Outcomes of Elective Surgical Patients Admitted to a Tertiary Paediatric Intensive Care Unit

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Master of Medicine in Child health and Paediatrics

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Declaration

I declare that this thesis is my own work and has not been submitted in any form for any other degree or diploma at any university or other institution of tertiary education.
Information derived from the published or unpublished work of others has been acknowledged in the text and a list of references is given.

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Date

26/01/2021

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Signature

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Abstract

Background: A paediatric intensive care unit (PICU) is a unit for critically ill medical and surgical children. It is imperative that the spectrum and outcome of elective surgical patients is reviewed to help develop admission criteria for elective surgical patients to assist in prudent resource allocation.

Objectives: To describe the clinical characteristics, diagnosis, complications, and outcome of elective surgical admissions, to the PICU.

Methods: A retrospective chart review of all elective paediatric surgical patients admitted between 01 January 2018 to 31 December 2019 at Grey's Hospital PICU, a tertiary hospital. All elective surgical patients admitted at Grey's PICU were included in the study. Data was analyzed using the statistical analysis involved both descriptive and inferential statistics. The descriptive statistics included frequency tables for categorical variables and number summaries for continuous variables. To determine the factors associated length of stay, general linear model was fitted using the Gamma family distribution since the length of stay was skewed. All the tests were benchmarked at $\alpha = 0.05$ level of significance. Ethical approval to access patient records was obtained from the Biomedical Research Ethics Committee of University of KZN (BREC/00001304/2020), Greys Hospital and Department of health.

Results: There were 320 elective surgical bed requests for PICU of which 279 (87.2%) were accepted but only 234 were admitted to PICU, the rest did not require PICU post theatre. Forty-one (12.8%) were not accepted due to unavailability of resources. The median age for this study population was 2 years (0 - 16 years). Gender distribution 50.0% were male, 35.0% female and 15.0% unknown. The majority, 80.9% were HIV negative with normal nutritional status (75.9%). Elective surgical admissions constituted 30.0% (234/ 798) of total PICU all admissions. The average waiting period was 4.0 days with an average length of stay of 2 days. With regards to indications for surgery, the majority were for airway problems 91 (28.0%) and 45 (14.2%) for feeding difficulties. 158 (49.7%) had no reported comorbidity. The most common comorbidity was cerebral palsy 5 (11.0%) followed by right heart failure 19 (6.0%). With regards to outcomes, 98.7% were discharged with no complications and 3 (1.3 %) died.

Conclusion: Elective surgical admissions constituted a third of all PICU admissions with the majority having upper airways abnormalities, with a good outcome. Majority of bed requests were met. Mortality was low and length of stay was shorter amongst the elective surgical cases. Children under the age or one year requiring surgery need prioritization for access to post-operative PICU care.

CHAPTER 1

1.1 Introduction

Surgical care for children is often overlooked and yet can play an important role in preventing death and disability [1]. Worldwide mortality in children under 5 years has been reported to have dramatically dropped even in the poorest areas of the world [2]. It has been shown that in the past 25 years, there has been improvement in global health, but progress is slower in the low and middle-income countries (LMICs) [3]. In order to ensure further progress, continued improvements across the full spectrum of child health services includes access to surgical care [3].

It has been shown that proper assessment of patients that require an elective surgical procedures by both the anaesthetic team and the surgeon decreases the risk of having unplanned intensive care admissions (UIA) which are associated with longer length of stay and poorer outcomes as compared to planned post-operative intensive care unit admissions [4]. Case fatality rates have been shown to be high for common easily treatable surgical conditions as a result of absence of surgical care and appropriate post-operative care [3].

The Lancet Commission on Global Surgery launched in 2014 reported about 5 billion people do not have access to safe, affordable surgical, anaesthetic care and appropriate post-operative care when needed [5]. Access is worse in LMICs, where nine in ten people cannot access basic surgical care [3]. It has been estimated that only 6.0% of 313 million elective surgical procedures are done in the LMICs where over a third of the world's population lives [3, 6]. The commission further demonstrated that investing in surgical services together with good post-operative care which includes high care and intensive care unit (ICU) if indicated in LMICs saves lives and promotes economic growth [5]. Making surgical and post-operative care available, accessible, safe, timely and affordable is in line with Sustainable Development Goals [7]. It has been shown that surgical and anaesthetic care is an indispensable part of health care and should be an integral component of a national health system at all levels of development [8, 9].

In LMICs the lack of infrastructure and human resources lead to minimally functional first level hospitals with the burden of care falling on tertiary hospitals. Less than 8.0% of the paediatric population in these countries has access to surgical care [1]. Tertiary centres are burdened with acute surgical volume from referral hospitals and lose the ability to offer more complex, planned surgery [10]. It is recommended that first level hospitals should be equipped with basic infrastructure and administrative and managerial support which will aim to offer broad range uncomplicated surgical procedures to relieve the pressure to the tertiary hospitals [2]. In order to achieve that, first level hospitals must ensure access of surgical services [2, 11]. Without improvements in surgical, anaesthetic and post-operative paediatric care, it will be impossible to achieve the second target of sustainable development goal 3 which is to end preventable deaths of new-borns and children younger than 5 years by 2023 [12]. A study done by Mullapudi *et al*. estimated around 1.7 billion children and adolescents worldwide did not have access to surgical care in 2017 [13]. Most lived in LMICs where children and adolescents make up large fraction of the population [13].

Paediatric surgical services are restricted to just two hospitals in the KwaZulu Natal province, namely, Inkosi Albert Luthuli Central Hospital (IALCH) in Durban and Grey's Hospital in Pietermaritzburg. Currently, the criteria for admission of elective surgical patients to the paediatric intensive care units remains ill defined. In order to develop evidence-based guidelines and equity in access of children with surgical conditions to the PICU, there is a need to audit the accessibility and outcomes of children with surgical conditions to the PICU.

The purpose of this study was to describe the reasons for elective surgical admissions to the Greys hospital PICU, the waiting period for elective bed bookings, the average length of stay, and outcomes.

CHAPTER 2

2.1 Background and Literature Review

2.1.1 Defining the Clinical Problem

A paediatric intensive care unit (PICU) is a unit for critically ill children. Since the PICU is a scarce resource with high demand, emergency medical or surgical patients take preference over elective surgical patients regarding PICU access. It is imperative that the spectrum and outcome of elective surgical patients is reviewed to help develop admission criteria for elective surgical patients. Such criteria can also help ensure admission to those elective surgical patients who need it.

2.1.2 The literature review

Paediatric critical care is an important component in reducing morbidity and mortality globally [1]. The majority of hospitals lack designated intensive care units, healthcare staff trained to care for critically ill children, adequate numbers of staff, and rapid access to necessary medications, supplies and equipment [1]. In Sub-Saharan Africa, the numbers of intensive care beds are extremely limited. In Zambia (with a population of 11.7 million), a survey of 68 hospitals showed a total of 29 intensive care beds at 5 hospitals. In South Africa, a total of 1 783 public and 2 385 private ICU beds serve a population of 57 million people [2, 3]. Due to limited resources, critically ill patients are treated in general wards with minimal staffing and facilities in some centres [4].

The great discrepancy in PICU bed availability between low middle income countries (LMICs) versus high income countries (HICs) was evidenced in a study done by Halpern *et a*l. in 2004, in the USA, where 13.0% of total hospital beds were for critical care; this is in contrast to 6.6% in LMICs [5, 6]. HICs have a higher number of surgical admissions to PICU compared to LMICs: 49.0% versus 15.0%. Argent *et al*., in a study done in Red Cross War Memorial Children's hospital in South Africa, reported that during the period 2009 and 2012, between 46 to 79 patients per annum had surgery cancelled due to unavailability of beds [7]. The average length

of stay is estimated to be 8 days in HICs vs. 11 days in LMICs [8-11]. A 2007 survey of critical care services throughout South Africa suggested that children did not have an equitable share of intensive care resources [14]. In upper-middle income countries like South Africa, there is inequality regarding availability of resources between provinces; Western Cape province has more health care resources compared to provinces like Eastern Cape and Limpopo [14]. Unlike children in KwaZulu-Natal, children in Western Cape and Gauteng have access to more advanced health care, where they have successful transplant programs (renal, liver) which are not offered in other provinces in South Africa [15-17]. Transplant patients contribute significantly to the number of elective PICU admissions as they require PICU beds post operatively for extensive monitoring [15-17]. Because of the high demand, but low availability of resources, it is difficult for critically ill patients to get access to PICU; this leaves little room for elective surgical patients to gain access to PICU post-operatively [18].

Risk factors for postoperative respiratory complications in patients include age younger than 2 years, weight less than 15kg and syndromes associated with airway abnormalities [12]. The surgery for these patients should be performed in a centre with paediatric intensive care unit facilities and the availability of PICU beds should be confirmed prior to surgery [12]. It has been shown that proper assessment of patients that require an elective surgical procedures by both the anaesthetic team and the surgeon decreases the risk of having unplanned intensive care admissions (UIA) which are associated with longer length of stay and poor outcomes as compared to planned post-operative intensive care unit admissions [13].

The PICU referral process involves triaging patients into categories such as urgent, emergency and elective requests. Triage systems and scores have been developed for use in resource-limited settings such as the “South African triage scale” to help prioritise patients according the severity of illness especially in the outpatient department [19]. Improved triage and emergency care have been shown to reduce outpatient mortality in Malawi and South Africa [20, 21]. Furthermore, the triage system aims to maximize benefits from available resources by giving priority to patients who require fewer resources to achieve maximal benefit and helps reduce preventable and unplanned admissions to a PICU, especially in resource limited settings [22, 23]. A study by Fenton *et a*l. showed in a study in the USA that about 36% of surgical admissions between 2002 and 2015 were preventable PICU admissions that could have been managed in a general ward [23].

The current study aims to describe types of elective surgical admissions admitted at Grey's hospital PICU, waiting period for elective bed bookings, the average length of stay and outcomes. This information will help develop guidelines for our elective PICU admissions that will ensure that the limited resources we have are utilized maximally.

2.2 The research questions (or hypothesis)

What is the proportion of children admitted to the PICU for elective surgery and what are the clinical characteristics of these patients?

2.2.1 Aims and Objectives

The primary aim was to describe the profile of elective surgical requests that are admitted to PICU.

2.2.2 Objectives

- To determine the time interval between bed request and accessing the bed
- To describe the clinical characteristics of elective surgical admissions
- To determine the PICU accessibility for elective surgical patients
- To describe diagnoses and complications in this population
- To determine the length of stay in PICU.
- To describe the outcomes of children admitted for elective surgery.

CHAPTER 3

3.1 Methods

A retrospective chart review of all elective paediatric surgical patients admitted between 01 January 2018 to 31 December 2019 at Greys Hospital Paediatric Intensive Care Unit (PICU), a tertiary hospital within Umgungundlovu district in KZN. All patients electively admitted to PICU during this period were included in the study. All elective surgical patients admitted at Grey's PICU were identified using a file of booking forms, ward admission registers, computerized data and discharge summaries as well as Child PIP database. Each patient record was reviewed for mortality.

3.1.1 Study design

Setting

Greys Hospital is a public-sector tertiary-level hospital located in Umgungundlovu Health District serving the Western half of KwaZulu-Natal. It includes five health districts with an estimated population of 4.5 million people, of which approximately 1.2 million are children. The PICU at Greys Hospital is an eight-bed intensive care and high care unit. There is a high turnover of both medical and surgical cases referred from both regional and district hospitals. The children range in age from 0 days to 12 years and come from rural, peri-urban and urban areas.

Participant selection and sampling strategy

All elective surgical paediatric patients between ages of 0 days to 12 years old admitted to Greys Hospital PICU from January 2018 to December 2019 were included in the study. All emergency surgical admissions and all medical admissions to PICU were excluded from the study.

Measurements

To describe the clinical characteristics of these patients, clinical data was collected including date of birth, age on admission, gender, weight and Z-scores for weight, height, and body mass index (BMI) calculations according to World Health Organization guidelines [17]. Data that was

collected included HIV test results for patients aged < 18month (HIV PCR) and > 18month HIV Elisa results.

All bed requests to the PICU have a booking form completed by the on-call doctor. The waiting period for a PICU bed was assessed by looking at the date the booking form was completed and the date of admission to PICU. For all the patients, a review of reason for PICU admission (which includes observation and recovery after elective procedure, ventilation, inotropic support, or pain management after elective procedure). Length of stay was calculated using the admission date and the date that the patient was discharged/or died or transferred to another hospital. For mortality, the patients' files were reviewed to analyze the circumstances surrounding the deaths.

3.1.2 Sample size, data collection and analysis

Sampling

No sampling was done as the whole population size was considered for the study.

Data collection

Data was collected from electronic and/or hardcopy databases as well as clinical notes using a capture form. The information collected was stored safely with password protected documents. There were no patient identifiers.

Statistical analysis

The statistical analysis involved both descriptive and inferential statistics. The descriptive statistics included frequency tables for categorical variables and number summaries for continuous variables. The counts were too small for the categorical variable of interest for group comparisons and hence no further statistical tests were conducted. To determine the factors associated length of stay, general linear model was fitted using the Gamma family distribution since the length of stay was skewed. All the tests were benchmarked at $\alpha = 0.05$ level of significance.

3.2 Ethical Considerations

This was a retrospective review of patients' records. The register used sequential study numbers; the individual data capture forms contained no patient identifiers. The principal researcher kept the register in a password protected computer. Ethical approval to access patient records was obtained from the Biomedical Research Ethics Committee of University of KZN (BREC/00001304/2020), Greys Hospital and Department of health. No informed consent was obtained as this was a retrospective data analysis with no participant contact.

3.3 Study Significance

Critical care service demand is higher than the resource availability. This study will help develop admission criteria for elective surgical patients in a PICU and help prevent unnecessary and unplanned PICU admissions.

CHAPTER 4

Results

This chapter presents the analysis results of the 320 patients under investigation. It is important to note that some information was not available for the other parameters. Hence, the summary measures for the numerical measurements and all percentage frequencies in graphical displays are based on the valid cases, that is, excluding the missing data or unknown observations. The tabulated percentage frequencies are calculated as a fraction of the overall 320 patients.

4.1 Demographic data

A total of 798 children were admitted at Greys hospital PICU between 01 January 2018 to December 2019 of these admissions; 234 (30.0%) were elective surgical admissions from a total 320 elective surgical bed requests that were received. Of these the median (IQR) age of the patients under study was 2.0(0-17) years and there were fairly equal proportions in the three age groups, <1 year (35.0%), 1 – 5 years (34.7%) and >5 years (30.3%). PICU usually admit children up to 12 years of age, unless the child is small for adults ward due to comorbidities such as cerebral palsy. Gender distribution was 160 (50.0%) were males, 111(35.0%) were females and 49 (15.0%) of patients their gender was not specified. Patents that had no gender specified (15.0%) are those with no gender indicated in all places where data was collected from which was a file of booking forms, ward admission registers, computerized data and discharge summaries. Majority of them, 259 (80.9%) were HIV negative and in 55 (17.2%) the status was unknown. Unknown HIV status refers to those who were discharged with pending results. Nutritional status according to world health organization classified as normal nutrition (NAM) being children with weight for height above -3 standard deviation (SD) z score, moderate acute malnutrition (MAM) those plotted between -2 and -3 SD z score and severe acute malnutrition being less than -3 z score or pitting oedema or mid upper arm circumferences of less than 11.5cm. in this study majority had NAM 243 (75.9%) with 55 (17.2%) that were unknown, which means it was not documented.

Table 1: Demographic characteristics of the elective surgical bed requests for PICU (N=320)

Gender	
Female	111 (34.7%)
Male	160 (50.0%)
Unknown	49 (15.3%)
Age	
Median (IQR))	2.0 (0.6-6.0)
Age group	
<1yr	112 (35.0%)
1-5yrs	111 (34.7%)
>5yrs	97 (30.3%)
Nutritional status	
NAM	243 (75.9%)
MAM	14 (4.4%)
SAM	8 (2.5%)
Unknown	55 (17.2%)
HIV status	
Negative	259 (80.9%)
Positive	6 (1.9%)
Unknown	55 (17.2%)

Key: SAM: severe acute malnutrition, MAM: moderate acute malnutrition, NAM: not acutely malnourished

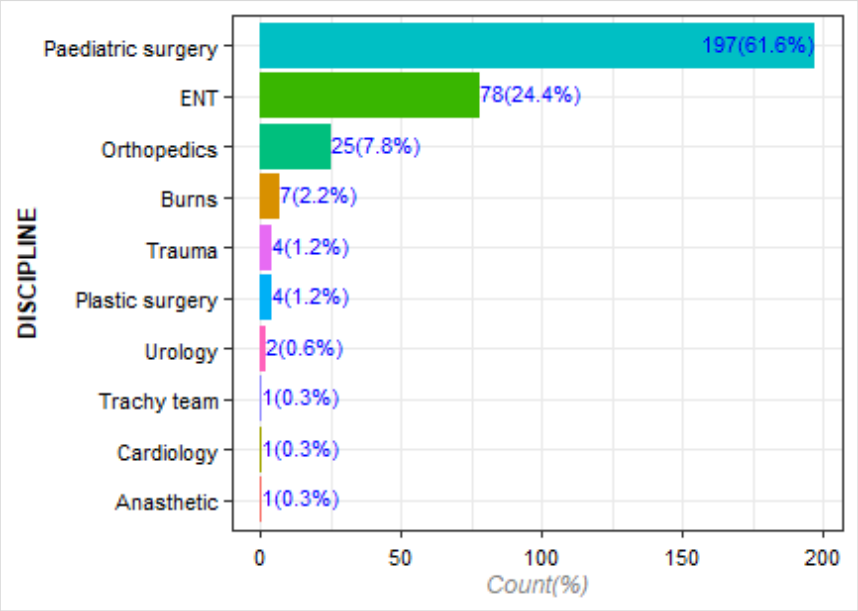


Figure 1: Bed request by surgical discipline, N=320.

4.1.1. Characteristics of children for whom bed requests were made from surgical disciplines

Figure 1 shows that the majority of bed requests were from paediatric surgery 61.6% (n = 197) and ear nose and throat (ENT) surgery 24.4% (n = 78), orthopaedic surgery and minor cases from burns, urology and trauma. The majority of admissions were for airway monitoring from ENT and paediatric surgery departments.

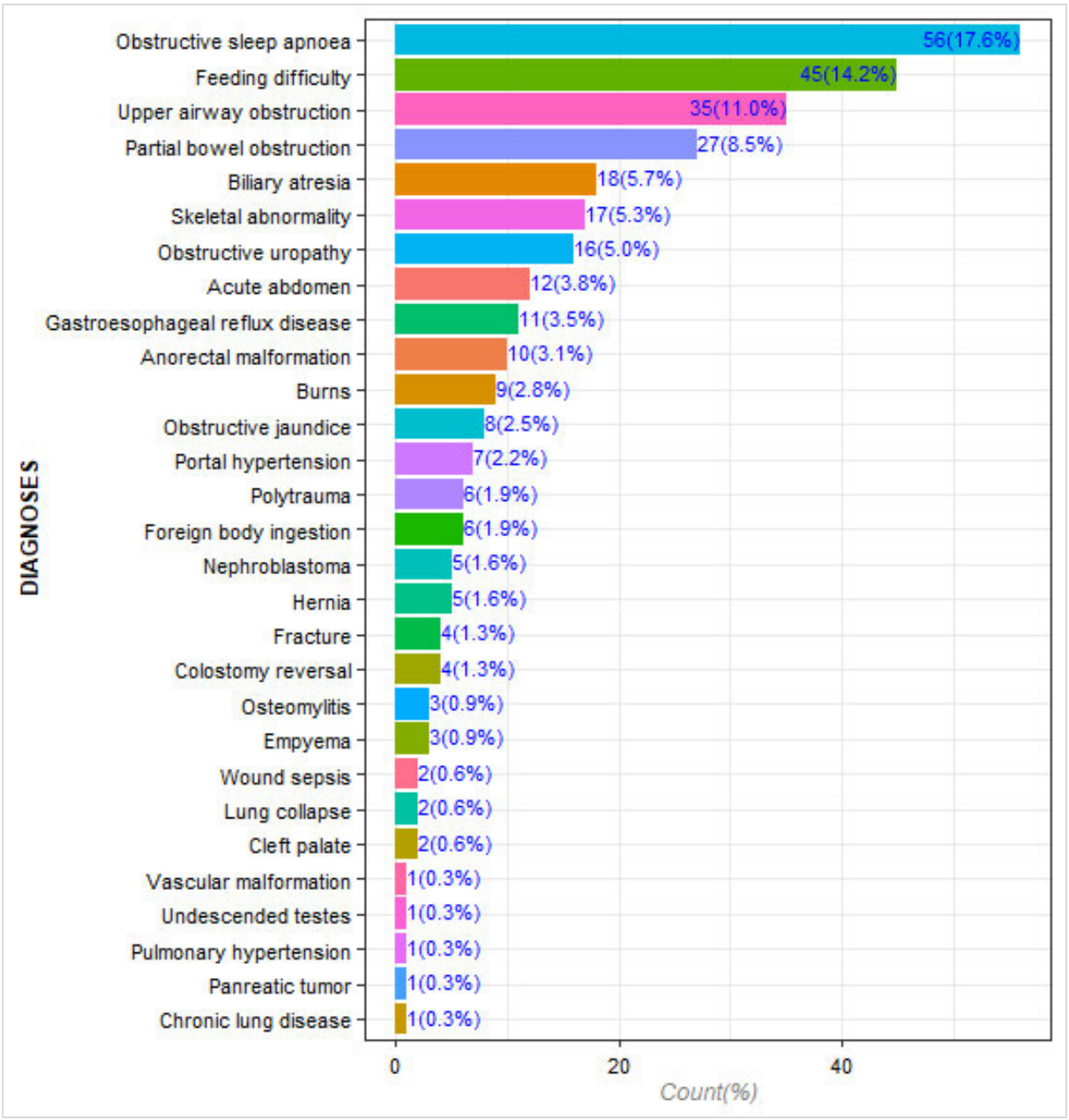


Figure 2: The diagnoses of patients for whom bed requests were made, N=320

Among the group of patients in this study, the most common diagnosis was obstructive sleep apnoea 56 (17.6%) followed by those with feeding difficulties 45 (14.2%) and upper airway obstruction 35 (11.0%), Figure 2. Among the least common diagnoses were vascular malformation, undescended testes, pancreatic tumor, and chronic lung disease

4.2 Characteristics of children admitted to the PICU

Of the bed requests, 259 (80.9%) were for high care and 20 (6.3%) were for an ICU bed. Forty-one (14.1%) did not require a post-operative bed. Of these 234 (73%) were admitted to the PICU. Only eight (2.5%) patients received anaesthetic input prior to theatre and 24 (7.5%) had

epidural as a form of pain control post-operatively. Of the admitted patients, 194 (82.9%) required high care (HC), and 40 (17.1%) needed ventilation (ICU).

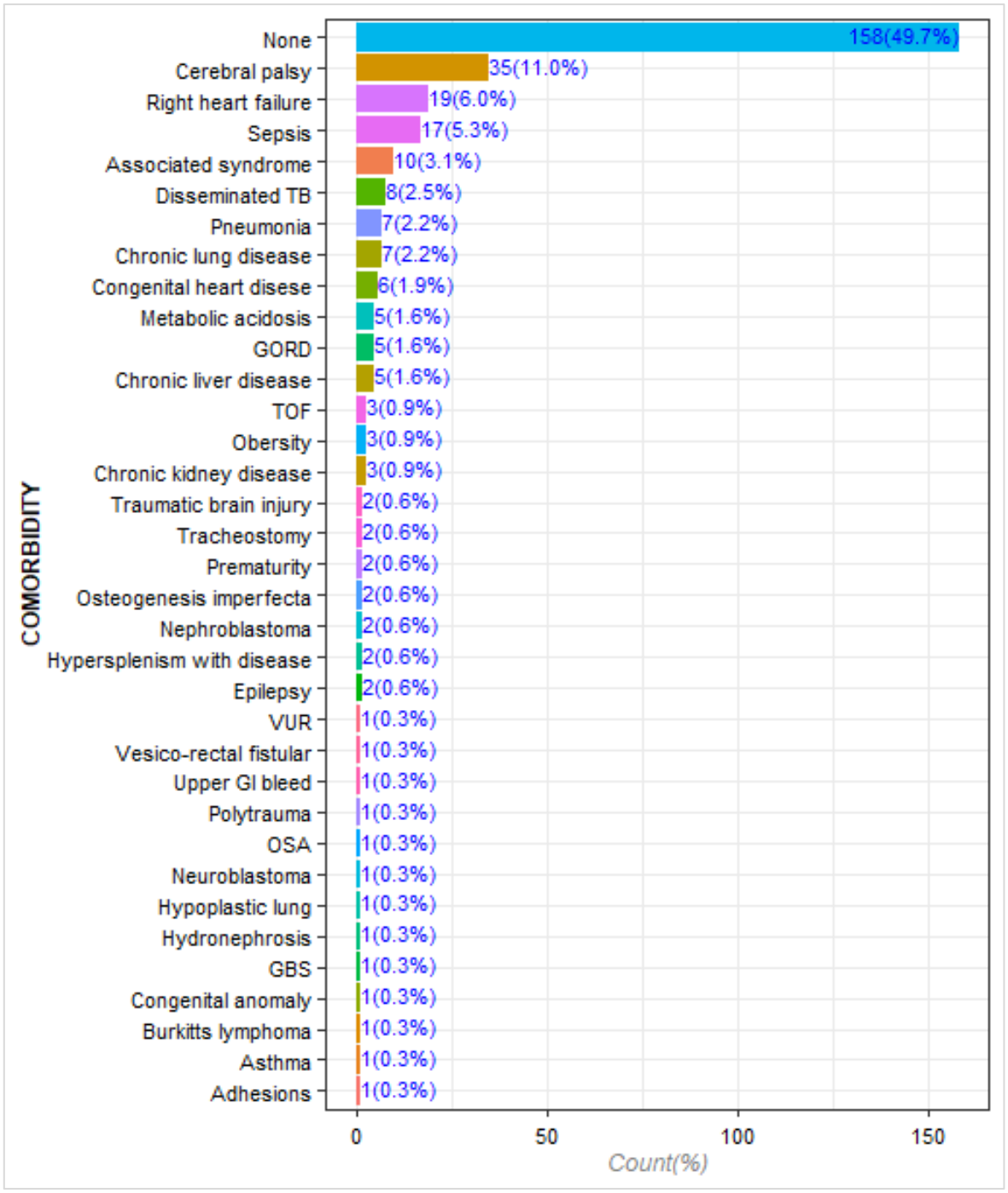
4.3 Waiting period, reason for decline, and length of stay

There were 234 elective surgical admissions, and the median (IQR) for waiting times was 2 (1-5) days. Half of the patients were admitted within 48 hours of a bed request, range (1-47) days. Majority of patients booked for an elective bed in PICU (87.2%) were offered a bed only (12.8%) were declined. Of the (87.2%) that were offered a bed (14.1%) were not admitted because they did not need a bed post-operatively as they were stable to be admitted into a general ward. 45 patients were accepted but did not require PICU bed post operatively. The majority were admitted for post-operative monitoring, 194 (82.9%). With regards to reasons for decline, 41 (12.8%) was due to lack of ICU beds. Of the ones that were declined due to lack of ICU beds 9 (2.8%) were re-booked. The average length of stay was 2 days (0 - 4.4 days). The length of stay was longer amongst those that required mechanical ventilation.

Table 2: Reason for decline and waiting time

Waiting time	
Median(IQR)	2.0(1.0-5.0)
***Re booked**	
No	311 (97.2%)
Yes	9 (2.8%)
PICU admission reason	
Post-operative stabilisation	12 (3.8%)
Post-operative pain management	27 (8.4%)
Post-operative monitoring	258 (80.6%)
Airway monitoring	13 (4.1%)
Ventilation	7 (2.2%)
Neuroprotection	3 (0.9%)
Bed request accepted	
Yes	279 (87.2%)
No	41 (12.8%)
Outcome of the request	
Accepted and admitted	234 (73.1%)
Declined no ICU bed	41 (12.8%)
Accepted not admitted (no need for ICU bed)	45 (14.1%)

*Re-booked mean patients who were initially booked on the elective PICU admission book but were cancelled due to unavailability of PICU bed or surgery was postponed due to lack of theatre time or a patient was unwell on the day of elective surgical procedure and had to be booked for another day.



Key: GBS: Guillain-Barre syndrome, TOF: Tetralogy of Fallot, VUR: Vesicoureteral reflux, OSA: Obstructive sleep apnoea

Figure 3: Co-morbidities in children admitted to PICU, N=234

Of the study population 158 (49.7%) reported no co-morbidity. The most common comorbidity was cerebral palsy 11.0% (35) followed by right heart failure 19 (6.0%) and sepsis in 17 (5.3%), Figure 3.

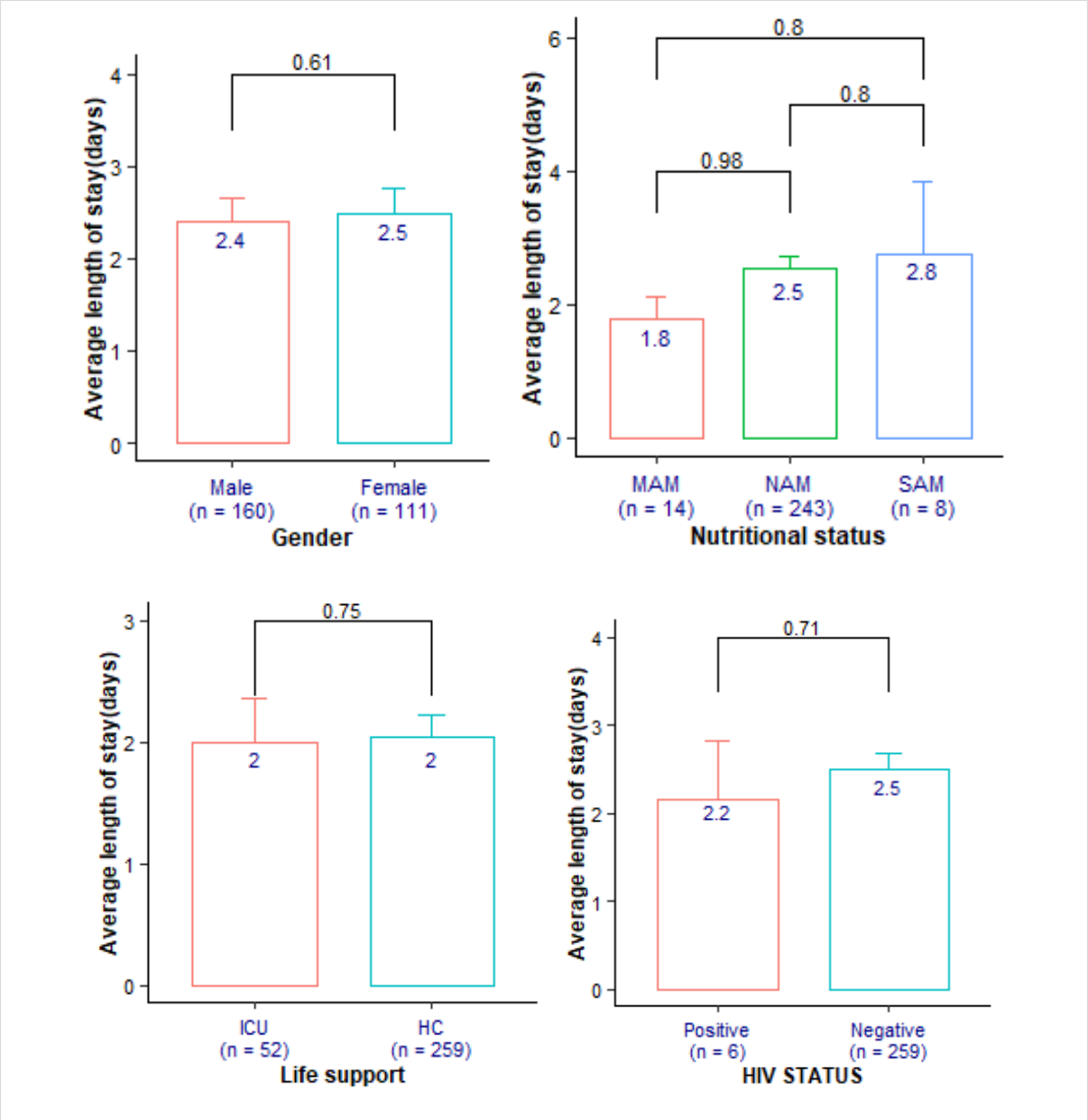


Figure 4: Comparison of length of stay gender, nutrition, life support and HIV status

There was no significant difference in the median lengths of stay between males and females p = 0.610, type of life support p = 0.75, HIV status p = 0.71 and between patients with different nutritional status p=0.8.

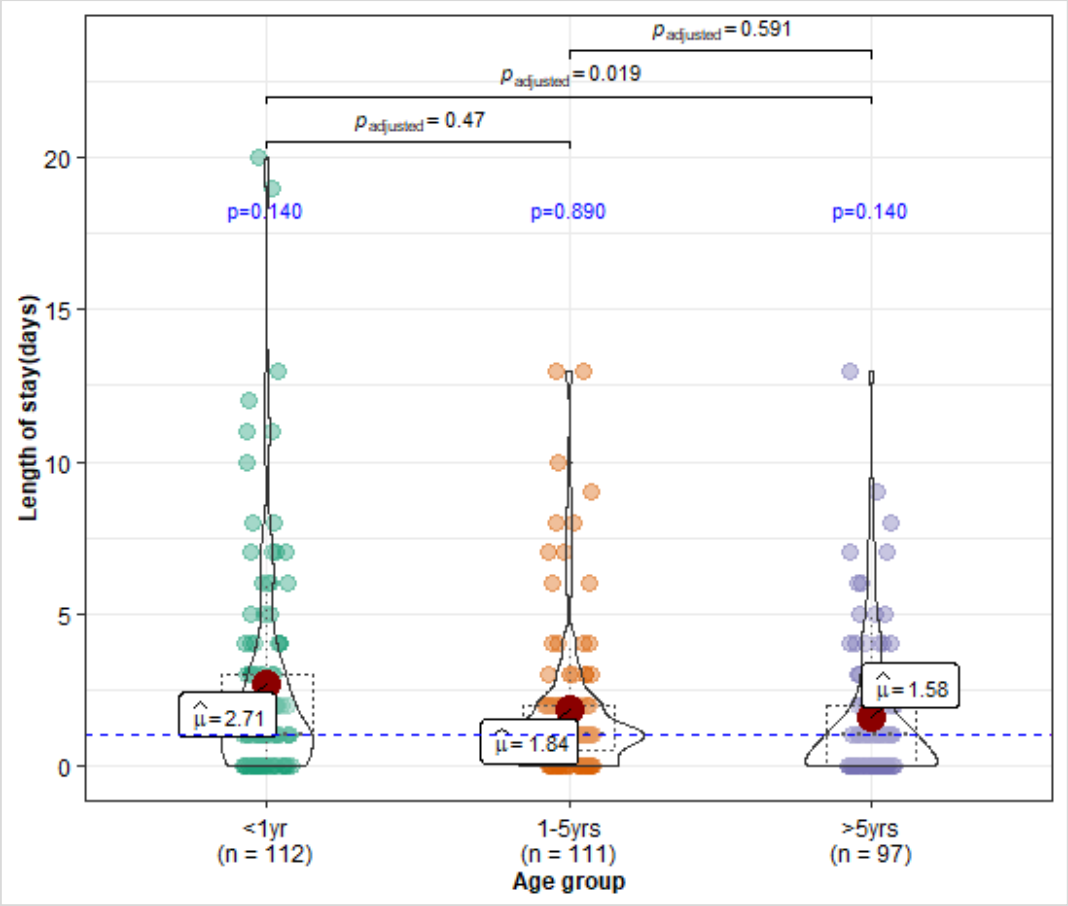


Figure 5: Comparison of length of stay by age group

However, the length of stay in hospital tended to differ by age group, p = 0.006 (Figure 5). A significant difference in the median number of days stayed at the hospital was observed between patients under one year and those above the age of five years p = 0.019. Patients under one year tended to stay longer with two individuals having length of stay of 20 days. When comparing length of stay by discipline, urology patients had a longer length of stay with an average 3.5 days longer when compared to other disciplines.

With regards to length of stay age group under 1 year was the only factor which impacted the length of stay, in the absence of the influence of other factors, the average length of stay for patients 1-5 years old was 28.0% lower that of those under one year. After controlling for the waiting time, nutritional status, HIV status, gender, anaesthetic input, epidural administration and life support, the average length of stay for patients 1-5 years old was 31.0% below that of those under one year, p = 0.026. Further, a stepwise regression suggested that dropping all the other studied potential factors resulted in the age group as the sole predictor of length of stay in hospital. With age group as the only predictor, the patients 1-5 years old were 28.0% less

likely to stay longer than those under one year. There was no significant difference in the length of stay between those aged below one year and those above the age of 5 years, p = 0.222.

Table 3: Factors associated with the length of stay

Explanatory	Unadjusted OR(CI,p-value)	Adjusted OR(CI,p-value)
Waiting time	1.00 (0.98-1.02, p=0.765)	1.00 (0.98-1.02,p=0.883)
Nutritional status MAM vs NAM	0.65 (0.38-1.23, p=0.146)	0.60 (0.35-1.13, p=0.089)
Nutritional status SAM vs NAM	1.42 (0.63-4.16, p=0.458)	1.35 (0.59-3.92, p=0.527)
HIV status Positive vs Negative	0.73 (0.35-1.95, p=0.475)	0.84 (0.40-2.18, p=0.676)
Gender Male vs Female	0.92 (0.69-1.23, p=0.590)	0.97 (0.72-1.29, p=0.834)
Anaesthetic input Yes vs No	1.14 (0.54-3.06, p=0.761)	1.26 (0.59-3.32, p=0.586)
Life support ICU vs HC	1.02 (0.71-1.51, p=0.932)	0.89 (0.61-1.33, p=0.537)
Age group 1-5yrs vs <1yr	0.72 (0.52-0.98,**p=0.040**)	0.69 (0.49-0.97, **p=0.026**)
Age group >5yrs vs <1yr	0.80 (0.57-1.15, p=0.222)	0.79 (0.56-1.14, p=0.205)

4.4 Outcome

Of the total 234 that were included in the study, 3 (0.9%) patients died, one was transferred to IALCH, whilst 231 (72.2%) were discharged. Of the three patients that died, two were under the age of one year and the other one between the 1 – 5 years. All the three were HIV negative, in the NAM nutritional status and with no anaesthetic input and did not have an epidural for post-operative pain control. One child was admitted to ICU and two were in HCU. They were admitted into either ICU (1/3) or HC (2/3).

Chapter 5

Discussion

In the current study, elective surgical admissions contributed to 30.0% of total admissions. Bed accessibility was high as majority of bed requests 87.2% were accepted, with an average waiting period of 4.0 days. Patients that had a longer length of stay were less than 1 year of age and were malnourished. Majority of patients tested negative for HIV (80.9%), only (1.9%) were HIV positive and all were on anti-retroviral treatment.17.2% of patient did not have an HIV results on discharge from PICU, this was as a result of HIV test results being pending as majority of patients had a short length of stay. Children admitted for urological interventions also tended to have a longer hospital stay when compared to other surgical disciplines. The outcome was good with only 1.3% mortality in the accepted patients.

The elective admissions in this study contributed 30.0% of all admissions, these findings are similar to those reported by Argent et al, who found between 32.0% and 41.0% of the PICU admissions to Red cross war memorial children's hospital, from 2007 to 2011 were elective surgical patients [7]. In South Africa PICU and High care facilities are linked which may explain higher levels of admission compared to Greece, where only 7.7 % of surgical patients admitted to the PICU [24]. In Latvia, the number was higher with 45.0% of admissions being elective postoperative patients [25].

In the current study, the majority of bed requests for post-surgical patients were accepted; this was higher than the study done locally at Helen Joseph Hospital in Johannesburg, which reported only 32.0% [27] of bed request accepted. Argent and colleagues reported that between 46 to 79 patients per annum had elective surgery cancelled due to unavailability of PICU beds which was higher than 41 patients in two years in the current study [7]. In higher income countries, Lapichino and colleagues, reported an overall admission rate of 85.6% which is similar to our study [28]. The majority of elective surgical admissions were for high care and they had a shorter length of stay compare to ICU patients which may contribute to our higher acceptance rate.

The average length of stay was 2 days in the current study which was similar to the study reported by Nupen and colleagues in Cape Town [11]. This is in keeping with what was reported in Latvia PICU, the short length of stay in that PICU was mostly driven by a large proportion of

elective post-operative admissions [25]. Patients that had a longer length of stay were less than 1 year of age and were malnourished, this was similar to what was reported in other studies [12, 13, and 18]. Pollack and colleagues reported that risk factors for prolonged length of stay were younger children, those with cardiovascular disease and those with cardiac arrest prior to admission [29]. The shorter length of stay in this study maybe associated with nutritional status of the patients admitted during the study period, with the majority (75.9%) having a normal nutritional status [29].

The overall outcome in this study was good, majority of admissions 98.7% were discharged with no morbidity. Mortality rate was low, this was lower that 36.1% reported in Nigeria [30]. They reported that the reason for their higher mortality rate was that paediatric patients were admitted in general ICU not in PICU which was not the case in the study [30]. Other risk factors for mortality are very young age (neonates and infants), children with American Society of Anaesthesiologists (ASA) physical status III and IV, emergency interventions and repeated anaesthetics [31]. The current study was based on elective surgical admissions, which could be the reason for low mortality rate as emergency interventions are reported to be associated with high mortality.

The strengths of this study was that all the requests for the beds in PICU were captured and the PICU is the only unit with paediatric surgical disciplines therefore this gives an indication of the need for post-surgical needs of children in Region 2 of the province. Due to the wide variety of surgical disciplines, this study gives a good indication of the broad-based needs of children for post-surgical intensive care in a low-middle income country. The study is limited by its retrospective nature and may be biased by possible lack of bed requests if disciplines are aware of lack of beds and therefore skewing the results of the study.

The other limitation identified was missing information on records, such as HIV status, gender and nutritional status of patients as it may contribute to the outcome such as length of stay and overall mortality and morbidity.

Conclusions

Elective surgical patients contributed about 30.0% of total PICU admission. The length of stay and mortality of these patients was low. Majority of the patients were from paediatric surgical department and were requiring high care management. Children younger than a year had longer length of stay and this should be factored in bed-planning and risk stratification of admission requests.

Recommendations

This study showed that elective surgical patients have good outcome such as length of stay and mortality. All patients had pre-operative assessment which has been reported to be associated with less post-operative complication. This study also highlighted the high demand for the PICU bed which is a limited resource. Our recommendation is to consider PICU expansion to accommodate the elective surgical cases as this service is limited in the province of KwaZulu natal. We recommend good the surgical team & PICU team working relationship for the best interest of the patient. We suggest improvement in data capturing.

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Appendices

Data collection sheet:

Referral

- The surgical discipline the patient was referred from
- The referring health facility (and hospital category)
- Date PICU bed was booked
- Date of admission to PICU
- Date of discharge

Patient demographics:

- Date of birth
- Gender
- Age

Nutritional status

- Weight for age z score
- Height for age z score
- Weight for height z score

HIV status

- Maternal HIV status at delivery
- Patient's HIV status
- If HIV infected, is the patient on treatment or not

Reason for PICU admission:

- Observation and recovery after elective procedure

- ICU care
- High care
- Pain management after procedure

Clinical features on admission to PICU:

- Initial BP
- Initial hydration status
- Initial perfusion status
- Initial temperature

Laboratory features on admission to PICU:

- Initial blood gas
- Initial CRP
- White cell count
- Blood glucose
- Haemoglobin
- Platelets
- Urine culture
- Blood culture

Final Diagnosis

- The spectrum of causes will be reviewed and categorized.

Management

- Ventilatory support
- Inotropic support
- Antibiotics
- Analgesia (epidural, morphine infusion etc.)

Outcome

- Waiting period for a PICU bed
- Complications while awaiting PICU bed
- Length of stay
- Discharged
- Transferred to other hospital
- Withdrawal of care
- Death