	4871	25901	23693	8362	23870	10799	6709	129417

Table 2: Breakdown of direct cost (US$) per patient (each numbered 1-10, disease group indicated as A, B or C, as well as the patient outcome (survived or died)) and contributing cost components.
[Lab: laboratory; chemo: chemotherapy; IV: intravenous; meds: medication; PO: per os]

The management and treatment of a child assigned to Group C was the most expensive at US$15508.91, followed by Group B (US$12808.28). Group A was the least expensive with an average cost of US$7510.98 per patient(figure 5).

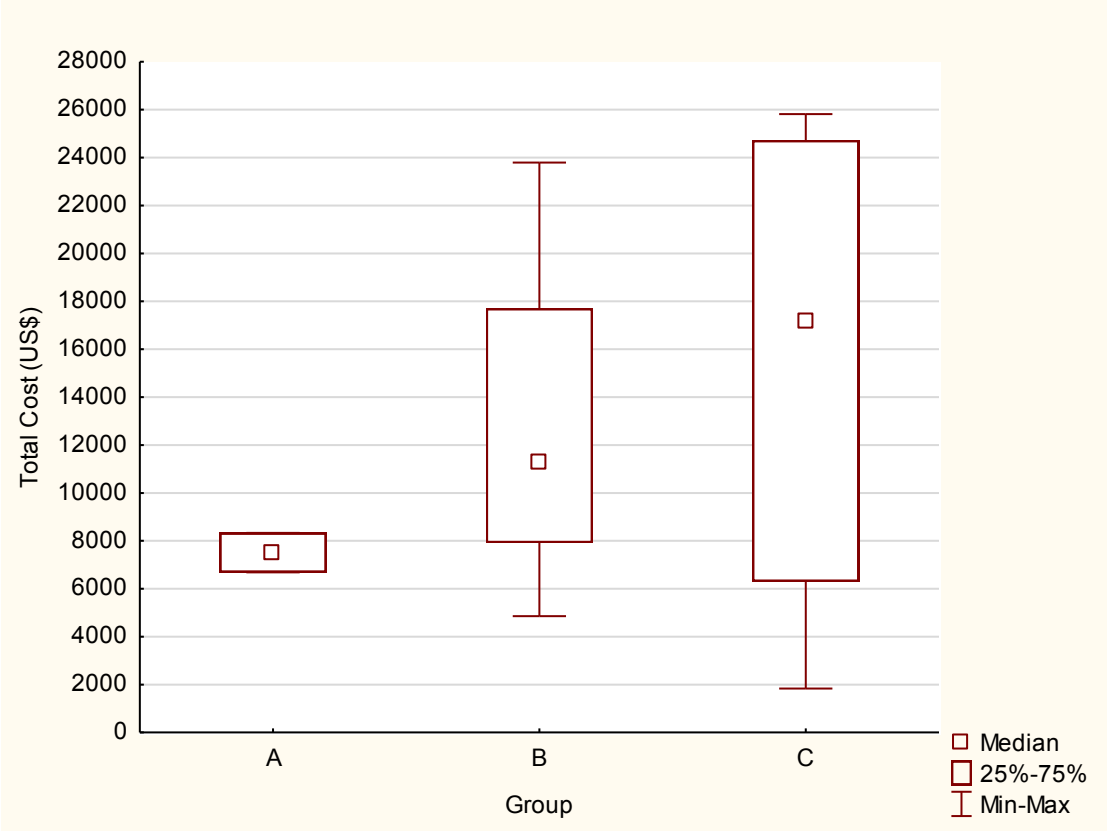

Figure 4: Box-plot comparing the cost (US$) of Burkitt Lymphoma treatment per assigned treatment protocol group. Median and range are shown. All patients were included.

Treating a HIV positive patient was more expensive than treating an HIV uninfected child, with an average cost of US$14243.10 and US$11415.04 respectively (figure 5). Costs directly related to HIV diagnosis and treatment (HIV Elisa, CD4 counts, viral load, anti-retroviral drugs) alone can not account for the cost difference as this amounted to only $101,on average, per HIV positive patient. There was no notable trend for patients with a lower CD4 count to present with more advanced disease.

Disease group	Outcome	Age at diagnosis (years)	Sex	CD4 (%)	Viral load (log)
A	Survived	2.58	Male	12.7	3.04
B	Survived	6.92	Male	28	4.4
C	Survived	10.16	Male	24	4.6
C	Died	2.92	Female	27.7	Not done
C	Died	5.75	Male	10	Not done

Table 3: Disease group; CD4 count and viral load for HIV positive children with Burkitt Lymphoma

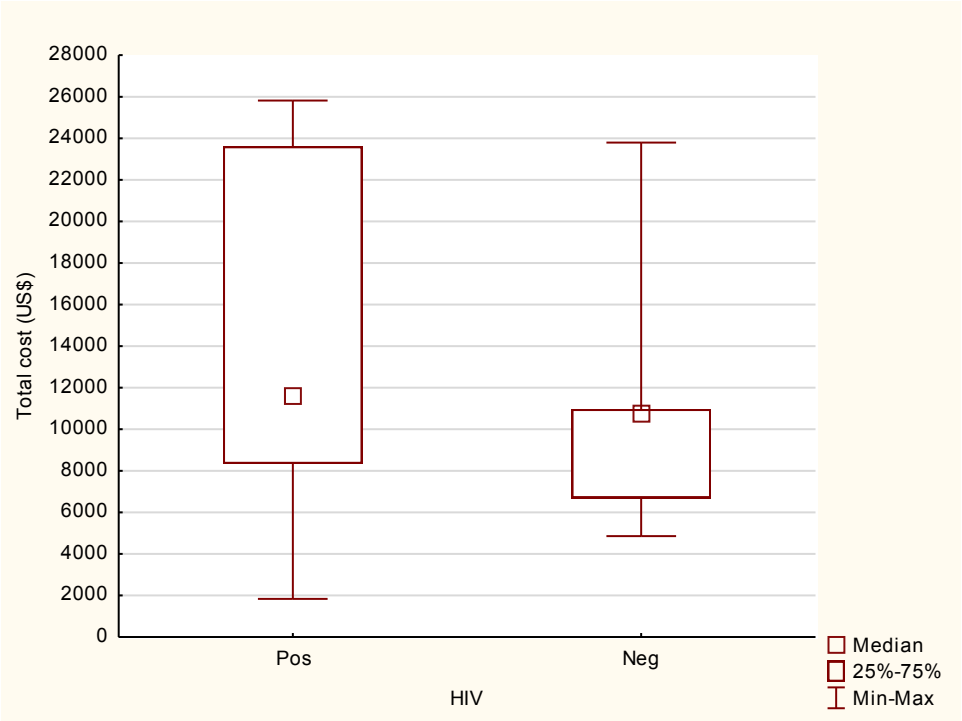

Figure 5: Box and whisker plot comparing the cost (US$) of Burkitt Lymphoma treatment per HIV status. The median and range are shown. All patients were included.

A trend was seen for young age (less than 3 years old) to be associated with a lower cost (figure 6). This is likely because in this cohort, these patients either presented at an early stage, or died soon after presentation. This data should be interpreted with care, due to the small sample size.

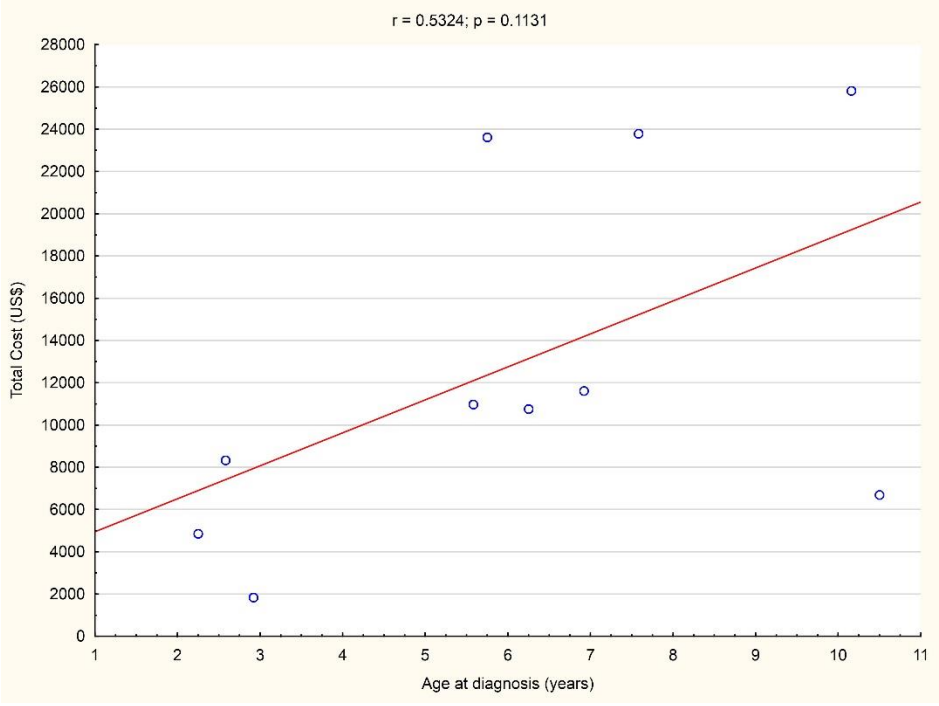

Figure 6: Scatterplot of age compared to cost (US$), showing a moderate, but non-significant positive correlation. All patients were included.

5.4 DALYs gained calculation

No DALYs were gained for patients that demised in spite of treatment and they required no further calculation. The cost of their treatment is compared to the DALYs gained in cured children.

For cured patients the Years of Life Lost averted were high (48.6 to 56.5 years), as expected. The disability weight during treatment and after cure were different, since the disability weight due to BL falls away at cure, but the disability weight for paraplegia and HIV persists for life. The final date of chemotherapy or hospital admission (whichever came last) was designated as the date of cure.

In the following examples, patient 5 (HIV positive patient, with Group C disease, who survived with paraplegia) will be used in the calculations.

Example: Calculation of Averted YLL = Life expectancy (male) – Age at date of admission

= 59.1 – 10.2

= 48.9 years

The Years of Life with Disabilty (YLD) during treatment, was almost negligable in all cases, given the relative short time on treatment, when compared to the expected life expectancy of a person. This held true even in the most extreme case when combined DW's were used (maximum 0.34 years).

Example: Duration of disability during treatment

= Date of admission – date of discharge/last chemo

= 0.51 years

Example: Combined DW of lower limb paraplegia, AIDS on ARV's and Burkitt Lymphoma (as a proportion of combined DW)

= 1 – (1-DW*hiv*)(1-DW*para*)(1-DW*bl*)

= 1 – (1-0.167)(1-0.57)(1-0.09)

= 0.67

Example: Years of life with disability during treatment

= Duration of disability during treatment x Combined DW during treatment

= 0.51 x 0.67

= 0.34 years

Where applicable, the DW after treatment were due to HIV status and paraplegia, which was the only permanent complication in this study group.

Example: Combined DW of HIV infection and lower limb paraplegia

= 1 – (1-DW*hiv*)(1-DW*Para*)

= 1 – (1-0.167)(1-0.57)

= 0.64

YLD after treatment were fairly low as well, even for HIV positive patients (max 9.45years). It was notably high only for the patient with permanent lower limb paraplegia. His calculations were used as examples, since it was the most complex.

Example: Calculation of YLD after treatment

= Averted YLL after treatment x Combined DW

= 48.43 x 0.64

= 31.1 years

Calculated DALYs gained for cured patients ranged from only 17.51 for the patient with paraplegia (due to the high YLD) to 53.20 for an otherwise well patient.

Example: Total YLD

= YLD during treatment + YLD after treatment

= 0.34 + 31.1

= 31.4 years

Example: Gained DALY

= Total averted YLL – total YLD

= 48.9 – 31.4

= 17.5 years

Category	Outcome	YLL averted	DW (During treatment)	YLD (During treatment)	Disability	DW (after treatment)	YLD (after treatment)	YLD (total)	DALY gained	US$/DALY gained	US$/DALY: GDP/Capita
A	Cure	48.6	0.09	0.01	Nil	0.00	0.00	0.00	48.6	137.60	0.02
A	Cure	56.52	0.24	0.02	HIV	0.17	9.42	9.45	47.07	177.06	0.03
B	Cure	53.52	0.09	0.02	Nil	0.00	0.00	0.02	53.5	205.15	0.03
B	Cure	52.18	0.24	0.06	HIV	0.17	8.67	8.73	43.45	267.20	0.05
B	Death	0	0	0	0	0	0	0	0	n/a	n/a
B	Death	0	0	0	0	0	0	0	0	n/a	n/a
C	Cure	48.94	0.67	0.34	Paraplegia and HIV	0.64	31.08	31.43	17.51	1474.14	0.25
C	Death	0	0	0	0	0	0	0	0	n/a	n/a
C	Death	0	0	0	0	0	0	0	0	n/a	n/a
C	Death	0	0	0	0	0	0	0	0	n/a	n/a
Total	n/a	259.76	n/a	0.45	n/a	n/a	49.17	49.63	210.1	n/a	n/a
Result										610.52	0.1

Table 4: Summary of DALYs gained *and ratio between DALYs* gained *and per capita GDP per patient. The US$/DALY and US$/DALY:GDP/Capita columns indicate values per patient but the calculated result shown takes cost of treating patients who died into account. (YLL: Years of life lost; DW: disability weight; YLD: Years of life with disability; DALY: Disability adjusted life year; GDP: Gross domestic product per capita; n/a: Not applicable)*

The DALYs gained for each patient was calculated and added (Table 4). The total cost of treatment (Table 2) was then divided by the total DALYs gained which yielded the average cost to avert one DALY. The result was that the average cost was $610.52 to avert one DALY. Earlier stages of disease were much more cost-effective to treat than late stages of disease, due to the shorter duration of treatment, lower cost and improved outcome. The average cost to avert one DALY was $157.01, $528.47 and $3542.19 respectively for groups A, B and C (Figure 8). In HIV positive patients, it cost US$659.22 to avert one DALY, compared to US$559.01 to avert one DALY in HIV negative patients.

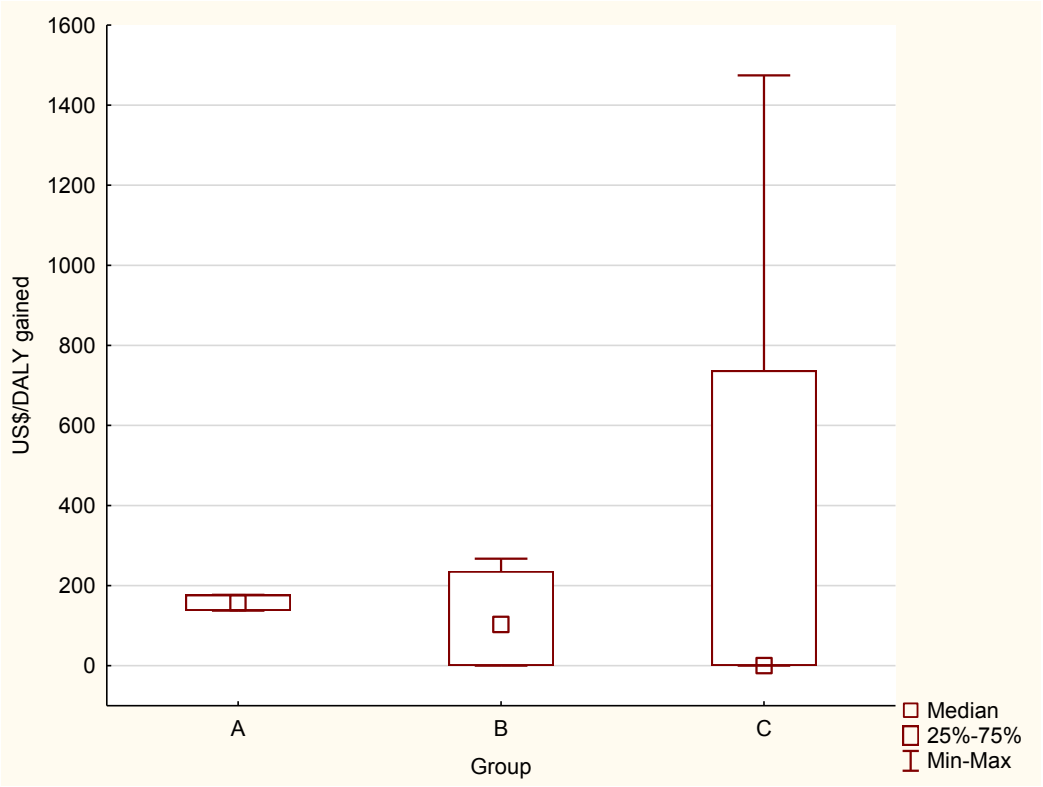

Figure 7: Box plot of US$ per one disability adjusted life year gained categorised by assigned treatment protocol group. All patients included. Median and range are shown (DALY: Disability adjusted life year; US$: United States of America Dollar)

The ratio of cost to avoid one DALY to GDP per Capita was 0.1:1. Therefore the treatment of Burkitt Lymphoma falls well within the very cost effective range according to the WHO CHOICE criteria(<1:1).(23) If subsets were formed based on assigned treatment groups, the ratios would be 0.03:1 for Group A, 0.09:1 for Group B and 0.60:1 Group C. Thus, the treatment of BL Group C disease is still in the very cost effective range. When comparing HIV positive and HIV negative patients, the cost to avoid 1 DALY to GDP per capita ratios were 0.11 and 0.09 respectively, indicating that even treating HIV positive patients with BL is also well within the very cost effective range.

6. Discussion

6.1 Summary of findings

Ten patients were diagnosed and treated for BL at Tygerberg Hospital from 2005 – 2010. The average direct cost of management was US$12829 per patient. The treatment resulted in a 2-year event-free survival rate of 50%.

The findings indicate that the treatment of BL at Tygerberg Children's Hospital is very cost effective, by a large margin. The average cost to avert 1 DALY, was US$610.52, thus the average ratio to GDP per capita was 0.1:1. Despite the higher cost and poor prognosis of advanced disease, the treatment of these children, with a ratio of 0.6:1, is still well within the 1:1 WHO-CHOICE threshold of very cost-effectiveness (1US$ per 1 DALY gained to GDP per capita ratio). (23) Treating HIV infected children with Burkitt Lymphoma was also shown to be very cost-effective with a US$ per DALY gained to GDP per capita of 0.11:1.

6.2 Comparison to previous studies

The cohort compares very well to the data on sporadic BL obtained in previous reviews(8–10) in terms of age, stage of presentation and complications due to disease and treatment. The cure and survival rate is also similar to data from a previous study done in South Africa,(14) which is quite assuring as it indicates that this study was not done on a biased sample.

Due to the paucity of cost-effectiveness studies in BL, we compared our results to other childhood cancers. We calculated that the average cost to treat a child with BL was US$12829, which is considerably lower than the reported $40400 it cost to treat paediatric cancer in a high income country like USA (25) and somewhat lower than the treatment of ALL in a middle income country (Brazil $16 700(29)). The cost correlated well to a previous South African study that calculated the average cost to treat a child with Hodgkin's Lymphoma at $6647(28), when considering that the cost of hospitalisation which contributed nearly half of the cost in the treatment of BL, was excluded in that study.

As expected, the cost to treat BL was much higher than the cost of treating infectious diseases such as tuberculosis or pneumonia.(32,33,36) These studies unfortunately were not cost-effective analyses, so the cost-effectiveness could not be compared. The paucity of cost-effectiveness studies in middle-income countries makes it difficult to compare the cost-effectiveness of BL to other infectious diseases.

6.3 Advanced stages of disease

As expected, this limited study also confirmed the poor prognosis associated with advanced disease (Group C).(14),(15)

We found a trend that the treatment of advanced stage disease (Group B and C) was more expensive, per patient, than early stage disease (Group A). This was in spite of some children with more advanced stages demising very soon after presentation to hospital, thus incurring very low cost. The US$ to avert 1 DALY to GDP per capita ratio for the different disease groups were 0.03:1, 0.09:1, and 0.6:1 for respectively Groups A, B and C. Two children included in this study (one Group B and one Group C), required the use of significantly more resources, e.g. blood product transfusions, admission to the

intensive care unit, special investigations and procedures than the other children who survived. The cost of chemotherapy administered to the child with Group C disease was also the second highest in the cohort. This had a strong influence on the above results.

As other studies did not differentiate between the different stages of presentation, it is not possible to validate this trend with the literature.

6.4 Burkitt Lymphoma and HIV infection

In this small cohort, there was no evidence that HIV comorbidity was associated with a worse prognosis. This was unexpected as the literature suggests otherwise.(14),(15)

A trend was seen for the treatment of HIV positive patients to cost more than HIV negative patients, but was still well within the threshold of very cost-effectiveness. The total US$ required to avert 1 DALY per GDP per capita ratio for HIV infected children with Burkitt Lymphoma was 0.11:1 versus 0.09:1 in HIV uninfected children. We found no other studies that compared the cost or cost-effectiveness of treating HIV-infected paediatric cancer patients to HIV-uninfected paediatric cancer patients.

This novel pilot data may be used when health care workers in developing countries need to lobby for equal cancer treatment for patients with HIV disease. When the HIV pandemic was young, many doctors believed that affected patients should not receive cancer treatment. This view started to change once ARTs became successful and available and cancer patients with HIV started to survive, but in some developing countries, this belief may persist.

6.5 Cost breakdown

Cost related to general supportive care was the largest proportion of the cost. This was somewhat surprising considering the expensive procedures, investigations and medication used. On the other hand, the chemotherapy agents used in the BL LMB protocol, are drugs that have been used for many decades and are therefore not that expensive, bar the anthracyclines (TBH pharmacy price list). Rituximab, an expensive monoclonal antibody used in the treatment of adult BL, is not used in this protocol either.

Hospitalisation and laboratory tests made up the bulk of the cost of supportive care. Full blood counts and electrolyte measurements were the most costly tests, mainly because of the frequency of repetition. This may be against a general perception that more specialized investigations, expensive chemotherapy and invasive procedures would drive the cost.

The second largest component of costs consisted of blood products administered, even though a restrictive blood transfusion policy was utilised in the unit. Severe bone marrow suppression is both disease- related and a treatment- related complication.(10) The use of leukocyte-depleted products (mainly to reduce the risk of allo-immune transfusion reactions) further contributed to this cost. In a Norwegian cost analysis in Hodgkin's Disease, hospital stay was found to be the main contributor to costs (36% of total cost), which correlates well with the findings of this study.(27)

6.6 Weaknesses and strengths

The first major limitation of the study is the small sample size that was studied. This prevented the calculation of statistical significance or confidence intervals. Being a retrospective study, it was dependent on good record keeping practices, thus there may also have been inaccurate or missing data

The third is the fact that the study only included one treatment centre. To some extent, however, these factors were negated by the fact that the characteristics of this cohort compared very well to that represented in the literature. The patients were also managed at a central academic health care facility using a standardised treatment protocol that is currently used in all the paediatric oncology units (POUs) in South Africa.

A strength would therefore be that the cost of treating patients with BL at other public sector POUs in South Africa should be very similar. The diagnostic investigations and supportive care required for treating patients with BL are available at all the units and the cost of the various contributing factors would be similar, since the overwhelming majority of units are in the public sector and therefore prices are similarly regulated. The exception would be that not all units have access to a paediatric intensive care unit.

The cost of treating a patient with BL in the private sector will most likely be higher, due to a different tariff structure; therefor our findings may not be applicable to the private sector and requires further research.

6.7 Relevance and implications

The main finding of the study is that it is very cost-effective to treat children with BL, even though it costs much more than treating children with potentially life threatening infectious diseases. The main factor contributing to the cost-effectiveness is the 100% mortality rate of untreated BL, compared to treatment, which has a reasonable chance of permanent cure in patients with a long life ahead of them. The large margin by which cost-effectiveness was achieved in this representative sample would suggest:

- That the treatment of any paediatric cancer with a chance of lasting cure is likely to be cost effective, even if patients present with late stage disease or HIV infection.
- In economic strife, public funding should not be diverted away from the treatment of paediatric cancer towards treatment of infectious diseases, even though the latter is a more common cause of death in South Africa.
- This study, or similar studies in future, could be used by advocates for treatment of children with cancer in middle-income countries.
- Any intervention that would improve the cure rate would further improve cost-effectiveness, even if the intervention were expensive.
- To improve cost-effectiveness even further, critical evaluation of the need of hospital admission days, careful consideration when requesting routine blood investigations, prevention of infectious complications and strict reinforcement of a restrictive blood transfusion policy should be targeted.

6.8 Recommendation for future studies

The findings should be validated by repeating the study in another treatment centre, or in a private sector treatment centre. A similar study in a different type of paediatric cancer would also serve as verification. It would also be interesting to see if the treatment of paediatric cancer would still be cost-effective if the study design were repeated in a low-income country.

6.9 Final conclusion

The treatment of children with Burkitt Lymphoma in Tygerberg Children's Hospital, South Africa is very cost effective, as it is well below the WHO-CHOICE threshold of very cost-effectiveness. It is also very cost-effective to treat children with Burkitt Lymphoma who present with advanced disease, as well as children with associated HIV infection.

Cost constraints should therefore not be a limitation to treating children with Burkitt Lymphoma, even if they present with advanced stage disease or HIV infection.

Similar cost-effective studies in another type of paediatric cancer, private health sector or low-income countries, should be performed to verify this data.

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Appendix 1

Research protocol for the Committee for Human Research

Project:

The cost effectiveness of treating paediatric cancer in South Africa –

A review of treatment cost for Burkitt lymphoma

Protocol Summary:

This will be a retrospective cost-effectiveness analysis of children diagnosed with Burkitt lymphoma at Tygerberg Children's Hospital from 2005-2010. The objective of the analysis will be to determine the true cost of management and determining the cost-effectiveness.

Childhood cancers are rare and require resource-intensive medical services to cure. Critical evaluation of the costs of management is scarce and there is a need to estimate if treatment of childhood cancers in South Africa meets the threshold of cost-effectiveness. Cost effectiveness is defined as the ratio of monetary expense required to avert 1 Disability Adjusted Life Year (DALY) to the annual gross domestic product (GDP) per capita in South Africa.

The purpose of the study is to review information obtained from all the children diagnosed and treated with Burkitt lymphoma(BL) at the Oncology Unit of Tygerberg Children's Hospital, from 2005-2010. The emphasis of the study will be to determine the average cost of treatment of children with Burkitt Lymphoma and to extrapolate its cost effectiveness.

Literature review:

Although cancer in children is rare, it is still the second highest cause of mortality in children in High income, Western countries. However, it is not even in the top 10 causes of death in middle and Low income African countries (1). Burkitt lymphoma, endemic to equatorial Africa (2), comprises 30 - 50% of paediatric cancers in these countries (3, 4).

In South-Africa, the incidence rate of BL in children (<15 years), is approximately 0.1 per 100000 per year (5). However, it is still one of the most common paediatric cancers in South Africa, comprising roughly 40% of lymphomas, which is ranked second most common cancer, behind leukemia (1, 5, and 6). Although there is a known association between HIV and Burkitt's lymphoma, the high prevalence of HIV has only caused a gradual rise in the incidence of paediatric BL in Africa(2,7), possibly attributable to the poor survival of African children born with HIV.

Burkitt's lymphoma is an aggressive form of B-cell; non-Hodgkin's Lymphoma (NHL) and divided by the WHO into 3 different clinical variants: endemic, sporadic and immunodeficiency associated.

- Endemic: Occurs in children from equatorial Africa and is highly associated with Epstein-Barr Virus (EBV). South Africa is not an endemic country.

- Sporadic: Accounts for 40-50% of childhood NHL.
- Immunodeficiency-associated: Occurs in patients infected with HIV, or other causes of immunosuppression (primary immunodeficiency, chronic immunosuppressive therapy, etc.). (8)

BL is a rapid growing tumor, that usually present primarily in the abdomen or head-and-neck(7,8) with a peak incidence in children aged 6-8 years and affects boys more common than girls(4,5,7). St Jude system for Non-Hodgkin's Lymphoma is used to stage BL. At diagnosis, most patients (60-70%) present with stage 3 diseases (4, 7). Untreated, BL leads to a 100% mortality rate, usually within 4-6 months (20). The long term cure rate for BL varies from <35% in Africa, using single or low dose chemotherapy agents and up to 90% in the first world setting, using high dose chemotherapy and providing optimal supportive care(4),. In SA, where the LMB=96 protocol is widely used, a recent retrospective study found a 77% cure rate in HIV negative patients. Once a 5 year survival is reached, BL has an extremely low relapse rate (17).

The LMB 96 treatment regime groups patients into 3 categories:

Group A comprises of Stage I and abdominal Stage II disease that is completely resectable. After resection this group receives two cycles of chemotherapy (COPAD).

Group B consists of patients with non-resectable disease in any stage, but with no central nervous system (CNS) involvement and less than 25% bone marrow (BM) involvement. These patients receive an initial cycle (COP), followed by 2 induction cycles (COPADM) and 2 consolidation cycles (CYM), but would be transferred to group C if they still have residual disease after the first consolidation cycle.

Group C consists of patients with CNS disease and/or BM involvement of greater than 25%. They receive initiation and induction cycles as above, with consolidation cycles (CYVE) and 4 maintenance cycles. Patients with CNS involvement also receive intra-thecal therapy as well as added Methotrexate between consolidation treatments. Over the last 10 years minimal changes have been made to the standardised protocol of managing children with Burkitt Lymphoma at Tygerberg Hospital.

Common complications during treatment include mucositis, infections, cytopenias, electrolyte disturbances and tumor lysis syndrome (22, 23).

As expected, HIV co-infection has been shown to have a significantly negative impact on survival, even though the objective tumour response to treatment appears similar (7, 13).

Life expectancy in South-Africa is 59.58 years (males 57, females 61)(14). As BL is an AIDS defining disease, the life expectancy for the HIV positive patients would be much poorer, even in the event of successful treatment and HAART initiation. During the last few years, due to advances in ARV therapy and early initiation of ARV's in all children under the age of 5 years, the life expectancy of HIV infected children are improving. In the USA,

the mean age at death for HIV-infected children improved from 8.9 years in 1994 to 18.2 years in 2006.

The Global Burden of Disease working group has set the Disability Weight for Non-Hodgkin's Lymphoma at 0.09(16). The South African Gross Domestic Product (GDP) per capita is $11600(18).

The treatment of Burkitt Lymphoma has been shown to be cost effective in Malawi(15), applying the WHO guide to cost effective analysis, but did not take HIV co-infection in account and to my knowledge, no such study has been done in South-Africa.

Study Question:

Does the cost of treating Burkitt lymphoma at Tygerberg Children's Hospital meet the calculated threshold of cost-effectiveness? This is defined as three times the South Africa's annual gross domestic product (GDP) per capita.

Research Question:

What is the monetary expense required to avert 1 Disability adjusted Life Year (DALY) of children with Burkitt lymphoma?

Aim, Objective and Impact:

This study will be a retrospective audit using the Tygerberg Children's Hospital tumour registry from 2005 to 2010 and selected patient's financial records.

The purpose of the study will be to review the data collected at Tygerberg Children's Hospital and then to document the incidence of Burkitt lymphoma, the age of presentation, race, gender, stage of presentation, amount of hospital admission days, chemotherapy, radiotherapy, surgery, outcome to date and associated costs of treatment.

The study will include the following information:

- Race; Gender
- Age at diagnosis
- Stage at diagnosis
- Number of days admitted to hospital. Number of outpatient appointments
- Complications
- Adjunctive treatment
- Chemotherapy; Radiotherapy; Surgery
- Outcome (Proportion of children who recover)
- Financial statements (where applicable)

Methodology

Study Design: A retrospective, descriptive study.

Inclusion criteria: All children diagnosed with Burkitt lymphoma at the Tygerberg Paediatric Oncology Unit from 2005 – 2010.

Data collection: Data will be obtained from the tumour registry of Tygerberg Children's Hospital, National Health Laboratory System (NHLS) data and Tygerberg Hospital department of finances.

Data will include: Race, age, gender, age at diagnosis, stage at diagnosis, treatment received, duration of hospital admissions, chemotherapy, radiotherapy, surgery, outcome to date and associated monetary expenses of treatment. Only direct medical costs associated with treating Burkitt's lymphoma will be used, which includes: costs of investigations; costs of hospital admissions during treatment period, costs of chemotherapy drugs and costs of follow-up care. Direct non-medical costs will not be included (transport costs, etc.) and neither would costs associated with loss of productivity of parents (due to illness of the children).

Program costs: Costs of central administration of intervention (planning and management of health system) and costs of developing interventions (training costs to achieve skills required to deliver intervention) will not be included in this research.

Cost data: Data of related direct healthcare costs of investigations and treatment for Burkitt's lymphoma will be obtained from Tygerberg Hospital's pharmacy, radiology and pathology departments, at 2010 tariffs. Overhead costs: Personnel costs and proportion of time they devote to managing patient and building costs (and proportion of space used) will also be included in calculations.

Costs of unrelated illnesses treated during admission period will not be included and neither will future costs arising in years of life gained, as this is beyond the scope of this research. Costs will be calculated in South African Rand (ZAR) and converted to US Dollar (USD) at an appropriate exchange rate (PPP rate). Costs will be adjusted for inflation using appropriate consumer price index (CPI), using 2010 as the base year.

Health outcomes: If information from the literature regarding disability weight and average duration of disability of Burkitt's lymphoma specific to South Africa is available, the total number of disability-adjusted life years (DALYs) due to Burkitt's lymphoma will be calculated. Using standard methods from the WHO Global Burden of Disease working group, the total number of DALY's due to Burkitt's Lymphoma are calculated by adding the years of life lost (YLL) due to ill health, disability or early death, with the years lived with disability (YLD). Years of life lost (YLL) without treatment is calculated by subtracting the estimated age at death without treatment from the standard life expectancy in South Africa, multiplied by the absolute annual number of cases of Burkitt's lymphoma. Years lived with disability (YLD) is calculated by multiplying the estimated duration of illness with and without treatment by the disability weight for Burkitt 's lymphoma (as set by the Global burden of Disease working group) and the incident number of cases.

Using the WHO-CHOICE framework for generalised cost-effectiveness to estimate the cost effectiveness of treating Burkitt lymphoma in South Africa. Cost-effectiveness is defined as the ratio of the monetary expense required to avert 1 DALY to the annual gross domestic product (GDP) per capita of South Africa. A ratio of 3:1 is considered cost effective and a ratio of 1:1 is considered very cost-effective. Thus if the cost to avert 1 Daly is equal or less than $34800 it is cost-effective to treat Burkitt Lymphoma and if it is $11600 or less it is regarded as very cost-effective.

Ethical points:

The project will be registered with the Health Research Ethics Committee of Stellenbosch, prior to collection of data. The principal investigator will collect all the relevant information from the file and complete a coded data sheet. The data will be collected anonymously using a study code; no patient identifying data will be used on the data-capturing sheet. Only the primary investigator will retain the patient identification log, as a separate document, in a secure location. This audit will not deviate from standard clinical practice.

Consent to pursue with the research will be obtained from the Superintendent of Tygerberg Children's' Hospital to access data mentioned above. I would like to request a waiver from obtaining individual informed consent.

Statistical analysis

Cost of treatment will be expressed in South African Rand and converted to US Dollars at the current exchange rate at the time of analysis. Mean cost of treatment per patient will be calculated. Confidence intervals will be calculated where applicable. A Statistician will oversee data analysis to ensure correct statistical methods.

Budget

All administrative costs will be carried by the principal investigator.

Time plan and logistics

Collection, evaluation and analysis of data will be performed by Dr C Kay.
Data will then be available to a statistician for statistical analysis.
Professional advice regarding health economical practises and evaluations will be obtained by a health economist. The project will be overseen by Prof C Stefan.

Time goals:
- Research protocol formulated: 2013

-Presentation to the postgraduate committee

- Submission to Ethics Committee and Chief Director, Tygerberg Hospital, for approval to perform research and access patient data: October 2013
- Collection of data completed: March 2014
- Data analysis: June 2014
- Presentation of findings by August 2014

Outcome measures:

Primary outcomes:

Calculate the true cost of treating a patient with Burkitt lymphoma, in South Africa.

Measure whether the cost of treating BL meets the threshold of established criteria for cost effectiveness.

Secondary outcomes:

Assess the perception that the management of paediatric cancer is a resource depleting financial burden.

Increase awareness of the need for economic evaluations and importance of cost effective management.

Appendix 2

UPFS Fee Schedule for H3 patients: 1 APRIL 2014

CODE	DESCRIPTION	BASIS	Professional Fee R	FACILITY FEE		
				LEVEL 1 R c	LEVEL 2 R c	LEVEL 3 R c
01	***Anaesthetics***					
0111	Anaesthetics Cat A – General medical practitioner	Procedure	122			
0112	Anaesthetics Cat A – Specialist medical practitioner	Procedure	183			
0121	Anaesthetics Cat B – General medical practitioner	Procedure	208			
0122	Anaesthetics Cat B – Specialist medical practitioner	Procedure	313			
0131	Anaesthetics Cat C – General medical practitioner	Procedure	730			
0132	Anaesthetics Cat C – Specialist medical practitioner	Procedure	1096			
02	***Confinement***					
0210	Natural Birth – Facility Fee	Incident	Free Services			
0211	Natural Birth – General medical practitioner	Incident				
0212	Natural Birth – Specialist medical practitioner	Incident				
0213	Natural Birth – Nursing practitioner	Incident				
0220	Caesarean Section – Facility Fee	Incident				
0221	Caesarean Section – General medical practitioner	Incident				
0222	Caesarean Section – Specialist medical practitioner	Incident				
03	***Dialysis***					
0310	Haemo – Facility Fee	Day		809	809	926
0311	Haemo-dialysis – General medical practitioner	Day	154			
0312	Haemo-dialysis – Specialist medical practitioner	Day	192			
0320	Peritoneal Dialysis – Facility Fee	Session		124	124	142
0321	Peritoneal Dialysis – General medical practitioner	Session	24			
0322	Peritoneal Dialysis – Specialist medical practitioner	Session	30			
0330	Plasmapheresis – Facility Fee	Day		809	809	926
0331	Plasmapheresis – General medical practitioner	Day	152			
0332	Plasmapheresis – Specialist medical practitioner	Day	191			
04	***Medical Reports***					
0410	Medical Report – Facility Fee	Report				
0411	Medical Report – General medical practitioner	Report		328	328	353
0412	Medical Report – Specialist medical practitioner	Report		443	443	468
0420	Copies Medical Report – Facility Fee	Copy				
0421	Copies of Medical Reports, records, X-Rays reports, completion of certificates / forms - General medical practitioner	Copy		221	221	246
0422	Copies of Medical Reports, records, X-Rays reports, completion of certificates / forms - Specialist medical practitioner	Copy		279	279	304
0425	Copies of X-Rays films, Ultrasounds etc.	Copy		221	221	246

05	***Imaging***					
0510	Radiology, Cat A – Facility Fee	Procedure		41	41	46
0511	Radiology, Cat A – General medical practitioner	Procedure	40			
0512	Radiology, Cat A – Specialist medical practitioner	Procedure	76			
0514	Radiology, Cat A – Allied health practitioner	Procedure	39			
0520	Radiology, Cat B – Facility Fee	Procedure		112	112	129
0521	Radiology, Cat B – General medical practitioner	Procedure	108			
0522	Radiology, Cat B – Specialist medical practitioner	Procedure	211			
0524	Radiology, Cat B – Allied health practitioner	Procedure	106			
0530	Radiology, Cat C – Facility Fee	Procedure		276	276	315
0531	Radiology, Cat C – General medical practitioner	Procedure	177			
0532	Radiology, Cat C – Specialist medical practitioner	Procedure	544			
0540	Radiology, Cat D – Facility Fee	Procedure		523	523	597
0541	Radiology, Cat D – General medical practitioner	Procedure	335			
0542	Radiology, Cat D – Specialist medical practitioner	Procedure	1 031			
0550	Radiology, Cat E – Facility Fee	Procedure		1 332	1 332	1 522
0551	Radiology, Cat E – General medical practitioner	Procedure	1 233			
0552	Radiology, Cat E – Specialist	Procedure	2 574			
06	***Inpatients***					
0620	Inpatient High care – Facility Fee	12 hours		642	803	1 151
0621	Inpatient High Care – General medical practitioner	12 hours	45			
0622	Inpatient High Care – Specialist medical practitioner	12 hours	85			
0630	Inpatient Intensive care – Facility Fee	12 hours		2 110	2 110	2 523
0631	Inpatient Intensive Care – General medical practitioner	12 hours	50			
0632	Inpatient Intensive Care– Specialist medical practitioner	12 hours	95			
0650	Day patient – Facility Fee	Day		345	435	638
0651	Day patient – General medical practitioner	Day	86			
0652	Day patient – Specialist medical practitioner	Day	150			
0653	Day patient – Nursing practitioner	Day	50			
0660	Inpatient Boarder – Facility Fee	12 hours		100	100	100
0663	Inpatient Boarder/Patient Companion – Nursing practitioner	12 hours	9			
0670	Inpatient General ward – Facility Fee	12 hours		208	265	499
0671	Inpatient General Ward – General medical practitioner	12 hours	43			
0672	Inpatient General Ward – Specialist medical practitioner	12 hours	75			
0673	Inpatient General Ward – Nursing medical practitioner (MOU)	12 hours	28			
0680	Inpatient Chronic care – Facility Fee	12 hours		122	122	122
0681	Inpatient Chronic care – General medical practitioner	12 hours	14			
0682	Inpatient Chronic care – Specialist medical practitioner	12 hours	32			
0683	Inpatient Chronic care – Nursing practitioner	12 hours	9			
07	***Mortuary***					
0710	Mortuary – Facility Fee	Day		106	106	120
0720	Cremation Certificate – Facility Fee	Certificate		106	106	120
08	***Pharmaceutical***					
0810	Medication Fee – Facility Fee	Prescription		19	19	22
0815	Item Fee	Item	Varies			
0816	Pharmaceutical - TTO	Item	Varies			
0817	Pharmaceutical - Chronic	Item	Varies			

09	*Oral Health (Hospitals) (contd)*					
0931	Oral Care Cat C – General practitioner	Procedure	473			
0932	Oral Care Cat C – Specialist practitioner	Procedure	812			
0940	Oral Care Cat D – Facility Fee	Procedure		1682	1682	1925
0941	Oral Care Cat D – General practitioner	Procedure	1452			
0942	Oral Care Cat D – Specialist practitioner	Procedure	2979			
0950	Oral Care Cat E – Facility Fee	Procedure		5666	5666	6475
0951	Oral Care Cat E – General practitioner	Procedure	4883			
0952	Oral Care Cat E – Specialist practitioner	Procedure	10019			
10	***Consultations***					
1010	Outpatient Consultation – Facility Fee	Visit		75	75	90
1011	Outpatient Consultation – General medical practitioner	Visit	83			
1012	Outpatient Consultation – Specialist medical practitioner	Visit	193			
1013	Outpatient Consultation – Nursing practitioner	Visit	48			
1014	Outpatient Consultation – Allied health practitioner	Visit	50			
1020	Emergency Consultation – Facility Fee	Visit		151	151	181
1021	Emergency Consultation – General medical practitioner	Visit	126			
1022	Emergency Consultation – Specialist medical practitioner	Visit	288			
1023	Emergency Consultation – Nursing practitioner	Visit	73			
1024	Emergency Consultation – Allied health practitioner	Visit	75			
11	***Minor Theatre Procedures***					
1110	Minor Procedure Cat A – Facility Fee	Procedure		356	356	427
1111	Minor Procedure Cat A – General medical practitioner	Procedure	124			
1112	Minor Procedure Cat A – Specialist medical practitioner	Procedure	237			
1120	Minor Procedure Cat B – Facility Fee	Procedure		356	356	427
1121	Minor Procedure Cat B – General medical practitioner	Procedure	182			
1122	Minor Procedure Cat B – Specialist medical practitioner	Procedure	413			
1130	Minor Procedure Cat C – Facility Fee	Procedure		356	356	427
1131	Minor Procedure Cat C – General medical practitioner	Procedure	287			
1132	Minor Procedure Cat C – Specialist medical practitioner	Procedure	645			
1140	Minor Procedure Cat D – Facility Fee	Procedure		356	356	427
1141	Minor Procedure Cat D – General medical practitioner	Procedure	758			
1142	Minor Procedure Cat D – Specialist medical practitioner	Procedure	1709			
12	***Major Theatre Procedures***					
1210	Theatre Procedure Cat A – Facility Fee	Procedure		1151	1686	1944
1211	Theatre Procedure Cat A – General medical practitioner	Procedure	124			
1212	Theatre Procedure Cat A – Specialist medical practitioner	Procedure	237			
1220	Theatre Procedure Cat B – Facility Fee	Procedure		1741	2556	2942
1221	Theatre Procedure Cat B – General medical practitioner	Procedure	182			
1222	Theatre Procedure Cat B – Specialist medical practitioner	Procedure	413			
1230	Theatre Procedure Cat C – Facility Fee	Procedure		2992	4390	5066
1231	Theatre Procedure Cat C – General medical practitioner	Procedure	287			
1232	Theatre Procedure Cat C – Specialist medical practitioner	Procedure	645			
1240	Theatre Procedure Cat D – Facility Fee	Procedure		7672	11253	12968
1241	Theatre Procedure Cat D – General medical practitioner	Procedure	758			
1242	Theatre Procedure Cat D – Specialist medical practitioner	Procedure	1709			
13	***Treatments***					
1310	Supplementary Health Treatment – Facility Fee	Contact		48	48	58
1313	Supplementary Health Treatment – Nursing practitioner	Contact	42			
1314	Supplementary Health Treatment – Allied health practitioner	Contact	42			
1320	Supplementary Health Group Treatment – Facility Fee	Contact		38	38	41
1324	Supplementary Health Group Treatment – Allied health practitioner	Contact	29			

08	***Pharmaceutical (contd.)***					
0818	Pharmaceutical – Oncology	Item	Varies			
0819	Pharmaceutical – Immune suppressant drugs	Item	Varies			
09	***Oral Health* (Hospitals)**					
0910	Oral Care Cat A – Facility Fee	Procedure		16	16	18
0911	Oral Care Cat A – General practitioner	Procedure	27			
0912	Oral Care Cat A – Specialist practitioner	Procedure	22			
0914	Oral Care Cat A – Allied health practitioner	Procedure	21			
0920	Oral Care Cat B – Facility Fee	Procedure		48	48	55
0921	Oral Care Cat B – General practitioner	Procedure	52			
0922	Oral Health Cat B – Specialist practitioner	Procedure	84			
0924	Oral Care Cat B – Allied health practitioner	Procedure	43			
0930	Oral Care Cat C – Facility Fee	Procedure		292	292	334
0931	Oral Care Cat C – General practitioner	Procedure	323			
0932	Oral Care Cat C – Specialist practitioner	Procedure	555			
0940	Oral Care Cat D – Facility Fee	Procedure		1 149	1 149	1 314
0941	Oral Care Cat D – General practitioner	Procedure	991			
0942	Oral Care Cat D – Specialist practitioner	Procedure	2 034			
0950	Oral Care Cat E – Facility Fee	Procedure		3 868	3 868	4 421
0951	Oral Care Cat E – General practitioner	Procedure	3 333			
0952	Oral Care Cat E – Specialist practitioner	Procedure	6 840			
10	***Consultations***					
1010	Outpatient Consultation – Facility Fee	Visit		51	51	62
1011	Outpatient Consultation – General medical practitioner	Visit	57			
1012	Outpatient Consultation – Specialist medical practitioner	Visit	132			
1013	Outpatient Consultation – Nursing practitioner	Visit	33			
1014	Outpatient Consultation – Allied health practitioner	Visit	35			
1020	Emergency Consultation – Facility Fee	Visit		104	104	123
1021	Emergency Consultation – General medical practitioner	Visit	86			
1022	Emergency Consultation – Specialist medical practitioner	Visit	197			
1023	Emergency Consultation – Nursing practitioner	Visit	50			
1024	Emergency Consultation – Allied health practitioner	Visit	51			
11	***Minor Theatre Procedures***					
1110	Minor Procedure Cat A – Facility Fee	Procedure		243	243	291
1111	Minor Procedure Cat A – General medical practitioner	Procedure	84			
1112	Minor Procedure Cat A – Specialist medical practitioner	Procedure	162			
1120	Minor Procedure Cat B – Facility Fee	Procedure		243	243	291
1121	Minor Procedure Cat B – General medical practitioner	Procedure	124			
1122	Minor Procedure Cat B – Specialist medical practitioner	Procedure	282			
1130	Minor Procedure Cat C – Facility Fee	Procedure		243	243	291
1131	Minor Procedure Cat C – General medical practitioner	Procedure	196			
1132	Minor Procedure Cat C – Specialist medical practitioner	Procedure	440			
1140	Minor Procedure Cat D – Facility Fee	Procedure		243	243	291
1141	Minor Procedure Cat D – General medical practitioner	Procedure	518			
1142	Minor Procedure Cat D – Specialist medical practitioner	Procedure	1166			
12	***Major Theatre Procedures***					
1210	Theatre Procedure Cat A – Facility Fee	Procedure		785	1 151	1 328
1211	Theatre Procedure Cat A – General medical practitioner	Procedure	84			
1212	Theatre Procedure Cat A – Specialist medical practitioner	Procedure	162			

12	***Major Theatre Procedures** (contd.)*					
1220	Theatre Procedure Cat B – Facility Fee	Procedure		1 189	1 744	2 009
1221	Theatre Procedure Cat B – General medical practitioner	Procedure	124			
1222	Theatre Procedure Cat B – Specialist medical practitioner	Procedure	282			
1230	Theatre Procedure Cat C – Facility Fee	Procedure		2 042	2 997	3 459
1231	Theatre Procedure Cat C – General medical practitioner	Procedure	196			
1232	Theatre Procedure Cat C – Specialist medical practitioner	Procedure	440			
1240	Theatre Procedure Cat D – Facility Fee	Procedure		5 238	7 683	8 855
1241	Theatre Procedure Cat D – General medical practitioner	Procedure	518			
1242	Theatre Procedure Cat D – Specialist medical practitioner	Procedure	1 166			
13	***Treatments***					
1310	Supplementary Health Treatment – Facility Fee	Contact		33	33	39
1313	Supplementary Health Treatment – Nursing practitioner	Contact	29			
1314	Supplementary Health Treatment – Allied health practitioner	Contact	29			
1320	Supplementary Health Group Treatment – Facility Fee	Contact		25	25	28
1324	Supplementary Health Group Treatment – Allied health practitioner	Contact	21			
14	***Emergency Medical Services***					
1410	Patient transport service – Facility Fee	100km		218	218	218
1420	Basic life support – Facility Fee	50km		595	595	595
1430	Intermediate life support – Facility Fee	50km		804	804	804
1440	Advanced life support – Facility Fee	50km		1 336	1 336	1 336
1450	Emergency service standby – Facility Fee	Once-off fee		422	422	422
1451	Emergency service standby – General medical practitioner	Hour	567			
1452	Emergency service standby – Specialist medical practitioner	Hour	763			
1453	Emergency service standby – Nursing practitioner	Hour	322			
1455	Emergency service standby – Emergency care practitioner (basic)	Hour	133			
1456	Emergency service standby – Emergency care practitioner (intermediate)	Hour	203			
1457	Emergency service standby – Emergency care practitioner (advanced)	Hour	356			
1490	Emergency service standby – Facility Fee	Additional 50km		195	195	195
1460	Rescue – Facility Fee	Incident		637	637	637
1461	Rescue – General medical practitioner	Incident	955			
1462	Rescue – Specialist medical practitioner	Incident	1 432			
1463	Rescue – Nursing practitioner	Incident	637			
1465	Rescue – Basic life support practitioner	Incident	88			
1466	Rescue – Intermediate life support practitioner	Incident	109			
1467	Rescue – Advanced life support practitioner	Incident	233			
1470	Emergency transport air services fixed wing	50km		1 336	1 336	1 336
1480	Emergency transport air services helicopter	50km		1 336	1 336	1 336
15	***Assistive Devices & Prosthesis***					
1510	Assistive Devices - Item Fee	Item	Varies			
1520	Prosthetic Devices – Item Fee	Item	Varies			
1530	Dental Items – Item Fee	Item	Varies			
1540	Assistive Devices – Repairs to item	Item	Varies			

16	***Cosmetic Surgery***					
1610	Cosmetic Surgery Cat A – Facility Fee	Procedure		2421	2421	2766
1611	Cosmetic Surgery Cat A – General practitioner	Procedure	1396			
1612	Cosmetic Surgery Cat A – Specialist practitioner	Procedure	2091			
1620	Cosmetic Surgery Cat B – Facility Fee	Procedure		5444	5444	6223
1621	Cosmetic Surgery Cat B – General practitioner	Procedure	1654			
1622	Cosmetic Surgery Cat B – Specialist practitioner	Procedure	2481			
1630	Cosmetic Surgery Cat C – Facility Fee	Procedure		8792	8792	10050
1631	Cosmetic Surgery Cat C – General practitioner	Procedure	2796			
1632	Cosmetic Surgery Cat C – Specialist practitioner	Procedure	4194			
1640	Cosmetic Surgery Cat D – Facility Fee	Procedure		14853	14853	16974
1641	Cosmetic Surgery Cat D – General practitioner	Procedure	3137			
1642	Cosmetic Surgery Cat D – Specialist practitioner	Procedure	4616			
17	***Laboratory Services***					
1700	Drawing of Blood	Per Contact		19	19	19
1710	Laboratory Tests	Varies				
18	***Radiation Oncology***					
1800	Radiation Oncology (NHRPL less VAT)	Procedure	Varies			
19	***Nuclear Medicine***					
1900	*Itemisation of Radiopharmaceuticals (Isotopes)*	Item	Varies			
1910	Nuclear Medicine Cat A – Facility Fee	Procedure		393	393	393
1912	Nuclear Medicine Cat A – Specialist practitioner	Procedure	196			
1920	Nuclear Medicine Cat B – Facility Fee	Procedure		393	393	393
1922	Nuclear Medicine Cat B – Specialist practitioner	Procedure	588			
1930	Nuclear Medicine Cat C – Facility Fee	Procedure		393	393	393
1932	Nuclear Medicine Cat C – Specialist practitioner	Procedure	1176			
1940	Nuclear Medicine Cat D – Facility Fee	Procedure		393	393	393
1942	Nuclear Medicine Cat D – Specialist practitioner	Procedure	1764			
1950	Positron Emission Tomography (PET) Cat E – Facility Fee	Procedure		721	721	721
1952	Positron Emission Tomography (PET) Cat E – Specialist practitioner	Procedure	2163			
20	***Ambulatory Procedures***					
2010	Ambulatory Procedure Cat A – Facility Fee	Procedure		78	78	95
2011	Ambulatory Procedure Cat A – General Medical Practitioner	Procedure	28			
2012	Ambulatory Procedure Cat A – Specialist Medical Practitioner	Procedure	56			
2013	Ambulatory Procedure Cat A – Nursing Practitioner	Procedure	17			
2014	Ambulatory Procedure Cat A – Allied Health Worker	Procedure	17			
2020	Ambulatory Procedure Cat B – Facility Fee	Procedure		78	78	95
2021	Ambulatory Procedure Cat B – General Medical Practitoner	Procedure	40			
2022	Ambulatory Procedure Cat B – Specialist Medical Practitioner	Procedure	62			
2023	Ambulatory Procedure Cat B – Nursing Practitioner	Procedure	22			
2024	Ambulatory Procedure Cat B – Allied Health Worker	Procedure	22			
21	***Blood and Blood Products***					
2100	Blood and Blood Products	Itemisation				
22	***Hyperbaric Oxygen Therapy***					
2200	Hyperbaric Oxygen Therapy	Per Hour/Part thereof		270	270	270
23	***Consumables (Not included in Facility Fee)***					
2300	Consumables not included in the facility fee	Item	Varies			

24	*Autopsies*					
2410	Autopsy – Facility Fee	Per Case		51	51	62
2411	Autopsy – General medical practitioner	Per Case	57			
2412	Autopsy – Specialist medical practitioner	Per Case	132			

NOTE: (1) Interest will be charged on overdue invoices
(2) Legal costs incurred and
(3) Any ancillary costs which may be levied by third parties may also be added

Appendix 3

UPFS RADIOLOGY CODE BOOK

		Ana	P	I
	X-ray skeletal survey under five years (00110)			**B**
	X-ray skeletal survey over five years (00115)			**B**
	X-ray sinogram any region (00120)			**B**
	X-ray with mobile unit in other facility (00130)			**A**
	X-ray control view in theatre any region (00135)			**A**
	X-ray fluoroscopy any region (00140)			**A**
	X-ray fluoroscopy guidance for biopsy, any region (00145)			**B**
	X-ray C-Arm (equipment fee only, not procedure) per half hour (00150)			**A**
	X-ray C-arm fluoroscopy in theatre per half hour (procedure only) (00155)			**A**
	X-ray fixed theatre installation (equipment fee only) (00160)			**A**
	X-ray examination contrast material (00190)			**Vary**
	Ultrasound with mobile unit in other facility (00210)			**A**
	Ultrasound intra-operative study (00220)	**A**		**B**
	Ultrasound guidance (00230)			**C**
	Ultrasound guidance for tissue ablation (00240)			**C**
	Ultrasound limited Doppler study any region (00250)			**B**
	CT planning study for radiotherapy (00310)			**D**
	CT guidance (separate procedure) (00320)			**C**
	CT guidance, with diagnostic procedure (00330)			**C**
	CT guidance and monitoring for tissue ablation (00340)			**D**
	CT examination contrast material (00390)			**Vary**
	MR study of the whole body for metastases screening			
(00410)	**B**		**E**	
	MR Spectroscopy any region (00420)			
	B		**D**	
	MR guidance for needle replacement (00430)	**B**		**D**
	MR low field strength imaging of peripheral joint any region (00440)	**B**		**B**
	MR planning study for radiotherapy or surgical procedure (00450)			**D**
	MR planning study for radiotherapy or surgical procedure, with contrast (00455)			**D**
	Analogue monoplane screening table (00510)			**D**
	Analogue monoplane table with DSA attachment (00520)			**D**
	Dedicated angiography suite: Analogue monoplane unit. Once off charge per patient by owner of equipment (00530)			**D**
	Digital monoplane screening table (00540)			**E**
	Dedicated angiography suite: Digital monoplane unit. Once off charge per patient by owner of equipment (00550)			**E**
	Dedicated angiography suite: Digital bi-plane unit. Once off charge per patient by owner of equipment (00560)			**E**
	Angiography and interventional examination contrast material (00590)			**Vary**
	Skull and Brain			
	X-ray of the skull (10100)			**A**
	X-ray tomography of the skull (10110)			**B**
	X-ray shuntogram for VP shunt (10120)			**C**
	Ultrasound of the brain – Neonatal (10200)	**A**		**B**
	Ultrasound of the brain including Doppler (10210)			**C**
	Ultrasound of the intracranial vasculature, including B mode, pulse and colour Doppler (10220)			**C**
	CT Brain uncontrasted (10300)	**B**		**D**
	CT Brain with contrast only (10310)	**B**		**D**
	CT Brain pre and post contrast (10320)	**B**		**D**
	CT brain pre and post contrast for perfusion studies (10325)	**B**		**D**
	CT angiography of the brain (10330)	**B**		**E**
	CT of the brain pre and post contrast with angiography (10335)	**B**		**E**
	CT brain for cranio-stenosis including 3D (10340**)**	**B**		**D**
	CT Brain stereotactic localization (10350)	**B**		**C**
	CT base of skull coronal high resolution study for CSF leak (10360)	**B**		**D**
	MR of the brain, limited study (10400)	**B**		**D**
	MR of the brain uncontrasted (10410)	**B**		**E**
	MR of the brain with contrast (10420)	**B**		**E**
	MR of the brain pre and post contrast (10430)	**B**		**E**
	MR of the brain pre and post contrast, for perfusion studies (10440)	**B**		**E**
	MR of the brain plus angiography (10450)	**B**		**E**
	MR of the brain pre and post contrast plus angiography (10460)	**B**		**E**
	MR angiography of the brain uncontrasted (10470)	**B**		**E**
	MR angiography of the brain contrasted (10480)	**B**		**E**
	MR of the brain, with diffusion studies(10485)	**B**		**E**
	MR of the brain, pre and post contrast, with diffusion studies, (10490)	**B**		**E**
	MR study of the brain plus angiography plus diffusion, uncontrasted (10492)	**B**		**E**
	MR of the brain pre and post contrast plus angiography and diffusion (10495)	**B**		**E**
	Arteriography of intracranial vessels: 1 - 2 vessels (10500)	**B**		**D**
	Arteriography of intracranial vessels: 3 - 4 vessels (10510)	**B**		**E**
	Arteriography of extra-cranial (non-cervical) vessels (10520)	**B**		**D**
	Arteriography of intracranial and extra-cranial (non-cervical) vessels (10530)	**B**		**E**
	Arteriography of intracranial vessels (4) plus 3 D rotational angiography (10540)	**B**		**E**
	Arteriography of intracranial vessels (1) plus 3D rotational angiography (10550)	**B**		**D**

Venography of dural sinuse (10560)	B		D

	Ana	P	I
Facial bones and nasal bones			
X-ray of the facial bones (11100)			A
X-ray tomography of the facial bones (11110)			B
X-ray of the nasal bones (11120)			A
CT of the facial bones (11300)	B		D
CT of the facial bones with 3D reconstructions (11310)	B		D
CT of the facial bones/soft tissue, pre and post contrast (11320)	B		D
MR of the facial soft tissue (11400)	B		E
MR of the facial soft tissue pre and post contrast (11410)	B		E
MR of the facial soft tissue plus angiography, with contrast (11420)	B		E
MR angiography of the facial soft tissue (11430)	B		E
Orbits, lacrimal glands and tear ducts			
X-ray orbits less than three views (12100)			A
X-ray of the orbits, three or more views, including foramina (12110)			B
X-ray of the orbits for foreign body (12120)			A
X-ray tomography of the orbits (12130)			B
X-ray dacrocystography (12140)	B		A
Ultrasound of the orbit/eye (12200)			B
Ultrasound of the orbit/eye including Doppler (12210)			C
CT of the orbits single plane (12300)	B		C
CT of the orbits, more than one plane (12310)	B		D
CT of the orbits pre and post contrast single plane (12320)	B		D
CT of the orbits pre and post contrast multiple planes (12330)	B		D
MR of the orbits (12400)	B		E
MR of the orbitae, pre and post contrast (12410)	B		E
Paranasal sinuses			
X-ray of the paranasal sinuses, single view (13100)			A
X-ray of the paranasal sinuses, two or more views (13110)			A
X-ray tomography of the paranasal sinuses (13120)			B
X-ray of the naso-pharyngeal soft tissue (13130)			A
CT of the paranasal sinuses single plane, limited study (13300)	B		B
CT of the paranasal sinuses, two planes, limited study (13310)	B		C
CT of the paranasal sinuses, any plane, complete study (13320)	B		C
CT of the paranasal sinuses, more than one plane, complete study (13330)	B		D
CT of the paranasal sinuses, any plane, complete study: pre and post contrast (13340)	B		D
CT of the paranasal sinuses, more than one plane, complete study; pre and post contrast (13350)	B		D
MR of the paranasal sinuses (13400)	B		E
MR of the paranasal sinuses, pre and post contrast (13410)	B		E
Mandible, teeth and maxilla			
X-ray of the mandible(14100)			A
X-ray orthopantomogram of the jaws and teeth (14110)			A
X-ray maxillofacial cephalometry (14120)	A		A
X-ray of the teeth single quadrant (14130)			A
X-ray of the teeth more than one quadran (14140)			A
X-ray of the teeth full mouth (14150)			A
X-ray tomography of the teeth per side (14160)			A
CT of the mandible (14300)			D
CT of the mandible, pre and post contrast (14310)			D
CT mandible with 3D reconstructions (14320)			D
CT for dental implants in the mandible (14330)			D
CT for dental implants in the maxilla (14340)			D
MR of the mandible/maxilla (14400)	B		E
MR of the mandible/maxilla, pre and post contrast (14410)	B		E
TM Joints			
X-ray tempero-mandibular joint, left (15100)			A
X-ray tempero-mandibular joint, right (15110)			A
X-ray tomography tempero-mandibular joint, left (15120)			A
X-ray tomography tempero-mandibular joint, right (15130)			A
X-ray arthrography of the tempero-mandibular joint, left (15140)	A		A
X-ray arthrography of the tempero-mandibular joint, right (15150)	A		A
Ultrasound tempero-mandibular joints, one or both sides (15200)	A		B
CT of the tempero-mandibular joints (15300)	B		D
CT of the tempero-mandibular joints plus 3D reconstructions (15310)	B		D

CT arthrogram of the tempero-mandibular joints (15320)	**B**		**D**
MR of the tempero-mandibular joints (15400)	**B**		**E**
MR of the tempero-mandibular joints, pre and post contrast (15410)	**B**		**E**
MR arthrogram of the tempero-mandibular joints (15420)	**B**		**E**
Mastoids and internal auditory canal			
X-ray of the mastoids, unilateral(16100)			**A**
X-ray of the mastoids, bilateral(16110)			**B**
X-ray tomography of the petro-temporal bone, unilaterall (16120)			**A**
X-ray tomography of the petro-temporal bone, bilateral (16130)			**A**
X-ray internal auditory canal, bilateral (16140)			**B**
X-ray tomography of the internal auditory canal, bilateral (16150)			**B**
CT of the mastoids (16300)	**B**		**B**
CT of the internal auditory canal (16310)	**B**		**D**
CT of the internal auditory canal, pre and post contrast (16320)	**B**		**D**
CT of the ear structures, limited study (16330)	**B**		**B**

	Ana	P	I
CT of the middle and inner ear structures, high definition including all reconstructions in various planes (16340)	**B**		**D**
MR of the internal auditory canals, limited study (16400)	**B**		**D**
MR of the internal auditory canals, pre and post contrast, limited study (16410)	**B**		**E**
MR of the internal auditory canals, pre and post contrast, complete study (16420)	**B**		**E**
MR of the ear structures (16430)	**B**		**E**
MR of the ear structures, pre and post contrast (16440)	**B**		**E**
Sella turcica			
X-ray of the sella turcica (17100)			**A**
X-ray tomography of the sella turcica (17110)			**B**
CT of the sella turcica/hypophysis (17300)	**B**		**C**
CT of the sella turcica/hypophysis, pre and post contrast (17310)	**B**		**D**
MR of the hypophysis (17400)	**B**		**D**
MR of the hypophysis, pre and post contrast (17410)	**B**		**E**
Salivary glands and floor of the mouth			
X-ray of the salivary glands and ducts for calculus (18100)			**A**
X-ray of the salivary glands and ducts for calculus (18110)			**A**
X-ray sialography, per gland (18120)			**A**
Ultrasound of the salivary glands/floor of the mouth (18200)			**B**
CT of the salivary glands, uncontrasted (18300)	**B**		**C**
CT of the salivary glands/floor of the mouth, pre and post contrast (18310)	**B**		**D**
CT sialography (18320)	**B**		**D**
MR of the salivary glands/floor of the mouth (18400)	**B**		**E**
MR of the salivary glands/floor of the mouth, pre and post contrast (18410)	**B**		**E**
Neck			
X-ray of soft tissue of the neck (20100)			**A**
X-ray of the larynx including tomography (20110)			**A**
X-ray laryngography (20120)			**A**
X-ray evaluation of pharyngeal movement and speech by screening and / or cine with or without video recording (20130)			**C**
Ultrasound of the thyroid (20200)			**B**
Ultrasound of soft tissue of the neck (20210)			**B**
Ultrasound of the carotid arteries, bilateral including B mode, pulsed and colour Dopple r(20220)	**B**		**B**
Ultrasound of the entire extracranial vascular tree including carotids, vertebral and subclavian vessels with B mode, pulse and colour Doppler (20230)	**B**		**D**
Ultrasound study of the venous system of the neck including pulse and colour Doppler (20240)	**B**		**B**
CT of the soft tissues of the neck (20300)	**B**		**C**
CT of the soft tissues of the neck, with contrast (20310)	**B**		**D**
CT of the soft tissues of the neck, pre and post contrast (20320)	**B**		**D**
CT angiography of the extracranial vessels in the neck (20330)	**B**		**E**
CT angiography of the extracranial vessels in the neck and intracranial vessels of the brain (20340)	**B**		**E**
CT angiography of the extracranial vessels in the neck and intracranial vessels of the brain plus a pre and post contrast study of the brain (20350)	**B**		**E**
MR of the soft tissue of the neck (20400)	**B**		**E**
MR of the soft tissue of the neck, pre and post contrast (20410)	**B**		**E**
MR of the soft tissue of the neck and uncontrasted angiography (20420)	**B**		**E**

MR angiography of the extracranial vessels in the neck, without contrast (20430)	B	E
MR angiography of the extracranial vessels in the neck, with contrast (20440)	B	E
MR angiography of the extra and intracranial vessels with contrast (20450)	B	E
MR angiography of the intra and extra cranial vessels plus brain, without contrast (20460)	B	E
MR angiography of the intra and extra cranial vessels plus brain, with contrast (20470)	B	E
Arteriography of cervical vessels: carotid 1 - 2 vessels (20500)	B	D
Arteriography of cervical vessels: vertebral 1 - 2 vessels (20510)	B	D
Arteriography of cervical vessels: carotid and vertebral (20520)	B	E
Arteriography of aortic arch and cervical vessels (20530)	B	E
Arteriography of aortic arch, cervical and intracranial vessels (20540)	B	E
Venography of jugular and vertebral veins (20550)	B	D

Thorax

Chest wall, pleura, lungs and mediastinum

X-ray of the chest, single view (30100)		A
X-ray of the chest two views, PA and lateral (30110)		B
X-ray of the chest complete with additional views (30120)		B
X-ray of the chest complete including fluoroscopy (30130)		B
X-ray tomography of the chest (30140)		B
X-ray of the ribs (30150)		A
X-ray of the chest and ribs (30155)		B
X-ray of the thoracic inlet (30160)		A
X-ray of the sterno-clavicular joints (30170)		A
X-ray tomography of the sterno-clavicular joint (30175)		B
X-ray of the sternum (30180)		A
X-ray tomography of the sternum (30185)		B
Ultrasound of the chest wall, any region (30200)		B
Ultrasound of the pleural space (30210)		B
Ultrasound of the mediastinal structures (30220)		B
CT of the chest, limited study (30300)	B	B

	Ana	P	I
CT of the chest uncontrasted (30310)	B		D
CT of the chest contrasted (30320)	B		D
CT of the chest, pre and post contrast (30330)	B		D
CT of the chest, limited high resolution study (30340)	B		B
CT of the chest, complete high resolution study (30350)	B		D
CT of the chest, complete high resolution study with additonal prone and expiratory studies (30355)	B		D
CT of the chest for pulmonary embolism (30360)	B		E
CT of the chest for pulmonary embolism with CT venography of abdomen, pelvis and lower limbs (30370)	B		E
MR of the chest (30400)	B		E
MR of the chest with uncontrasted angiography (30410)	B		E
MR of the chest, pre and post contrast (30420)	B		E

Oesophagus

X-ray barium swallow (31100)	A	B
Xray 3 phase dynamic contrasted swallow (31105)	B	C
X-ray barium swallow, double contrast (31110)	B	C
X-ray barium swallow with cinematography (31120)	B	C

Aorta and large vessels

Ultrasound intravascular arterial or venous assessment for intervention, once per complete procedure (32200)	B	B
Ultrasound intravascular (IVUS) first vessel (32210)	B	B
Ultrasound intravascular (IVUS) subsequent vessels (32220)	B	B
CT angiography of the aorta and branches (32300)	B	E
CT angiography of the thoracic and abdominal aorta and branches (32305)	B	E
CT angiography of the pulmonary vasculature (32310)	B	E

aorta and branches (32400)	B		E
MR angiography of the pulmonary vasculature (32410)	B		E
Arteriography of thoracic aorta (32500)	B		D
Arteriography of bronchial intercostal vessels alone (32510)	B		D
Arteriography of thoracic aorta, bronchial and intercostal vessels (32520)	B		E
Arteriography of pulmonary vessels (32530)	B		E
Arteriography of heart chambers, coronary arteries (32540)	B		D
Venography of thoracic vena cava (32550)	A		D
Venography of vena cava, azygos system (32560)	A		E
Venography patency of A-port or other central line (32570)	A		C
Heart			
Ultrasound study of the heart for foetal or paediatric cases including Doppler (33205)	B		C
Ultrasound study of the heart, including Doppler (33200)			B
Ultrasound study of the heart trans-oesophageal (33210)			B
Ultrasound intravascular imaging to guide placement of intracoronary stent once per vessel (33220)	B		B
		CT	
anatomical/functional study of the heart (33300)	B		D
CT angiography of heart vessels (33310)	B		E
MR of the heart, anatomical study (33400)	B		E
MR of the heart, anatomical and functional study (33410)	B		E
MR of the heart, pre and post contrast (33420)	B		E
MR angiography of the heart vessels (33430)	B		E
MR of the heart, anatomical, functional and coronary angiography (33440)	B		E
Mamma			
X-ray mammography including ultrasound (34100)			B
X-Ray mammography unilateral, including ultrasound (34101)			B
X-ray mammography galactography (34105)			C
X-ray mammography study for localization (34110)			B
X-ray stereotactic mammography – localization (34120)			C
X-ray stereotactic mammography – biopsy (34130)	B		B
X-ray of biopsy specimen of the mamma (34140)			A
X-ray Mammotome hand held biopsy apparatus (34150)			C
Ultrasound study of the breast (34200)			B
Ultrasound guided aspiration FNA/localisation of the breast (34205)	B		B
Computer assisted diagnosis for mammography (34300)			A
MR study of the breast (34400)	B		E
MR study of the breast pre and post contrast (34410)	B		E
Abdomen and Pelvis			
Abdomen/stomach/bowel			
X-ray of the abdomen (40100)			A
X-ray of the abdomen supine and erect, or decubitus (40105)			B
X-ray of the abdomen multiple views including chest (40110)			C
X-ray tomography of the abdomen (40120)			B
X-ray barium meal single contrast (40140)			B
X-ray barium meal double contrast (40143)			C
X-ray barium meal double contrast with follow through (40147)			C
X-ray small bowel enteroclysis (meal) (40150)			B
X-ray small bowel meal follow through single contrast (40153)			C
X-ray small bowel meal with pneumocolon (40157)			D
	Ana	**P**	**I**
X-ray large bowel enema single contrast (40160)			B
X-ray large bowel enema double contrast (40165)			C
X-ray guided gastro oesophageal intubation (40170)			A
X-ray guided duodenal intubation (40175)			A
X-ray defaecogram (40180)			B
X-ray guided reduction of intussusception (40190)			B
Ultrasound study of the abdominal wall (40200)			B
Ultrasound study of the whole abdomen including the pelvis (40210)			B
CT study of the abdomen (40300)	B		D
CT study of the abdomen with contrast (40310)	B		D
CT study of the abdomen pre and post contrast (40313)	B		D
CT of the pelvis (40320)	B		D
CT of the pelvis with contrast (40323)	B		D
CT of the pelvis pre and post contrast (40327)	B		D
CT of the abdomen and pelvis (40330)	B		D
CT of the abdomen and pelvis with contrast (40333)	B		D
CT of the abdomen and pelvis pre and post contrast (40337)	B		D
CT triphasic study of the liver, abdomen and pelvis pre and post contrast (40340)	B		D
CT of the chest, abdomen and pelvis without contrast (40345)	B		D
CT of the chest, abdomen and pelvis with contrast (40350)	B		D

CT of the chest triphasic of the liver, abdomen and pelvis with contrast (40355)	B	E
CT of the base of skull to symphysis pubis with contrast (40360)	B	E
CT colonoscopy (40365)	B	D
MR of the abdomen (40400)	B	E
MR of the abdomen pre and post contrast (40410)	B	E
MR of the pelvis, soft tissue (40420)	B	E
MR of the pelvis, soft tissue, pre and post contrast (40430)	B	E
Liver, spleen, gall bladder and pancreas		
X-ray ERCP including screening (41100)	B	B
X-ray cholangiography intra-operative (41110))	B	B
X-ray T-tube cholangiography post operative (41120)	B	B
X-ray transhepatic percutaneous cholangiography (41130)	B	B
Ultrasound study of the upper abdomen (41200)		B
Ultrasound doppler of the hepatic and splenic veins and inferior vena cava in assessment of portal venous hypertension or thrombosis (41210)	B	C
CT of the abdomen triphasic study – liver (41300)	B	D
MR study of the liver/pancreas (41400)	B	E
MR study of the liver/pancreas pre and post contrast (41410)	B	E
MRCP (41420)	B	D
MR study of the abdomen with MRCP (41430)	B	E
MR study of the abdomen pre and post contrast with MRCP (41440)	B	E
Renal tract		
X-ray tomography of the renal tract (42100)		B
X-ray excretory urogram including tomography (42110)		B
X-ray excretory urogram including tomography with micturating study (42115)		B
X-ray cystography (42120)		B
X-ray urethrography (42130)		B
X-ray micturating cysto-urethrography (42140)		B
X-ray retrograde/prograde pyelography (42150)	A	B
X-ray prograde pyelogram – percutaneous (42160)	A	D
Ultrasound study of the renal tract including bladder (42200)		B
Ultrasound doppler for resistive index in vessels of transplanted kidney (42205)		B
Ultrasound study of the renal arteries including Doppler (42210)		C
CT of the renal tract for a stone (42300)	B	D
MR of the renal tract for obstruction (42400)	B	D
MR of the kidneys without contrast (42410)	B	E
MR of the kidneys pre and post contrast (42420)	B	E
Reproductive system		
X-ray pelvimetry single (43100)		B
X-ray pelvimetry multiple views (43110)		B
X-ray hystero-salpingography (43120)	A	A
X-ray hystero-salpingography with introduction of contrast (43130)	A	C
Ultrasound study of the pelvis transabdominal (43200)		B
Ultrasound study of the female pelvis transvaginal (43205)		B
Ultrasound study of the prostate transrectal (43210)	B	B
Ultrasound transrectal prostate volume for brachytherapy (43215)	B	B
Ultrasound study of the testes (43220)		B
Ultrasound study for male impotence including doppler and injection of vaso contrictor (43225)	A	C
Ultrasound guided transvaginal aspiration for ova (43230)	B	B
Ultrasound guided amniocenthesis (43240)	B	B
Ultrasound study of the pregnant uterus, first trimester (43250)		B
Ultrasound study of the pregnant uterus, second trimester (43260)		B
Ultrasound study of the pregnant uterus, third trimester, first visit (43270)		B
Ultrasound study of the pregnant uterus, third trimester, follow-up visit (43273)		B
Ultrasound study of the pregnant uterus, multiple gestation, second or third trimester, first visit (43277)		C

	Ana	P	I
Ultrasound doppler of the umbilical cord for resistive index (43280)			B
CT pelvimetry – Topogram (43300)			B
MR study of pelvic reproductive organs - limited study (43400)	B		D
(43405) **B** MR study for pelvimetry		**D**	
MR study of pelvic reproductive organs - complete – uncontrasted (43410)	B		C
MR study of pelvic reproductive organs - complete – pre and post contrast (43420)	B		E
Aorta and vessels			
Ultrasound study of abdominal aorta and branches including Doppler (44200)			C
Ultrasound study of the IVC and pelvic veins including Doppler (44205)			C
CT angiography of abdominal aorta and branches (44300)	B		E
CT angiography of the abdominal aorta and branches and pre and post contrast study of the upper abdomen (44305)	B		E

CT angiography of the pelvis (44310)	B	E
CT angiography of the abdominal aorta and pelvis (44320)	B	E
CT angiography of the abdominal aorta and pelvis and pre and post contrast study of the upper abdomen and pelvis (44325)	B	E
CT portogram (44330)	B	E
MR angiography of abdominal aorta and branches (44400)	B	E
Arteriography of abdominal aorta alone (44500)	B	D
Arteriography of aorta plus coeliac, mesenteric branches (44503)	B	E
Arteriography of aorta plus renal, adrenal branches (44505)	B	E
Arteriography of aorta plus renal, non-visceral branches (44507)	B	E
Arteriography of coeliac, mesenteric vessels alone (44510)	B	E
Arteriography of renal, adrenal vessels alone (44515)	B	D
Arteriography of non-visceral abdominal vessels alone (44517)	B	E
Arteriography of internal and external iliac vessels alone (44520)	B	E
Venography of internal and external iliac veins alone (44525)	B	E
Corpora cavernosography (44530)	B	D
Vasography, vesciculography (44535)	B	D
Venography of inferior vena cava (44540)	B	D
Venography of hepatic veins alone (44543)	B	E
Venography of inferior vena cava and hepatic veins (44545)	B	E
Venography of lumbar azygos system alone (44550)	B	D
Venography of inferior vena cava and lumbar azygos veins (44555)	B	E
Venography of renal, adrenal veins alone (44560)	B	D
Venography of inferior vena cava and renal/adrenal veins (44565)	B	E
Venography of spermatic, ovarian veins alone (44570)	B	D
Venography of inferior vena cava, renal, spermatic, ovarian veins (44573)	B	E
Venography indirect splenoportogram (44580)	B	D
Venography direct splenoportogram (44583)	B	D
Venography transhepatic portogram (44587)	B	D

Spine, Pelvis and Hips

General

X-ray of the spine scoliosis view AP only (50100)		B
X-ray of the spine scoliosis view AP and lateral (50105)		C
X-ray of the spine scoliosis view AP and lateral including stress views (50110)		C
X-ray bone densitometry (50120)		C
X-ray guided lumbar puncture (50130)	A	B
X-ray guided cisternal puncture cisternogram (50140)	A	D
CT quantitive bone mineral density (50300)	B	B
Arteriogram of the spinal column and cord, all vessels (50500)	B	E
Venography of the spinal, paraspinal veins (50510)	A	E

Cervical

X-ray f the cervical spine, stress views only (51100)		A
X-ray of the cervical spine, one or two views (51110)		A
X-ray of the cervical spine, more than two views (51120)		B
X-ray of the cervical spine, more than two views including stress views (51130)		B
X-ray Tomography cervical spine (51140)		B
X-ray myelography of the cervical spine (51160)	B	B
X-ray discography cervical spine per level (51170)	A	B
CT of the cervical spine limited study (51300)	B	C
CT of the cervical spine – regional study (51310)	B	C
CT of the cervical spine – complete study (51320)	B	D
CT of the cervical spine pre and post contrast (51330)	B	D
CT myelography of the cervical spine (51340)	B	D
CT myelography of the cervical spine following myelogram (51350)	B	D
MR of the cervical spine, limited study (51400)	B	D
MR of the cervical spine and cranio-cervical junction (51410)	B	E
MR of the cervical spine and cranio-cervical junction pre and post contrast (51420)	B	E

Thoracic

X-ray of the thoracic spine, one or two views (52100)		A
X-ray of the thoracic spine, more than two views (52110)		B
X-ray tomography thoracic spine (52120)		B
X-ray of the thoracic spine, more that two views including stress views (52140)		B
X-ray myelography of the thoracic spine (52150)	B	B

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CT of the thoracic spine limited study (52300)	B	C
CT of the thoracic spine – regional study (52305)	B	C
CT of the thoracic spine complete study (52310)	B	D
CT of the thoracic spine pre and post contrast (52320)	B	E
CT myelography of the thoracic spine (52330)	B	D

CT myelography of the thoracic spine following myelogram (52340)	B	D
MR of the thoracic spine, limited study (52400)	B	D
MR of the thoracic spine (52410)	B	E
MR of the thoracic spine pre and post contrast (52420)	B	E
Lumbar		
X-ray of the lumbar spine – stress study only (53100)		A
X-ray of the lumbar spine, one or two views (53110)		A
X-ray of the lumbar spine, more than two views (53120)		B
X-ray of the lumbar spine, more that two views including stress views (53130)		B
X-ray tomography lumbar spine (53140)		B
X-ray myelography of the lumbar spine (53160)	B	B
X-ray discography lumbar spine per level (53170)	B	B
CT of the lumbar spine limited study (53300)	B	C
CT of the lumbar spine – regional study (53310)	B	C
Ct of the lumbar spine complete study (53320)	B	D
CT of the lumbar spine pre and post contrast (53330)	B	D
CT myelography of the lumbar spine (53340)	B	D
CT myelography of the lumbar spine following myelogram (53350)	B	D
MR of the lumbar spine, limited study (53400)	B	D
MR of the lumbar spine (53410)	B	E
MR of the lumbar spine pre and post contrast (53420)	B	E
Sacrum		
X-ray of the sacrum and coccyx (54100)		A
X-ray of the sacro-iliac joints (54110)		B
X-ray tomography – sacrum and/or coccyx (54120)		B
CT of the sacrum – limited study (54300)	B	B
CT of the sacrum – complete study – uncontrasted (54310)	B	D
CT of the sacrum with contrast (54320)	B	D
CT of the sacrum pre and post contrast (54330)	B	D
MR of the sacrum (54400)	B	E
MR of the sacrum pre and post contrast (54410)	B	E
Pelvis		
X-ray of the pelvis (55100)		A
X-ray tomography – pelvis (55110)		B
CT of the bony pelvis limited (55300)	B	C
CT of the bony pelvis complete uncontrasted (55310)	B	D
CT of the bony pelvis complete 3D recon (55320)	B	D
CT of the bony pelvis with contrast (55330)	B	D
CT of the bony pelvis – pre and post contrast (55340)	B	D
MR of the bony pelvis (55400)	B	E
MR of the bony pelvis pre and post contrast (55410)	B	E
Hips		
X-ray of the left hip (56100)		A
X-ray of the right hip (56110)		A
X-ray pelvis and hips (56120)		B
X-ray tomography – hip (56130)		B
X-ray of the hip/s – stress study (56140)		B
X-ray arthrography of the hip joint including introduction contrast (56150)		C
X-ray guidance and introduction of contrast into hip joint only (56160)		B
Ultrasound of the hip joints (56200)		B
CT of hip – limited (56300)	B	C
CT of hip – complete (56310)	B	D
CT of hip – complete with 3D recon (56320)	B	D
CT of hip with contrast (56330)	B	D
CT of hip pre and post contrast (56340)	B	D
MR of the hip joint/s, limited study (56400)	B	D
MR of the hip joint/s (56410)	B	E
MR of the hip joint/s, pre and post contrast (56420)	B	E
Upper limbs		
General		
X-ray upper limbs - any region - stress studies only (60100)		A
X-ray upper limbs - any region – tomography (60110)		B
Ultrasound upper limb – soft tissue - any region (60200)		B
Ultrasound of the peripheral arterial system of the left arm including B mode, pulse and colour Doppler (60210)		B
Ultrasound of the peripheral arterial system of the right arm including B mode, pulse and colour Doppler (60220)		B
Ultrasound peripheral venous system upper limbs including pulse and colour Doppler for deep vein thrombosis(60230)		B
Ultrasound peripheral venous system upper limbs including pulse and colour Doppler(60240)		C

	Ana	P	I
CT of the upper limbs limited study (60300)	B		C
CT angiography of the upper limb (60310)	B		E
MR of the upper limbs limited study, any region (60400)	B		D
MR angiography of the upper limb (60410)	B		E
Arteriogram of subclavian, upper limb arteries alone, unilateral (60500)	B		D
Arteriogram of subclavian, upper limb arteries alone, bilateral (60510)	B		E
Arteriogram of aortic arch, subclavian, upper limb, unilateral (60520)	B		D
Arteriogram of aortic arch, subclavian, upper limb, bilateral (60530)	B		E
Venography, antegrade of upper limb veins, unilateral (60540)	B		B
Venography, antegrade of upper limb veins, bilateral (60550)	B		D
Venography, retrograde of upper limb veins, unilateral (60560)	B		B
Venography, retrograde of upper limb veins, bilateral (60570)	B		E
Venography, shuntogram, dialysis access shunt (60580)	B		D
Shoulder			
X-ray of the left clavicle (61100)			A
X-ray of the right clavicle (61105)			A
X-ray of the left scapula (61110)			A
X-ray of the right scapula (61115)			A
X-ray of the left acromio-clavicular joint (61120)			A
X-ray of the right acromio-clavicular joint (61125)			A
X-ray of acromio-clavicular joints plus stress studies bilateral (61128)			B
X-ray of the left shoulder (61230))			A
X-ray of the right shoulder (61135)			A
X-ray of the left shoulder plus subacromial impingement views (61140)			B
X-ray of the right shoulder plus subacromial impingement views (61145)			B
X-ray of the left subacromial impingement views only (61150)			B
X-ray of the right subacromial impingement views only (61155)			B
X-ray arthrography shoulder joint including introduction of contrast (61160)			C
X-ray guidance and introduction of contrast into shoulder joint only (61170)			B
Ultrasound of the left shoulder joint (61200)			B
Ultrasound of the right shoulder joint (61210)			B
CT of the left shoulder joint – uncontrasted (61300)	B		D
CT of the right shoulder joint – uncontrasted (61305)	B		D
CT of the left shoulder – complete with 3D recon (61310)	B		D
CT of the right shoulder – complete with 3D recon (61315)	B		D
CT of the left shoulder joint - pre and post contrast (61320)	B		D
CT of the right shoulder joint - pre and post contrast (61325)	B		D
MR of the left shoulder (61400)	B		E
MR of the right shoulder (61405)	B		E
MR of the left shoulder pre and post contrast (61410)	B		E
MR of the right shoulder pre and post contrast (61415)	B		E
Humerus			
X-ray of the left humerus (62100)			A
X-ray of the right humerus (62105)			A
CT of the left upper arm (62300)	B		D
CT of the right upper arm (62305)	B		D
CT of the left upper arm contrasted (62310)	B		D
CT of the right upper arm contrasted (62315)	B		D
CT of the left upper arm pre and post contrast (62320)	B		D
CT of the right upper arm pre and post contrast (62325)	B		D
MR of the left upper arm (62400)	B		E
MR of the right upper arm (62405)	B		E
MR of the left upper arm pre and post contrast (62410)	B		E
MR of the right upper arm pre and post contrast (62415)	B		E
Elbow			
X-ray of the left elbow (63100)			A
X-ray of the right elbow (63105)			A
X-ray of the left elbow with stress (63110)			B
X-ray of the right elbow with stress (63115)			B
X-ray arthrography elbow joint including introduction of contrast (63120)			C
X-ray guidance and introduction of contrast into elbow joint only (63130)			B
Ultrasound of the left elbow joint (63200)			B
Ultrasound of the right elbow joint (63205)			B
CT of the left elbow (63300)	B		D
CT of the right elbow (63305)	B		D
CT of the left elbow – complete with 3D recon (63310)	B		D
CT of the right elbow – complete with 3D recon (63315)	B		D
CT of the left elbow contrasted (63320)	B		D
CT of the right elbow contrasted (63325)	B		D
CT of the left elbow pre and post contrast (63330)	B		D
CT of the right elbow pre and post contrast (63335)	B		D
MR of the left elbow (63400)	B		E

MR of the right elbow (63405)	B	E
MR of the left elbow pre and post contrast (63410)	B	E
MR of the right elbow pre and post contrast (63415)	B	E

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Forearm			
X-ray of the left forearm (64100)			A
X-ray of the right forearm (64105)			A
X-ray peripheral bone densitometry (64110)			A
CT of the left forearm (64300)	B		D
CT of the right forearm (64305)	B		D
CT of the left forearm contrasted (64310)	B		D
CT of the right forearm contrasted (64315)	B		D
CT of the left forearm pre and post contrast (64320)	B		D
CT of the right forearm pre and post contrast (64325)	B		D
MR of the left forearm (64400)	B		E
MR of the right forearm (64405)	B		E
MR of the left forearm pre and post contrast (64410)	B		E
MR of the right forearm pre and post contrast (64415)	B		E
Hand and Wrist			
X-ray of the left hand (65100)			A
X-ray of the right hand (65105)			A
X-ray of the left hand – bone age (65110)			A
X-ray of a finger (65120)			A
X-ray of the left wrist (65130)			A
X-ray of the right wrist (65135)			A
X-ray of the left scaphoid (65140)			A
X-ray of the right scaphoid (65145)			A
X-ray of the left wrist, scaphoid and stress views (65150)			B
X-ray of the right wrist, scaphoid and stress views (65155)			B
X-ray arthrography wrist joint including introduction of contrast (65160)			C
X-ray guidance and introduction of contrast into wrist joint only (65170)			B
Ultrasound of the left wrist (65200)			B
Ultrasound of the right wrist (65210)			B
CT of the left wrist and hand (65300)	B		D
CT of the right wrist and hand (65305)	B		D
CT of the left wrist and hand - complete with 3D recon (65310)	B		D
CT of the right wrist and hand - complete with 3D recon (65315)	B		D
CT of the left wrist and hand contrasted (65320)	B		D
CT of the right wrist and hand contrasted (65325)	B		D
CT of the left wrist and hand pre and post contrast (65330)	B		D
CT of the right wrist and hand pre and post contrast (65335)	B		D
MR of the left wrist and hand (65400)	B		E
MR of the right wrist and hand (65405)	B		E
MR of the left wrist and hand pre and post contrast (65410)	B		E
MR of the right wrist and hand pre and post contrast (65415)	B		E
Lower Limbs			
General			
X-ray lower limbs - any region- stress studies only (70100)			B
X-ray lower limbs - any region-tomography (70110)			B
X-ray of the lower limbs full length study (70120)			B
Ultrasound lower limb – soft tissue - any region (70200)			B
Ultrasound of the peripheral arterial system of the left leg including B mode, pulse and colour Doppler (70210)			B
Ultrasound of the peripheral arterial system of the right leg including B mode, pulse and colour Doppler (70220)			B
Ultrasound peripheral venous system lower limbs including pulse and colour doppler for deep vein thrombosis (70230)			C
Ultrasound peripheral venous system lower limbs including pulse and colour doppler in erect and supine position including all compression and reflux manoeuvres, deep and superficial systems bilaterally (70240)			C
CT of the lower limbs limited study (70300)	B		C
CT angiography of the lower limb (70310)	B		E
CT angiography abdominal aorta and outflow lower limbs (70320)	B		E

MR of the lower limbs limited study (70400)	B	D
MR angiography of the lower limb (70410)	B	E
MR angiography of the abdominal aorta and lower limbs (70420)	B	E
Angiography of pelvic and lower limb arteries unilateral (70500)	B	D
Angiography of pelvic and lower limb arteries bilateral (70505)	B	E
Angiography of abdominal aorta, pelvic and lower limb vessels unilateral (70510)	B	D
Angiography of abdominal aorta, pelvic and lower limb vessels bilateral (70515)	B	E
Angiography translumbar aorta with full peripheral study (70520)	B	D
Venography, antegrade of lower limb veins, unilateral (70530)	B	B
Venography, antegrade of lower limb veins, bilateral (70535)	B	D
Venography, retrograde of lower limb veins, unilateral (70540)	B	B
Venography, retrograde of lower limb veins, bilateral (70545)	B	E
Lymphangiography, lower limb, unilateral (70560)	B	D
Lymphangiography, lower limb, bilateral (70565)	B	E

	Ana	P	I
Femur			
X-ray of the left femur (71100)			A
X-ray of the right femur (71105)			A
CT of the left femur (71300)	B		D
CT of the right femur (71305)	B		D
CT of the left upper leg contrasted (71310)	B		D
CT of the right upper leg contrasted (71315)	B		D
CT of the left upper leg pre and post contrast (71320)	B		D
CT of the right upper leg pre and post contrast (71325)	B		D
MR of the left upper leg (71400)	B		E
MR of the right upper leg (71405)	B		E
MR of the left upper leg pre and post contrast (71410)	B		E
MR of the right upper leg pre and post contrast (71415)	B		E
Knee			
X-ray of the left knee one or two views (72100)			A
X-ray of the right knee one or two views (72105)			A
X-ray of the left knee, more than two views (72110)			A
X-ray of the right knee, more than two views (72115)			A
X-ray of the left knee including patella (72120)			B
X-ray of the right knee including patella (72125)			B
X-ray of the left knee with stress views (72130)			B
X-ray of the right knee with stress views (72135)			B
X-ray of left patella (72140)			A
X-ray of right patella (72145)			A
X-ray both knees standing – single view (72150)			A
X-ray arthrography knee joint including introduction of contrast (72160)			C
X-ray guidance and introduction of contrast into knee joint only (72170)			B
Ultrasound of the left knee joint (72200)			B
Ultrasound of the right knee joint (72205)			B
CT of the left knee (72300)	B		D
CT of the right knee (72305)	B		D
CT of the left knee complete study with 3D reconstructions (72310)	B		D
CT of the right knee complete study with 3D reconstructions (72315)	B		D
CT of the left knee contrasted (72320)	B		D
CT of the right knee contrasted (72325)	B		D
CT of the left knee pre and post contrast (72330)	B		D
CT of the right knee pre and post contrast (72335)	B		D
MR of the left knee (72400)	B		E
MR of the right knee (72405)	B		E
MR of the left knee pre and post contrast (72410)	B		E
MR of the right knee pre and post contrast (72415)	B		E
Lower Leg			
X-ray of the left lower leg (73100)			A
X-ray of the right lower leg (73105)			A
CT of the left lower leg (73300)	B		D
CT of the right lower leg (73305)	B		D
CT of the left lower leg contrasted (73310)	B		D
CT of the right lower leg contrasted (73315)	B		D
CT of the left lower leg pre and post contrast (73320)	B		D
CT of the right lower leg pre and post contrast (73325)	B		D
MR of the left lower leg (73400)	B		E
MR of the right lower leg (73405)	B		E
MR of the left lower leg pre and post contrast (73410)	B		E
MR of the right lower leg pre and post contrast (73415)	B		E

Ankle and Foot

X-ray of the left ankle (74100)			A
X-ray of the right ankle (74105)			A
X-ray of the left ankle with stress views (74110)			B
X-ray of the right ankle with stress views (74115)			B
X-ray of the left foot (74120)			A
X-ray of the right foot (74125)			A
X-ray of the left calcaneus (74130)			A
X-ray of the right calcaneus (74135)			A
X-ray of both feet – standing – single view (74140)			A
X-ray of a toe (74145)			A
X-ray of the sesamoid bones one or both sides (74150)			A
X-ray arthrography ankle joint including introduction of contrast (74160)			C
X-ray guidance and introduction of contrast into ankle joint (74170)			B
Ultrasound of the left ankle (74210)			B
Ultrasound of the right ankle (74215)			B
Ultrasound of the left foot (74220)			B
Ultrasound of the right foot (74225)			B
Ultrasound bone densitometry (74290)			A
CT of the left ankle/foot (74300)	B		D
CT of the right ankle/foot (74305)	B		D
CT of the left ankle/foot – complete with 3D recon (74310)	B		D
CT of the right ankle/foot – complete with 3D recon (74315)	B		D

	Ana	P	I
CT of the left ankle/foot contrasted (74320)	B		D
CT of the right ankle/foot contrasted (74325)	B		D
CT of the left ankle/foot pre and post contrast (74330)	B		D
CT of the right ankle/foot pre and post contrast (74335)	B		D
MR of the left ankle (74400)	B		E
MR of the right ankle (74405)	B		E
MR of the left ankle pre and post contrast (74410)	B		E
MR of the right ankle pre and post contrast (74415)	B		E
MR of the left foot (74420)	B		E
MR of the right foot (74425)	B		E
MR of the left foot pre and post contrast (74430)	B		E
MR of the right foot pre and post contrast (74435)	B		E

Intervention

General

Percutaneous abscess, cyst drainage, any region (80600)			C
Fine needle aspiration biopsy, any region (80605)	A		B
Cutting needle, trochar biopsy, any region (80610)	A	A	B
Tumour/cyst ablation chemical (80620)			D
Tumour ablation radio frequency, per lesion (80630)			D
Insertion of CVP line in radiology suite (80640)	C		C
Peripheral central venous line insertion (80645)			C
Infiltration of a peripheral joint, any region (80650)			B

Neuro intervention

Intracranial aneurysm occlusion, direct (81600)	C		E
	Intracranial		
arteriovenous shunt occlusion (81605)	C		E
Dural sinus arteriovenous shunt occlusion (81610)	C		E
Extracranial arteriovenous shunt occlusion (81615)	C		E
Extracranial arterial embolisation (head and neck) (81620)	C		E
Caroticocavernous fistula occlusion (81625)	C		E
Intracranial angioplasty for stenosis, vasospasm (81630)	C	D	E
Intracranial stent placement (including PTA)(81632)	C	D	E
Temporary balloon occlusion test (81635)	C		E
Permanent carotid or vertebral artery occlusion (including occlusion test) (81640)	B		E
Intracranial aneurysm occlusion with balloon remodeling (81645)	B	B	E
Intracranial aneurysm occlusion with stent assistance (81650)	B	B	E
Intracranial thrombolysis, catheter directed (81655)	B	B	E
Nerve block, head and neck, per level (81660)	B		B
Neurolysis, head and neck, per level (81665)	B		D
Nerve block, head and neck, radio frequency, per level (81670)	B		C
Nerve block, coeliac plexus or other regions, per level (81680)	B		C

Thorax

Chest drain insertion (82600)	A		B

Trachial, bronchial stent insertion (82605)	B	B	D
Gastrointestinal			
Oesophageal stent insertion (83600)	C		C
GIT balloon dilation (83605)	B	B	D
GIT stent insertion (non-oesophageal) (83610)	C		D
Percutaneous gastrostomy, jejunostomy (83615)	A	B	D
Hepatobiliary			
Percutaneous biliary drainage, external (84600)	B		D
Percutaneous external/internal biliary drainage(84605)	B		D
Permanent biliary stent insertion (84610)	B	C	D
Drainage tube replacement (84615)			D
Percutaneous bile duct stone or foreign object removal (84620)	C		D
Percutaneous gall bladder drainage (84625)	B		D
Percutaneous gallstone removal, including drainage (84630)	B	B	E
Transjugular liver biopsy (84635)	B	B	D
Transjugular intrahepatic Portosystemic shunt (84640)	C		E
Transhepatic Portogram including venous sampling, pressure studies (84645)	C		E
Transhepatic Portogram with embolisation of varices (84650)	C		E
Percutaneous hepatic tumour ablation (84655)			C
Percutaneous hepatic abscess, cyst drainage (84660)	A	A	C
Hepatic chemoembolization (84665)			E
Hepatic arterial infusion catheter placement (84670)	B	C	D
Urogenital			
Percutaneous nephrostomy, external drainage (85600)	B	B	D
Percutaneous double J stent insertion including access (85605)	B	B	D
Percutaneous renal stone, foreign body removal including access (85610)	C		D
Percutaneous nephrostomy tract establishment (85615)	B	B	D
Change of nephrostomy tube (85620)			C
Percutaneous cystostomy (85625)	A		C
Urethral balloon dilatation (85630)	A	A	B
Urethral stent insertion (85635)	A		D
Renal cyst ablation (85640)			B
Renal abscess, cyst drainage (85645)	B		C
Fallopian tube recanalization (85655)	B	C	D

	Ana	P	I
Spinal			
Spinal vascular malformation embolization (86600)	C		E
Vertebroplasty per level (86605)	C	B	D
Facet joint block per level, uni- or bilateral (86610)			C
Spinal nerve block per level, uni- or bilateral (86615)			C
Epidural block (86620)			C
Chemonucleolysis, including discogram (86625)			C
Spinal nerve ablation per level (86630)			C
Vascular			
Percutaneous transluminal angioplasty: aorta, IVC (87600)	C		D
Percutaneous transluminal angioplasty: iliac (87601)	C		D
Percutaneous transluminal angioplasty: femoropopliteal (87602)	C	B	D
Percutaneous transluminal angioplasty: subpopliteal (87603)	C		D
Percutaneous transluminal angioplasty: brachiocephalic (87604)	C		D
Percutaneous transluminal angioplasty: subclavian, axillary (87605)	C		D
Percutaneous transluminal angioplasty: extracranial carotid (87606)	C		E
Percutaneous transluminal angioplasty: extracranial vertebral (87607)	C		E
Percutaneous transluminal angioplasty: renal (87608)	C		D
Percutaneous transluminal angioplasty: coeliac, mesenteric (87609)	C	B	E
Aorta stent-graft placement (87620)	C	C	E
Stent insertion (including PTA): aorta, IVC (87621)	C		D
Stent insertion (including PTA): iliac (87622)	C	C	D
Stent insertion (including PTA): femoropopliteal (87623)	C		D
Stent insertion (including PTA): subpopliteal (87624)	C		D
Stent insertion (including PTA): brachiocephalic (87625)	C		D
Stent insertion (including PTA): subclavian, axillary (87626)	C		E
Stent insertion (including PTA): extracranial carotid (87627)	C		E
Stent insertion (including PTA): extracranial vertebral (87628)	C		D
Stent insertion (including PTA): renal (87629)	C		E
Stent insertion (including PTA): coeliac, mesenteric (87630)	C		E
Stent-graft placement: iliac (87631)	C	C	E
Stent-graft placement: femoropopliteal (87632)	C	C	E
Stent-graft placement: brachiocephalic (87633)	C	C	E
Stent-graft placement: subclavian, axillary (87634)	C	C	E
Stent-graft placement: extracranial carotid (87635)	C	C	E
Stent-graft placement: extracranial vertebral (87636)	C	C	E

Stent-graft placement: renal (87637)	**C**	**C**	**E**
Stent-graft placement: coeliac, mesenteric (87638)	**C**	**C**	**E**
Thrombolysis in angiography suite, per 24 hours (87650)			**D**
Aspiration, rheolytic thrombectomy (87651)			**E**
Atherectomy, per vessel (87652)	**B**	**D**	**E**
Percutaneous tunnelled / subcutaneous arterial or venous central or other line insertion (87653)	**C**		**D**
Percutaneous sclerotherapy, vascular malformation (87655)	**B**	**B**	**D**
Embolisation, mesenteric (87660)	**B**	**C**	**E**
Embolisation, renal (87661)	**B**	**C**	**E**
Embolisation, bronchial, intercostals (87662)	**B**	**C**	**E**
Embolisation, pulmonary arteriovenous shunt (87663)	**B**	**C**	**E**
Embolisation, abdominal, other vessels (87664**)**	**B**	**C**	**E**
Embolisation, thoracic, other vessels (87665)	**B**	**C**	**E**
Embolisation, upper limb (87666)	**B**	**C**	**E**
Embolisation, lower limb (87667)	**B**	**C**	**E**
Embolisation, pelvis, non-uterine (87668)	**B**	**C**	**E**
Embolisation, uterus (87669)	**B**	**C**	**E**
Embolisation, spermatic, ovaria veins (87670)	**B**	**C**	**E**
Inferior vena cava filter placement (87680)	**B**	**C**	**D**
Intravascular foreign body removal (87681)	**C**	**D**	**D**
Revision of access port (tunnelled or implantable) (87682)	**A**	**B**	**C**
Removal of access port (tunnelled or implantable) (87683)	**A**	**B**	**C**
Superior petrosal venous sampling (87690)			**E**
Pancreatic stimulation test (87691)			**E**
Transportal venous sampling (87692)			**E**
Adrenal venous sampling (87693)			**E**
Parathyroid venous sampling (87694)			**E**
Renal venous sampling (87695)			**E**

Lithotripsy

Lithotripsy is a non-invasive procedure used to break up stones inside the patient's body.

1st Electro Shock wave Lithotripsy (56245**)**			**E**
2nd Electro Shock wave Lithotripsy (56246)			**E**
1st Laser Lithotripsy (56222)			**E**
2nd Laser Lithotripsy (56223)			**E**

Appendix 4

STATE PRICELIST

as at 02 May 2014

WP Blood Transfusion Service
Do something remarkable

WHOLE BLOOD PRODUCTS

NAPPI/BHF Code	WPBTS Code	Description	Volume	Price Excl. Vat	Price Incl. Vat
702074001	WB	Whole Blood	513 ± 45 ml	R 988.60	R 1,127.00
702079001	WB96	Whole Blood - <96hr	513 ± 45 ml	R 1,125.44	R 1,283.00
702077001	WBE	Whole Blood - Emergency	513 ± 45 ml	R 988.60	R 1,127.00
702073001	LRWB	Whole Blood - Leucocyte Poor	493 ± 45 ml	R 1,974.56	R 2,251.00
707161001	WBRD	Whole Blood Rare Donation & Levy	525 ± 50 ml	R 2,207.02	R 2,516.00

RED CELL PRODUCTS

NAPPI/BHF Code	WPBTS Code	Description	Volume	Price Excl. Vat	Price Incl. Vat
702152001	RBC	Red Cell Concentrate	300 ± 50 ml	R 890.35	R 1,015.00
702155001	RBC96	Red Cell Concentrate - <96hr	300 ± 50 ml	R 1,014.04	R 1,156.00
702154001	RBCE	Red Cell Concentrate - Emergency	300 ± 50 ml	R 890.35	R 1,015.00
702136001	LEURHL	Red Cell Concentrate - Haemoconcentrate	n/a	R 2,841.23	R 3,239.00
702144001	LRRBC	Red Cell Concentrate - Leucocyte Poor	260 ± 50 ml	R 1,764.91	R 2,012.00
702139001	LRBCPE	Red Cell Concentrate Prestore LcPr - Emergency	260 ± 50 ml	R 1,764.91	R 2,012.00
702143001	LRBCPS	Red Cell Concentrate Prestore Leucocyte Poor	260 ± 50 ml	R 1,764.91	R 2,012.00
702388001	ALWRBC	Albumin Red Cell Concentrate Washed	> 185 ml	R 3,104.39	R 3,539.00
702147001	LRWRBC	Filtered Washed Red Cell Concentrate	280 ± 50 ml	R 2,947.37	R 3,360.00
707157001	RBCRDA	Red Cell Concentrate Rare Don.Add S&L	300 ± 50 ml	R 2,604.39	R 2,969.00
707159001	RBCRDT	Red Cell Concentrate Rare Donation T&L	300 ± 50 ml	R 2,604.39	R 2,969.00

PAEDIATRIC PRODUCTS

NAPPI/BHF Code	WPBTS Code	Description	Volume	Price Excl. Vat	Price Incl. Vat
702392001	PWB1	Paediatric Whole Blood	263 ± 50 ml	R 1,156.14	R 1,318.00
702392001	PWB2	Paediatric Whole Blood	263 ± 50 ml	R 1,156.14	R 1,318.00
702392001	PWB3	Paediatric Whole Blood	263 ± 50 ml	R 1,156.14	R 1,318.00
702151001	PRBC1	Paediatric Red Cell Concentrate Leucocyte Poor	87.5 ± 62.5 ml	R 1,079.82	R 1,231.00
702135001	IRBC1	Infant Red Cell Concentrate (Sgl) Leucocyte Poor	87.5 ± 62.5 ml	R 534.21	R 609.00
702135001	IRBC2	Infant Red Cell Concentrate (Sgl) Leucocyte Poor	87.5 ± 62.5 ml	R 534.21	R 609.00
702135001	IRBC3	Infant Red Cell Concentrate (Sgl) Leucocyte Poor	87.5 ± 62.5 ml	R 534.21	R 609.00
702135001	IRBC4	Infant Red Cell Concentrate (Sgl) Leucocyte Poor	87.5 ± 62.5 ml	R 534.21	R 609.00
707152001	PPLAF1	Paediatric Platelet Single Donor	130 ± 30 ml	R 3,062.28	R 3,491.00
707152001	PPLAF2	Paediatric Platelet Single Donor	130 ± 30 ml	R 3,062.28	R 3,491.00
705843001	IPLAPH1	Infant Apheresis Platelet	50 ± 10 ml	R 1,227.19	R 1,399.00
705843001	IPLAPH2	Infant Apheresis Platelet	50 ± 10 ml	R 1,227.19	R 1,399.00
705843001	IPLAPH3	Infant Apheresis Platelet	50 ± 10 ml	R 1,227.19	R 1,399.00
705843001	IPLAPH4	Infant Apheresis Platelet	50 ± 10 ml	R 1,227.19	R 1,399.00
705843001	IPLAPH5	Infant Apheresis Platelet	50 ± 10 ml	R 1,227.19	R 1,399.00
705843001	IPLAPH6	Infant Apheresis Platelet	50 ± 10 ml	R 1,227.19	R 1,399.00
705843001	IPLAPH7	Infant Apheresis Platelet	50 ± 10 ml	R 1,227.19	R 1,399.00
705843001	IPLAPH8	Infant Apheresis Platelet	50 ± 10 ml	R 1,227.19	R 1,399.00