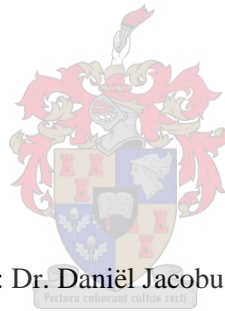


A Cross Sectional Study of the Availability of Paediatric Emergency Equipment in 24 hour Cape Town Emergency Centres

by

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Research assignment presented in partial fulfilment of the requirements
for the degree Masters of Medicine in the Faculty of Medicine and Health Sciences
at Stellenbosch University



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December 2019

Declaration

I, the undersigned, hereby declare that the work contained in this assignment is my original work and that I have not previously submitted it, in its entirety or in part, at any university for a degree.

Date: December 2019

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Part A: LITERATURE REVIEW

Introduction

South Africa is an upper middle income country with an estimated population of 56 million.(1,2) In 2017, the World Bank reported that 55.5% of South Africans live below the poverty line and 30% of the population is aged younger than 15 years.(1,2) National and international inequities in income promote subsequent disparities in health care which are particularly disadvantageous for children. Children represent a vulnerable group in society and it is of paramount importance that children's rights are safeguarded to mitigate their vulnerability, particularly as it relates to health and access to health care services.(3) Paediatric emergency care impacts on child health and survival due to the significant global paediatric emergency care burden.(4–7) It is therefore imperative that the importance of access to appropriate and efficient paediatric emergency care is recognised because of its potential to limit morbidity and mortality of our children.(8)

Goals of paediatric care

The provision of high-quality paediatric care, is a global priority that is essential in protecting the rights of the child.(9-11) In South Africa, access to health care is a human right for all children that the government is legally bound to implement.(12) Section 27 of the Constitution of South Africa provides that “everyone has the right to have access to health care services and no one may be refused emergency medical treatment”.(11) In addition, section 28(1)(c) gives children “the right to basic nutrition and basic health care services”.(11) Regional and international treaties echo the importance of child health as per The African Charter on the Rights and Welfare of the Child and the UN Convention on the Rights of the Child.(9,10)

Commitment to these legal responsibilities is evidenced by South Africa's current participation in the 2030 Global Agenda for Sustainable Development.(13) Prior to this, as part of the United Nations Millennium Declaration, the Millennium Development Goals(MDG) constituted eight international development goals to be achieved during the period 2000-2015.(14) MDG 4 called for a two-thirds reduction in the under-5 mortality rate(U5MR).(15) Global burden of disease is reflected in the infant mortality rate(IMR) and U5MR and are key indicators of health and development.(16) In a systematic analysis of the progress towards MDG 4, Lozano et al estimated that South Africa, along with the majority of Sub-Saharan African countries, would only achieve MDG 4 sometime after 2040 based on data collected from 1990-2011.(17) The 2015 MDG Country Report confirmed that South Africa had made insufficient progress to meet the MDG 4 target with a decrease in the U5MR from 60.9 per 1,000 live births to 40.3 per 1,000 live births between 1990 and 2015. (18,19) The final global MDG Report described a 53% reduction(90% uncertainty level 50-55%) in the global U5MR which did not meet the MDG 4 target.(14,20)

Following progress made during the MDG era, the 2030 Global Agenda for Sustainable Development identified 17 Sustainable Development Goals(SDG) which endeavours to build on the

foundation of the MDGs.(12) The SDGs inform and guide paediatric care and the child survival agenda for the period 2016-2030.(12,21) SDG 3, to ensure good health and well-being, is a progression of MDG 4 and seeks to limit preventable deaths and reduce the U5MR to a maximum of 25 deaths per 1,000 live births and neonatal mortality rate(NMR) to 12 deaths per 1,000 live births.(12) The current situation in South Africa in relation to the SDG 3 target, as per the 2018 United Nations Inter-Agency Group for Child Mortality Estimation report, estimates an U5MR of 37 per 1,000 live births with an annual rate of reduction of 1.8% for the period 1990-2017 and a NMR of 11 per 1 000 live births.(19)

Paediatric emergency care burden

The literature confirms a significant global paediatric emergency care burden.(4–7) In Sub Saharan Africa, the majority of the 10 leading causes of under-5 mortality are time sensitive emergency conditions requiring treatment within hours to days to avoid major morbidity and mortality (Figure 1).(22)

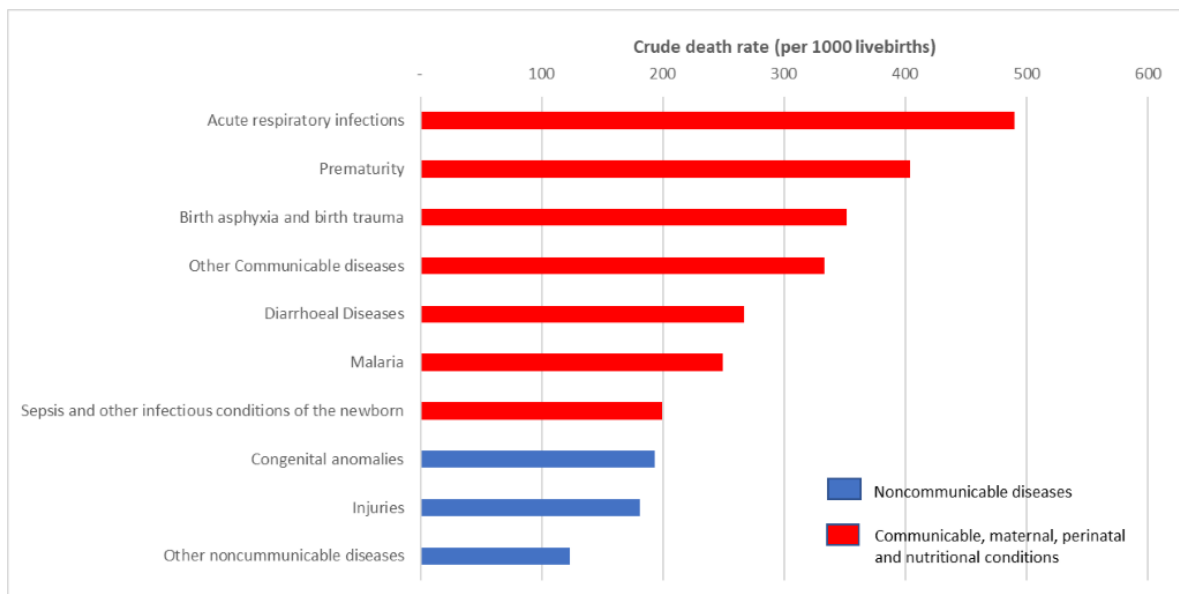


Figure 1 - Top 10 causes of child deaths (ages 0-5) in Sub-Saharan African countries in 2016. Source: Global Health Estimates 2016: Deaths by Cause, Age, Sex, by Country and by Region, 2000-2016. Geneva, World Health Organization; 2018.

This is substantiated by a systematic review of emergency care in 59 low- and middle-income countries(LMIC) which reported particularly high mortality in pediatric facilities and in Sub-Saharan Africa.(23)

In a report by the Institute of Medicine, children represent 27% of all emergency centre(EC) visits in the United States.(4) Similarly, in the United Kingdom(UK), children under the age of 19 years account for approximately 25% of all EC visits.(24) The Pakistan National Emergency Department Surveillance

project identified 25% of patients aged less than 16 years presenting to ECs.(7) Studies from Tanzania and South Africa also reported a 25% paediatric patient burden in ECs.(5,6)

A 2017 research report on emergency hospital care for children and young people in the UK, described the 10 most common emergency conditions presenting to the EC ranging from viral and bacterial respiratory infections to abdominal complaints and traumatic injuries (Table 1).(25) Common to all presentations was the high acuity of the conditions requiring immediate and appropriate medical attention.(25)

Table 1 The 10 most common conditions diagnosed on emergency admission for 0 to 24-year-olds in the United Kingdom during 2015 and 2016

Rank	Condition
1	Viral infection
2	Acute bronchiolitis
3	Other upper respiratory infections
4	Abdominal pain
5	Intestinal infection
6	Acute and chronic tonsillitis
7	Poisoning by other medications and drugs
8	Epilepsy, convulsions
9	Asthma
10	Fracture of the upper limb

Despite this patient burden and high acuity disease profile, many ECs are not adequately prepared to respond based on a range of quality indicators including emergency paediatric supplies and equipment.(4)

Paediatric-specific emergency care

Sick and injured children are a challenge in the acute care environment largely due to their unique medical, social and emotional requirements.(4) Physiological and anatomical parameters change as children grow; vital signs that would be within the normal range for an adult patient may signal distress in a child.(4) Routine procedures such as intubation and prescribing medication must also be adjusted for weight.(4) Socially, children must be handled with sensitivity and communication must, as far as possible, be tailored to their individual emotional and developmental needs notwithstanding the importance of maintaining effective communication with care givers.(4)

Minimum standards required to provide safe and effective care for acutely ill children in ECs have been suggested.(26) One of the identified standards was an organised EC with easy access to essential equipment required for the care of acutely ill or injured children of all ages at all times.(26)

Paediatric emergency care equipment

Appropriate and efficient paediatric care in the EC is paramount to limit morbidity and mortality.(27,28) Numerous problems exist that can restrict access to emergency care; one being the non-availability of age-appropriate equipment.(4,8) Literature from multiple regions globally demonstrates that the availability and accessibility of paediatric emergency equipment is variable with considerably bigger deficits in ECs with low paediatric volumes.(28-31) McGillivray et al performed a survey of more than 700 ECs in Canada and reported 15.9% intraosseous needle, 3.5% infant bag valve mask device and 3.5% infant laryngoscope blade non-availability, all of which are essential paediatric emergency equipment.(29) The 2002-2003 National Hospital Ambulatory Medical Care Survey, reported that only 6% of ECs in the United States of America had all the recommended paediatric supplies and equipment.(31) Research reported from LMIC echoes these results. A cross sectional study undertaken in district hospitals across Rwanda reported 50% availability of infant bag valve mask devices and no intraosseous needles in any of the facilities surveyed.(32)

Resources within emergency care systems vary regionally and internationally.(8) One method of facilitating high quality paediatric emergency care is by publishing relevant institutional and international guidelines to define the expected standards of paediatric emergency care in ECs.(8)

Guidelines defining expected standards of paediatric emergency care

Global standards for the provision of paediatric emergency care have been established by international organisations such as the World Health Organisation and the International Federation of Emergency Medicine.(33,34) The standards apply to any emergency care system and do not mandate the need for highly specialised equipment, staff or facilities. More importantly, attention to the differences between adults and children is emphasised which facilitates simple changes to practice and better utilisation of available resources.(33) Similarly, the American Academy of Paediatrics and the Royal College of Paediatrics and Child Health (UK) have published region specific guidelines in line with the international standards; including recommendations regarding resuscitation equipment.(31,35) Currently, there are no region specific guidelines for Africa.

The Western Cape province of South Africa has adopted an expert consensus report, *Standards for Paediatric Emergency Care*, established by the Western Cape Provincial Clinical Governance Committees for both Child Health and Emergency Medicine.(36) This report is a valuable local guideline in the Western Cape but has not been recognised on a national level by the South African Department of Health. It was however, approved by Paediatric Emergency Care South Africa, a special interest sub group of the Emergency Medicine Society of South Africa.

Unfortunately, the availability of essential emergency equipment remains sub optimal despite the establishment of local standards of paediatric emergency care guidelines.(4) This suggests the influence

of additional factors and the need for further research to guide future quality improvement measures in paediatric emergency care.(37)

Conclusion

Paediatric emergency care is a vital, nuanced sub-speciality which relies on attention to detail for the provision of high quality care. The time sensitive nature of resuscitation demands the presence and easy access to emergency equipment to ensure the most optimal outcome. It is intuitive that appropriate emergency equipment is a core requirement to provide high quality emergency care however, it is also necessary to remain cognisant of the unique paediatric requirements. The literature confirms the importance of the availability of paediatric specific emergency equipment, however determinants of paediatric emergency equipment availability are poorly described. Such information would be invaluable in efforts to improve paediatric emergency care in the emergency centre.

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Part B: MANUSCRIPT IN ARTICLE FORMAT

Title page

A Cross Sectional Study of the Availability of Paediatric Emergency Equipment in 24-hour Cape Town Emergency Centres

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Abstract

Background: Healthcare facilities are often not equipped to deliver effective paediatric emergency care despite a significant paediatric emergency patient burden. The availability of paediatric emergency equipment potentially impacts on morbidity and mortality.

Objective: To describe the availability of essential, functional paediatric emergency resuscitation equipment on the resuscitation trolley, in 24-hour emergency centres within the Cape Town Metropole.

Methods: A cross sectional study was conducted over a 6-month period in government funded hospitals (district-level and higher), within the Cape Town Metropole, providing 24-hour emergency paediatric care. A standardised data collection sheet of essential resuscitation equipment expected to be available on the resuscitation trolley, was used. Items were considered to be available if at least one piece of equipment was present. Functionality of equipment available on the resuscitation trolley was defined as: equipment that hadn't expired, whose original packaging was not outwardly damaged or compromised and all components were present and intact. Comparisons were done using the χ^2 -test.

Results: Overall, a mean of 43% (30/69) of equipment was available across all hospitals. Mean availability of functional equipment was 42% overall, 41% at district-level hospitals, and 45% at regional/tertiary hospitals ($p=0.91$). The overall mean availability of equipment in the resuscitation area was 49% across all hospitals. There was no difference between emergency centres run by emergency physicians and those run by non-emergency physicians (43% versus 41%, $p=0.95$).

Conclusion: The suboptimal availability and functionality of equipment at district-level and higher is a modifiable barrier to the provision of high quality paediatric emergency care.

Background

Paediatric emergencies contribute significantly to the patient burden in emergency centres (EC).^[1-4] In the United States of America (USA), children represent 27% of all EC visits whereas the burden of patients under 18 years old was 25% in both Tanzania and South Africa.^[1-3] Despite this significant patient burden, many healthcare facilities are not adequately prepared to deliver effective paediatric emergency care.^[1] The variable availability of paediatric expertise, paediatric specific equipment, appropriately trained staff and standardised treatment guidelines adversely affects the optimal emergency care of children.^[5]

The availability and accessibility of paediatric emergency equipment varies globally, with considerably more shortages in ECs with low paediatric volumes and in low- to middle-income (LMIC) regions.^[6-10] A Canadian study involving 700 ECs, reported that intraosseous needles were not available in 15.9% of centres, infant bag valve mask devices in 3.5% and infant laryngoscope blades in 3.5%.^[6] A similar survey in the USA indicated that only 6% of ECs had all the recommended paediatric supplies and equipment.^[8] The situation in Africa is even worse: A cross sectional study undertaken in district hospitals across Rwanda reported 50% availability of infant bag valve mask devices and no intraosseous needles in any of the facilities surveyed.^[10]

Resources within emergency care systems differ regionally and internationally, nonetheless several universal measures have been shown to improve and promote access to high quality paediatric emergency care.^[5] One such measure is defining the expected standards for the emergency care of children in ECs through the development of institutional and international guidelines, including recommendations regarding resuscitation equipment. There are no official guidelines for the standard of care for paediatric emergencies in Africa. In South Africa, the best available benchmark of care is an expert consensus report established by the Western Cape Provincial Clinical Governance Committees for both Child Health and Emergency Medicine.^[11] The report consists of a set of recommendations focussing on the emergency care of ill and injured children within the public health service. Although the expert consensus report is an indicator of the suggested paediatric emergency equipment required, there is no available literature in South Africa to confirm that this is being implemented in healthcare facilities. The aim of the study is to describe the availability of essential, functional paediatric emergency resuscitation equipment on the resuscitation trolley, in 24-hour ECs within the Cape Town Metropolitan region.

Methods

Study design

A cross sectional study was performed over a 6-month period (June 2018 to November 2018). The study was approved by the Stellenbosch University Health Research Ethics Committee (Ref: S17/11/273),

University of Cape Town Human Research Ethics Committee (Ref: 820/2018) and Western Cape Provincial Health Research and Ethics Committee (Ref: WC_201804_015).

Study setting and population

Primary level health services in South Africa are provided through local clinics and 24-hour community health centres. Higher-level services are largely provided at hospitals; categorised as district, regional, or tertiary/central hospitals. The study was conducted in government funded hospitals (district-level and higher) within the Cape Town Metropolitan health district, who provide 24-hour emergency paediatric care (Table 1). Tertiary hospitals have separate areas for medical- and trauma-related patients, and both areas have been included in the study. Primary care facilities (e.g. community health centres) were excluded as sampling of these centres exceeded the logistical capabilities of the study.

Table 1. Study hospitals within the Cape Town metropolitan health district providing 24-hour paediatric emergency care

Hospital	Location	Hospital level
Eerste River Hospital	Eerste River, Cape Town	District
False Bay Hospital	Fish Hoek, Cape Town	District
Helderberg Hospital	Somerset West, Stellenbosch	District
Karl Bremer Hospital	Bellville, Cape Town	District
Khayelitsha Hospital	Khayelitsha, Cape Town,	District
Mitchells Plain Hospital	Mitchells Plain, Cape Town	District
Somerset Hospital	Green Point, Cape Town	Regional
Tygerberg Hospital	Bellville, Cape Town	Central/Tertiary
Victoria Hospital	Wynberg, Cape Town	District
Westfleur Hospital	Atlantis, Cape Town	District

Data collection and management

Data was collected by the principal investigator (LLK), visiting each EC once during the study period. A standardised data collection sheet was used (Appendix 1). The data collection sheet included an abbreviated list of essential resuscitation equipment (grouped into airway, breathing, circulation and disability categories) expected to be available on the resuscitation trolley. Within the 4 categories of essential equipment, 9 types of airway equipment, 5 types of breathing equipment, 4 types of circulation

equipment and 3 types of disability equipment were assessed. A total of 69 pieces of equipment were assessed. The list was adapted from an expert consensus report (The Western Cape Standards of Paediatric Emergency Care resuscitation trolley equipment list) in consultation with a specialist paediatric emergency physician (Appendix 2). It was not logistically feasible in this study to evaluate the presence of all proposed items and the selected items mainly represent new-born and small infant sized equipment. The rationale behind this decision was that it is very difficult to adapt adult equipment for this specific patient group.

The availability of equipment was measured in the following way: 1) Items were considered to be available if at least one piece of equipment was present on the resuscitation trolley; 2) Functionality of equipment available on the resuscitation trolley was defined as: equipment that had not expired, whose original packaging was not outwardly damaged or compromised and all component parts were present and intact; 3) Availability of equipment in the resuscitation area (but not solely on the resuscitation trolley), was included as an additional measure during the data collection period. This was due to the observation that, in many instances, equipment not available in the resuscitation trolley was available within proximity of the resuscitation trolley. This area, in proximity of the resuscitation trolley, was formally or informally designated as the resuscitation area by the individual health facility. In the event of multiple paediatric resuscitation trolleys within immediate proximity of each other, a single combined result was generated as it is a realistic expectation that equipment not available in one trolley would be obtained from an adjacent trolley if needed. Functionality testing was limited to those items that were present on the resuscitation trolley.

Data collection was conducted at any time during weekday business hours. Data collection times were intentionally performed at random since it is an operational expectation that the resuscitation trolley is constantly present and stocked in the event of a resuscitation which may occur at any time, without prior notice. Data collection was rescheduled if a clinical resuscitation was in progress at the planned time. Data was directly entered into an access controlled Microsoft Excel spread sheet on an access controlled laptop computer.

Statistical Analysis

Summary statistics were used to describe the variables. Comparisons of proportions of equipment available were done using the χ^2 -test. Statistical analyses were performed using MedCalc for Windows, version 18.5 (MedCalc Software, Ostend, Belgium; <https://www.medcalc.org>; 2018).

Results

Availability on Resuscitation Trolley: Overall, a mean of 43% (30/69) of essential equipment pieces was available across all hospitals. The best stocked EC had 35 pieces (51%), while the worst had 21 (31%); both were district-level hospitals. The overall availability of equipment was higher at regional/tertiary-level hospitals than at district-level hospitals (47% versus 41%, $p=0.86$) (Figure 1).

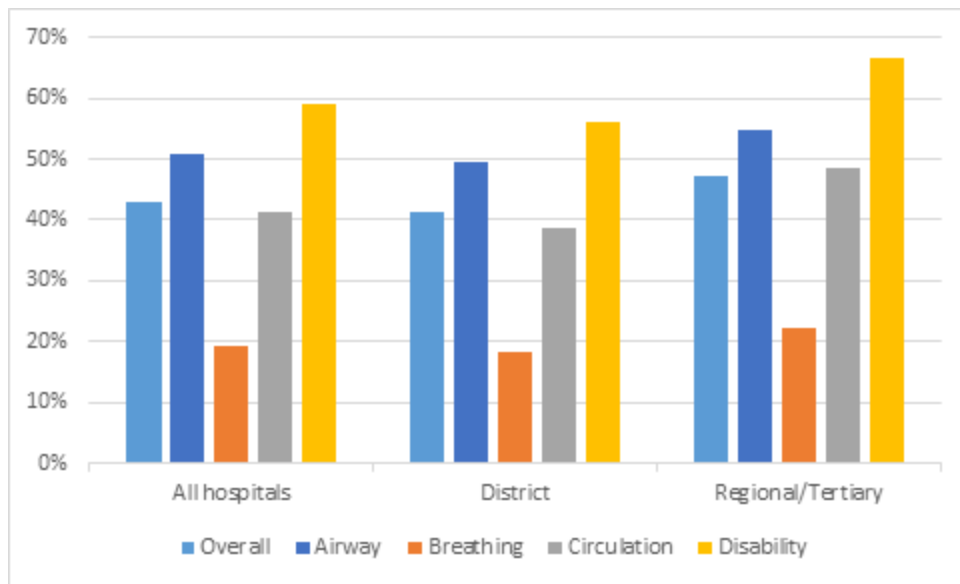


Figure 1. Resuscitation trolley availability of essential paediatric equipment on the resuscitation trolley at different hospital levels and divided per category

Functionality of Equipment on Resuscitation Trolley: The mean availability of functional equipment on the resuscitation trolley across all hospitals was 42% (minimum 32%, maximum 51%) (Figure 2). District-level hospitals had 41% of functional equipment available compared to 45% at regional/tertiary-level hospitals ($p=0.91$). A detailed breakdown of the availability and functionality of equipment is presented in supplemental material (Table S1-S9).

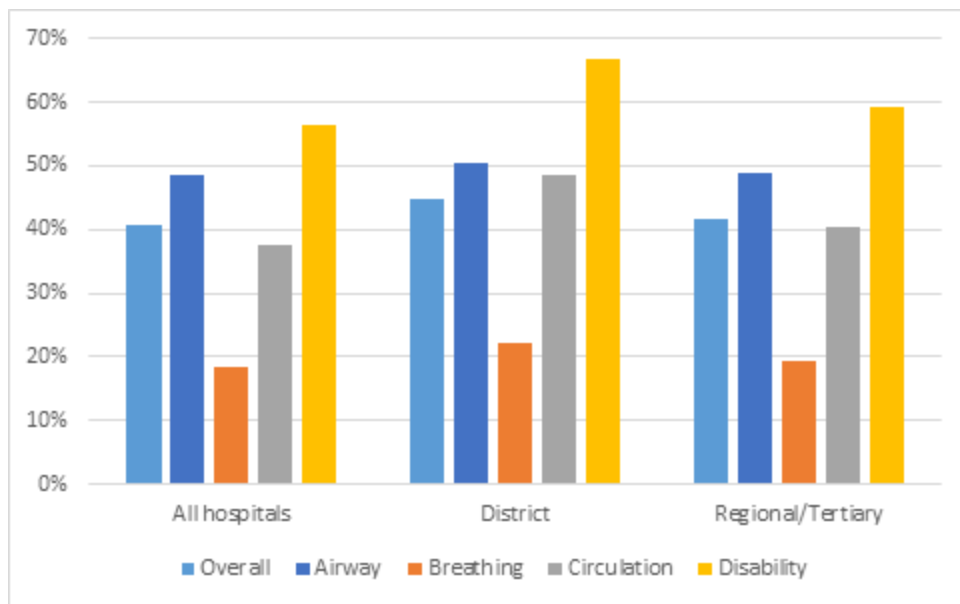


Figure 2. Functional paediatric equipment available on the resuscitation trolley at different hospital levels and divided per category

Functional equipment was equally available in centres run by emergency physicians and non-emergency physicians (43% versus 41%, $p=0.95$).

Availability in Resuscitation Area: The overall mean availability of equipment either on the resuscitation trolley or in the resuscitation area was 49% (minimum 41%, maximum 52%) across all hospitals (Figure 3).

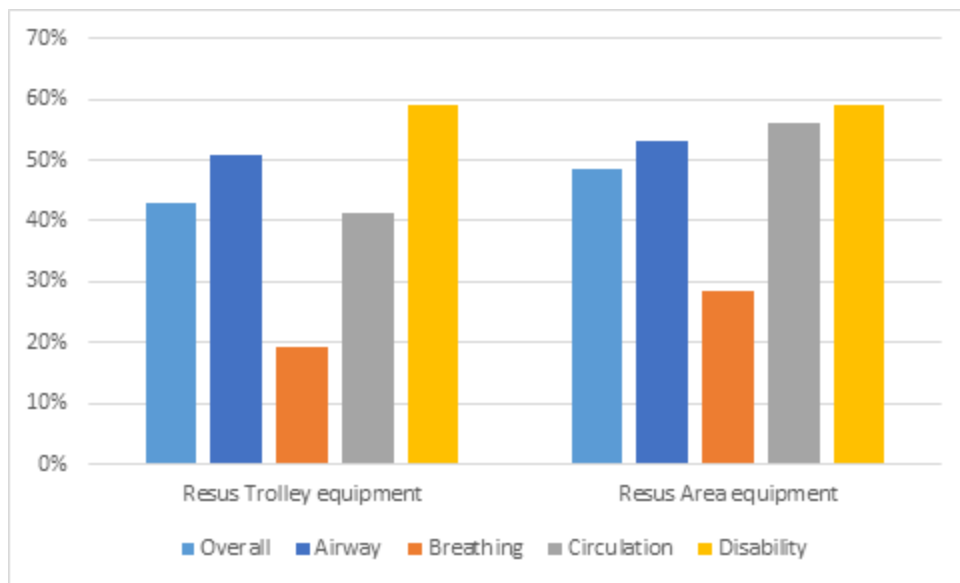


Figure 3. Availability of essential paediatric equipment on the resuscitation trolley and within the resuscitation area at study hospitals

The availability of all equipment didn't differ significantly between ECs run by emergency physicians (44%) and those run by non-emergency physicians (42%) ($p=0.95$).

Discussion

The study indicates suboptimal availability and functionality of equipment at healthcare facilities providing district-level care and higher. We found no statistical difference in both the availability and functionality of equipment in district-level hospitals compared to regional- and tertiary-level hospitals. These findings are cause for concern as the absence of essential emergency equipment compromises the potential to achieve the most optimal outcome during a time pressured resuscitation. Furthermore, the results of this study are of clinical significance because they suggest that there exists a modifiable barrier to the provision of high quality paediatric emergency care.

Our study indicates that, on average, less than 45% of essential equipment pieces was available in the ECs of the included Cape Town hospitals (43% on resuscitation trolleys and 49% when the nearby area was included). This finding is supported in the literature which stipulates that many ECs do not meet the necessary emergency paediatric equipment requirements, despite a high paediatric emergency care patient burden with a high acuity disease profile.^[1] However, the availability and accessibility of paediatric emergency equipment is noted to be inconsistent, with considerably more shortages in ECs with low paediatric volumes and in low- to middle-income (LMIC) regions such as Sub Saharan Africa.^[6-10] Our results further indicate that available equipment on the resuscitation trolley was mostly functional. This is important as a seemingly well-stocked resuscitation area could contain non-functional or expired items, thus creating a false sense of assurance. The recent implementation of a

National Core Standards (NCS) Policy in South Africa, may have contributed to removal of expired items.^[13,14] The NCS Policy addresses the operational management of health facilities (including essential equipment), which is checked during compulsory quality assurance and NCS audits.^[13,14]

The discrepancy of overall availability and functionality of equipment between regional/tertiary-level and district-level hospitals was not statistically significant (45% versus 41%, $p=0.91$). This suggests that resuscitation equipment capabilities are similar, albeit suboptimal, in ECs across the different levels of care in Cape Town. We attribute this to the fact that although regional- and tertiary-level hospitals provide a more specialised definitive paediatric service as compared to the district-level hospitals, initial paediatric emergency care remains the same irrespective of the level of care. This is also reflected in international emergency care standards, where the standards are specifically designed to be applied to any emergency care system and do not mandate the need for highly specialised equipment, staff or facilities.^[15,16] The district health system functions as the backbone of the South African health system and as such, it is important and expected that adequate essential equipment be available at district-level facilities.^[17] This is further supported by international data which indicates that ECs with a dedicated in-patient paediatric service, as is the case in district-level and higher ECs in Cape Town, are likely to have adequate paediatric supplies available.^[12]

The strength of the study is its contribution to the limited data pertaining to paediatric emergency care, particularly in LMIC regions. The description of the presence of equipment on the resuscitation trolley and the nearby resuscitation area is an important indicator of the ability to provide high quality advanced life support to children, with the potential to positively influence morbidity and mortality.^[20,21] However, the study has several limitations. Firstly, the study was restricted to the Cape Town metropole in the Western Cape and care must be taken in generalising the results to other settings. Secondly, a single investigator collected the data. Sampling errors may have occurred despite measures taken to ensure accurate data collection. Lastly, a dedicated paediatric tertiary level hospital in the Cape Town Metropolitan Health District was excluded from the study due to failure to obtain the necessary permissions within the timeframe of the study. Data from the excluded site might have influenced the study, although the direction cannot be determined.

The results of this study serve as a valuable benchmark for future advocacy efforts to improve health facilities and essential paediatric emergency resuscitation equipment. Follow up research questions, to build on the results of this study, would be invaluable to the research and clinical community given the paucity of literature focussed on paediatric emergency care in emergency centres. In view of the poor performance by a range of health facilities in the Cape Town metropole, we believe that it is an important next step to re-evaluate and critically assess what are the determinants for not being able to meet the required standards and to consider if the standardised emergency equipment list is a reasonable and appropriate standard for health facilities in low-middle income regions, such as Sub Saharan Africa.

Conclusion

To the best of our knowledge, this is the first study to describe the availability and functionality of paediatric emergency equipment in ECs in district-, regional- and tertiary-level facilities in South Africa. The study indicates suboptimal availability of functional equipment at healthcare facilities providing district-level care and higher, which is a potential modifiable barrier to the provision of high quality paediatric emergency care.

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Appendices

Appendix 1.

Full Equipment List

	Equipment name	Size
Airway	Endotracheal tubes (cuffed and uncuffed)	2,5
	Endotracheal tubes (cuffed and uncuffed)	3
	Endotracheal tubes (cuffed and uncuffed)	3,5
	Endotracheal tubes (cuffed and uncuffed)	4
	Endotracheal tubes (cuffed and uncuffed)	4,5
	Endotracheal tubes (cuffed and uncuffed)	5
	LMA	0
	LMA	1
	LMA	1.5
	LMA	2
	LMA	2.5
	LMA	3
	Introducer/Stylet	2mm (paediatric)
	Bougie	5 Ch (paediatric)
	McGill forceps	paediatric
	Laryngoscope	Mac 0
	Laryngoscope	Mac 1
	Laryngoscope	Mac 2
	Laryngoscope	Mac 3
	Laryngoscope	Mac 4
	Laryngoscope	Mi 00
	Laryngoscope	Mi 0
	Laryngoscope	Mi 1
	Laryngoscope	Mi 2
	Laryngoscope	Mi 3
	Laryngoscope	Mi 4
	Laryngoscope	Mi 5
	Bag-valve mask device (BVM)	250ml neonatal
	Bag-valve mask device (BVM)	500ml infant
	Facemask for BVM	round 00
	Facemask for BVM	round 0
	Facemask for BVM	round 1
	Facemask for BVM	round 2
	Facemask for BVM triangular	
	Oropharyngeal airway	size 000 (pink)
	Oropharyngeal airway	size 00 (blue)
	Oropharyngeal airway	size 0 (black/grey)
	Oropharyngeal airway	size 1 (white)

	Oropharyngeal airway	size 2 (green)
Breathing	Nasal prongs	neonate
	Nasal prongs	child
	Nasal prongs	adult
	Simple oxygen mask	infant
	Simple oxygen mask	child
	Venturi mask	28% infant (yellow/white)
	Venturi mask	28% child (yellow/white)
	Venturi mask	35-40% infant (green/pink)
	Venturi mask	35-40% child (green/pink)
	Venturi mask	60% infant (orange)
	Venturi mask	60% child (orange)
	Non rebreather mask	infant
	Non rebreather mask	child
	Nebuliser mask	infant
	Nebuliser mask	child
Circulation	Intravenous canulae	24G (yellow)
	Intravenous canulae	22G (blue)
	Intravenous canulae	20G (pink)
	Volume control device (eg: buretrol)	150ml
	Volume control device (eg: buretrol)	50ml
		Rate control device (eg dial-a-flow)
	Intraosseous (IO) needles	mechanical device
	Intraosseous (IO) needles	custom made IO needle
	Intraosseous (IO) needles	bone marrow aspiration needle (15/18G)
	Intraosseous (IO) needles	lumbar puncture needle 18G
	Intraosseous (IO) needles	21G needle (green)
Disability		Weight/height estimation device
	Defibrillator	PAED PADDLES
	Electrodes	neonate
	Electrodes	paediatric

Appendix 2.**Paediatric resuscitation trolley equipment list according to “Standards for Paediatric Emergency Care: Expert Consensus Report for Emergency Centres in the Western Cape”**

AIRWAY	Sizing	
Laryngoscope	Macintosh (curved) blades 0-4	
	Miller (straight) blades 0-4	
Endotracheal Tubes*	2.5- 8 cuffed & uncuffed	
KY Jelly*		
Introducer/ stylet	Adult & paediatric (2mm / 3.5mm)	
Bougie	Adult & paediatric (5 Ch / 10 Ch)	
Securing Strapping/ tape*		
MCagills forceps	Adult & Paediatric	
Bag-Valve Mask Device	Adult +- 1000ml	
	Infant 500 ml	
	Neonatal 250ml	Only for neonates(<1/12)
Face Mask for BVM	Round – 00/0/1/2 Anatomical range of sizes	
Oropharyngeal Airway	000,00, 0,1, 2, 3, 4,5 and 6	Tongue depressor
Laryngeal Mask Airway	0/ 1/ 1.5/ 2/ 2.5/ 3/ 4/ 5	
Suction Catheter*	5F, 6F, 7F, 8F, 10F, 12F	
Yankauer catheter tip*	paediatric and adult	size Mini 15 FG Midi 18 FG
OXYGEN DELIVERY DEVICES		
Nasal prongs	neonate/ child / adult	Max flow: <1 year 1l/min – 24-40% 1 year 2 l/min – 24-30%
Simple Oxygen mask	infant, child and adult	Non-venturi, delivers 35-50%
Venturi mask	28%/ 35-40%/ 60% infant, child and adult	28%/ 35-40%/ 50%
Non rebreather mask/	infant, child and adult	60-90%
ASTHMA		
Nebulizer mask*	infant, child and adult	
Spacer for MDI delivery*	appropriate size for device & patient	
IV ACCESS & SUPPLIES		
Intravenous Cannulae	14G to 24 G	26G for Neonate only
Strapping/ securing for IV*		Alcohol swabs
Fluid administration set*	suitable for infusion pump used/ 60 dropper / blood administration	
Volume control device	150 ml/ 50ml	eg Buretrol
Rate control device		Ed Dial-a-flow
IO needles	(in order of preference) Mechanical device eg. EZY-IO drill or Bone Injection Gun Custom made IO needle – eg. Cooke needle BM aspiration needle (eg. JamShedi) LP needle 18G x 1.5” (SHORT) pink If nothing else available use plain 21G needle	
Needles*	15-25G	
Syringes*	1,2,5,10,20, 50 ml	
Insulin Syringe*	0.5ml, 1ml	
	T-piece /Y connector – flexible/ short/ lightweight	
	Short Set 75cm - for infusions such as inotropes	

Extension sets*	Long Set 150cm - for infusions such as inotropes	
3 way tap*		
OTHER		
Scissors*		
Stethoscope*		
Blood Tubes*	Xmatch/ haem/ chem/ blood culture	
Weight/ height estimation tool	Broselow/ Pawper	
Universal precautions*	Gloves/ goggles/ mask/ gown	
Electrodes	Neonate, paediatric & adult	
Medications & Fluids*	As per Medication & Fluids Chapter	
ANCILLARY EQUIPMENT/ SUPPLIES TO RESUS TROLLEY		
Monitors*	Oxygen Saturation Heart Rate Blood Pressure ECG tracing Respiratory Rate (Capnography)	Probes infant/ child/ adult Cuffs for all ages Electrodes adult/ child Probes/ leads
Oxygen*	Wall mounted (humidified) Portable cylinder	
Suction units*	With tubing	
Defibrillator	With paediatric paddles, gel	

*Equipment not included in the study equipment list as provided in Appendix 1

Supplementary material

Table S1. Availability of essential paediatric equipment on the resuscitation trolley at different hospital levels and divided per category

Availability	Equipment	All hospitals		District		Regional/Tertiary	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Resus Trolley equipment	Airway	51%	9.85%	49%	10.94%	55%	5.92%
	Breathing	19%	10.52%	18%	12.22%	22%	3.85%
	Circulation	41%	11.03%	39%	11.65%	48%	5.25%
	Disability	59%	20.23%	56%	17.68%	67%	28.87%
	Overall	43%	5.73%	41%	5.75%	47%	3.02%

Table S2. Functional paediatric equipment on the resuscitation trolley at different hospital levels and divided per category

Functionality	Equipment	All hospitals		District		Regional/Tertiary	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Resus Trolley equipment	Airway	49%	9.96%	48%	11.82%	50%	1.48%
	Breathing	19%	10.52%	18%	12.22%	22%	3.85%
	Circulation	40%	11.03%	38%	11.33%	48%	5.25%
	Disability	59%	20.23%	56%	17.68%	67%	28.87%
	Overall	42%	5.75%	41%	6.43%	45%	0.00%

Table S3. Availability of essential paediatric equipment on the resuscitation trolley in emergency physician(EP) and non-emergency physician(Non EP) run emergency centres

Availability	Equipment	All hospitals		Non EP		EP	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Resus Trolley equipment	Airway	51%	9.85%	47%	9.82%	55%	8.62%
	Breathing	19%	10.52%	24%	8.07%	13%	11.39%
	Circulation	41%	11.03%	42%	13.69%	40%	8.13%
	Disability	59%	20.23%	58%	25.82%	60%	13.69%
	Overall	43%	5.73%	42%	6.42%	44%	5.29%

Table S4. Functionality of essential paediatric equipment on the resuscitation trolley in emergency physician(EP) and non-emergency physician(Non EP) run emergency centres

Functionality	Equipment	All hospitals		Non EP		EP	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Resus Trolley equipment	Airway	49%	9.96%	45%	10.59%	53%	7.99%
	Breathing	19%	10.52%	24%	8.07%	13%	11.39%
	Circulation	40%	11.03%	42%	13.69%	38%	7.61%
	Disability	59%	20.23%	58%	25.82%	60%	13.69%
	Overall	42%	5.75%	41%	6.96%	43%	4.54%

Table S5. Availability of essential paediatric equipment within the resuscitation area at different hospital levels and divided per category

Availability	Equipment	All hospitals		District		Regional/Tertiary	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Resus Area equipment	Airway	53%	8.03%	52%	8.98%	56%	5.34%
	Breathing	28%	7.94%	29%	9.20%	28%	6.38%
	Circulation	56%	7.94%	56%	7.59%	58%	10.50%
	Disability	59%	20.23%	56%	17.68%	67%	28.87%
	Overall	49%	3.85%	48%	4.06%	50%	3.35%

Table S6. Availability of essential paediatric equipment within the resuscitation area in emergency physician(EP) and non-emergency physician(Non EP) run emergency centres

Availability	Equipment	All hospitals		Non EP		EP	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Resus Area equipment	Airway	53%	8.03%	51%	7.78%	55%	8.62%
	Breathing	28%	7.94%	30%	6.99%	27%	10.18%
	Circulation	56%	7.94%	56%	8.94%	56%	7.61%
	Disability	59%	20.23%	58%	25.82%	60%	13.69%
	Overall	49%	3.85%	48%	4.67%	50%	2.79%

Table S7. Overall availability of essential paediatric equipment on the resuscitation trolley

Resus Trolley equipment	Availability	Total	District	Regional/Tertiary	Non-EP	EP
	Mean	43%	41%	47%	42%	44%
	Standard Error	1.73%	2.03%	1.74%	2.87%	2.4%
	Median	43%	41%	46%	42%	43%
	Standard Deviation	5.7%	5.7%	3.0%	6.4%	5%
	Minimum	33%	33%	45%	33%	36%
	Maximum	51%	51%	51%	51%	51%
	Count	11	8	3	6	5

Table S8. Overall functionality of essential paediatric equipment on the resuscitation trolley

Resus Trolley equipment	Functionality	Total	District	Regional/Tertiary	Non-EP	EP
	Mean	42%	41%	45%	41%	43%
	Standard Error	1.73%	2.28%	0.00%	2.84%	2.0%
	Median	43%	41%	45%	41%	43%
	Standard Deviation	5.8%	6.4%	0.0%	7.0%	5%
	Minimum	32%	32%	45%	32%	35%
	Maximum	51%	51%	45%	51%	46%
	Count	11	8	3	6	5

Table S9. Overall availability of essential paediatric equipment within the resuscitation area

Resus Area equipment	Availability	Total	District	Regional/Tertiary	Non-EP	EP
	Mean	49%	48%	50%	48%	50%
	Standard Error	1.16%	1.43%	1.93%	1.91%	1.2%
	Median	51%	50%	52%	49%	51%
	Standard Deviation	3.9%	4.1%	3.3%	4.7%	3%
	Minimum	41%	41%	46%	41%	45%
	Maximum	52%	52%	52%	52%	52%
	Count	11	8	3	6	5

PART C: ADDENDA

Addendum 1. Author guidelines: South African Journal of Child Health

Available from: <http://www.sajch.org.za/index.php/SAJCH/about/submissions#authorGuidelines>

Addendum 2. Research Proposal

A Cross Sectional Study of the Availability of Paediatric Emergency Equipment in 24-hour Cape Town Emergency Centres

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Introduction

Background

Every child has the right to access health care and receive emergency medical treatment.(1) Reducing child mortality was the fourth Millennium Development Goal, and is a reliable indicator of child health within a population.(2) Data from the Global Health Observatory indicates that local and international targets have not been adequately met, despite the average annual rate of under-five mortality reduction having increased from 1.8% for the period 1990-2000 to 3.9% for 2000-2015.(3) Almost six million children under age five died in 2015 with the risk of death being highest in the African region of the World Health Organization.(3)

South Africa has a large population under 15 years of age (30%), and has endeavoured to meet the fourth Millennium Development Goal.(2,4,5) This requires a multimodal approach to provide adequate health care and to ensure adequate access to emergency health services. One proposed strategy is to improve paediatric emergency care services. There is the potential to positively influence health outcomes and reduce the long-term burden on the health system if injuries and illnesses are effectively managed during the acute phase. It is therefore necessary to implement strategies to maintain acceptable standards of paediatric emergency care.(6-11)

Evidence supports the use of published guidelines and standards to uphold levels of care.(6,7,9,10) As such, regional guidelines have been established and are routinely reviewed based on evolving clinical practices and best available clinical evidence. Additionally, these guideline assist in identifying areas requiring support and development.(11) The International Federation of Emergency Medicine (IFEM) Paediatric Special Interest Group has developed a consensus document which assists in the development of region specific standards of care for children in the emergency department.(6) The Emergency Medicine Society of South Africa is a member of this special interest group however, there are no official guidelines for the standard of care for paediatric emergencies in South Africa.

In the Western Cape, the best available benchmark of care has been established by the Provincial Clinical Governance Committees for both Child Health and Emergency Medicine.(12) A technical work group was formed in response to the lack of guidance available with regards to providing quality emergency care to the paediatric population. The multi-disciplinary workgroup consisted of local experts from paediatrics, paediatric emergency medicine, emergency medicine, critical care, and family medicine. The group included doctors, specialists, nurses and paramedics. This workgroup used a consensus approach to develop the standards document. The final document was reviewed by the executive committee of the Western Cape Department of Health, and approved for publication as an expert report, however, it does not represent official Department of Health policy. The report consists of a set of guidelines focussing on emergency care of ill and injured children within the public health

service. These guidelines include a paediatric emergency resuscitation equipment list as access to appropriate medical equipment is a cornerstone in providing emergency care (Appendix 1).

Motivation

The ideal is for emergency centres to be 100% compliant with the standard paediatric equipment and supplies requirements. However, it is apparent that even in high resourced settings this target is not being achieved.(7–9,13)

International studies reported that emergency centres are not complying to guidelines relating to the availability of paediatric equipment and supplies.(9,10,13,14). A 2006 report indicated that only 7% of hospital-based emergency centres in the United States had all the recommended paediatric emergency supplies available.(14) The situation is worse in less developed countries where poor organisation and suboptimal availability of essential supplies within emergency treatment areas has impacted on the quality of care.(11,15)

There is no comparable data currently available in South Africa and limited data is available to assess the quality of paediatric emergency care being provided. Although international guidelines exist, local guidelines are preferred for more contextual analysis. At present, the best available South African guideline is an expert consensus report from the Western Cape Department of Health.(12) If a national policy was in place, it would be possible to collect and present data reflecting the level of paediatric emergency care provided in relation to the expected standard of care. In doing so, it would be possible to determine if the poor compliance to paediatric supplies and equipment availability guidelines is as true for low resource settings, such as South Africa, as has been reported in high resource settings. In this study, a consensus local guideline with the potential for national implementation has been identified and will be used to assess the availability of emergency paediatric equipment and supplies within a low resource setting.

Aim and objectives

The aim of the study is to describe the availability of essential functional paediatric emergency resuscitation equipment on the resuscitation trolley, in 24-hour emergency centres (providing paediatric emergency care at district, regional and central level) within the Cape Town Metropolitan region as recommended by the Western Cape expert consensus report for Standards of Paediatric Emergency Care.

In order to achieve this aim, the objectives of the study are:

- i. To measure the availability of essential functional paediatric equipment on the resuscitation trolley in the following equipment categories –airway, breathing, circulation, and disability.

- ii. To describe the percentage of essential functional paediatric equipment available in the relevant health care facilities.
- iii. To compare the availability of essential functional paediatric equipment between district level facilities and regional/tertiary level facilities.

Methodology

Study design

The study will be observational in nature and a cross-sectional design will be used. Reporting will be in line with the STROBE statement for observational research.(16)

Study setting

The study will be conducted in the Cape Town Metropolitan Health District of the Western Cape Provincial Department of Health. The Cape Town metropolitan district services a population of 3.75 million people with a population density of 1500 people per square kilometre.(17) Primary level health services are provided through local clinics and 24-hour community health centres. Higher-level services are largely provided at hospitals: categorised as district (level 1), regional (level 2), or tertiary/central (level 3) hospitals.(18)

Study population

The study will be conducted in all the hospitals (district-level and higher) within the Cape Town Metropolitan health district, which provide 24-hour emergency paediatric care (Table 1). The study sample will be representative of all government funded hospitals within the Cape Town metropolitan region and will be representative of the spectrum of health services from district-level hospitals and higher. The central hospitals have separate areas for medical- and trauma-related patients, and both of these areas will be included in the study. Facilities that do not primarily provide paediatric emergency care (e.g. Groote Schuur hospital) will be excluded from the study. In addition, primary care facilities (e.g. community health centres) will be excluded as sampling of these centres would exceed the logistical capabilities of the study at present.

Table 1. Hospitals within the Cape Town metropolitan health district providing 24-hour paediatric emergency care

Hospital	Location	Hospital level
Eerste River Hospital	Eerste River, Cape Town	District
False Bay Hospital	Fish Hoek, Cape Town	District
Helderberg Hospital	Somerset West, Stellenbosch	District
Karl Bremer Hospital	Bellville, Cape Town	District
Khayelitsha Hospital	Khayelitsha, Cape Town,	District
Mitchells Plain Hospital	Mitchells Plain, Cape Town	District
Red Cross War Memorial Children's Hospital	Rondebosch, Cape Town	Central/Tertiary
Somerset Hospital	Green Point, Cape Town	Regional
Tygerberg Hospital	Bellville, Cape Town	Central/Tertiary
Victoria Hospital	Wynberg, Cape Town	District
Wesfleur Hospital	Atlantis, Cape Town	District

Data collection and management

Data will be collected by the principal investigator who will visit each emergency centre. The availability of essential resuscitation equipment will be evaluated for equipment relating to Airway (A), Breathing (B), Circulation (C) and Disability (D) categories. A list of A, B, C and D related equipment has been selected (Appendix 2) from the full Western Cape Standards of Paediatric Emergency Care equipment list (Appendix 1) It is not logistically feasible at this time to evaluate the presence of all items of equipment as proposed in the expert consensus report. The selected items relate to the A, B, C and D equipment for new-borns and small infants, as it is not possible to adapt adult equipment to perform the same function in these patients.

Only equipment that is expected to be present on the resuscitation trolley at all times will be assessed. Items will be considered to be available if at least one functional piece of equipment is present on the resuscitation trolley. Functionality of equipment is defined as equipment that has not expired, whose original packaging is not outwardly damaged or compromised and all component parts are present and intact.

It is an operational expectation that the resuscitation trolley is constantly present and stocked in the event of a resuscitation which may occur at any time, without prior notice. As such, data collection should be possible at any time. Should a clinical resuscitation be in progress at the time of the planned data collection, the data collection will be terminated and the facility will be revisited at another time.

Data will be directly entered into an access controlled Microsoft Excel spread sheet (Appendix 3) on an access controlled laptop computer. The data collection sheet has been populated with imaginary data to reflect the way in which the built-in formulas will summarize data as it is collected. Backup copies of the data will be stored in a password protected folder in an internationally recognised, password protected cloud database. Access will be restricted to the research team listed on this proposal. Transfer

of essential research material will occur between the principal investigator and study supervisors via email using a secure server and the investigators' institutional mailboxes.

Statistical Analysis

Statistical analysis will be performed by the study team using Microsoft Excel and OpenEpi (a free, Web-based, open-source statistical tool; www.OpenEpi.com). Availability of functional equipment will be assessed as present or not present and will be reported as percentages. We will report the percentage of equipment available across all facilities as well as the percentage of equipment available at each individual facility. The distributions of variables will be presented with bar charts or frequency tables. The chi square test will be used to compare the percentage of equipment available between district level facilities and tertiary level facilities. A 5% significance level will be applied.

Timeframe:

- October 2017: EMDRC approval
- April 2018: SU HREC approval
- June 2018: WCG provincial ethics approval
- July 2018: Data collection and management
- August 2018: Data analysis
- August – October 2018: Writing up results

Ethical and legal considerations

Risks and benefits

This study does not involve humans or biological samples and will only evaluate the availability of equipment. Therefore, there are no risks to individuals. The study will be done independently to the clinical staff at the study hospital and will cause minimal disturbance to service provision.

The study should yield valuable information that can be used to better healthcare to the paediatric population and hopefully improve health outcomes indirectly.

Informed consent

The study doesn't involve human subjects. It only describes the availability of equipment at the study hospitals' emergency centres. We therefore request a waiver of informed consent under the following conditions:

- This is a low risk descriptive study not involving humans or biological specimens
- No personal or identifying information will be collected

- The findings of the study will provide valuable information that is likely to influence paediatric emergency care within the Western Cape. Hospitals with inadequate equipment can be identified and recommendations made to properly stock these units.

Institutional consent will be obtained through the Western Cape Health Research Committee.

Health facilities will not be given advance notice of the exact timing of data collection so as to avoid planned alterations.

Privacy and confidentiality

No personal or identifying information will be collected. Reporting will only be done on an aggregate level and the identity of the emergency centres will not be disclosed in the public domain. However, the Western Cape Provincial Clinical Governance Committees for both Child Health and Emergency Medicine as well as the management teams of the relevant emergency centres will be informed of results of individual emergency centres in order to amend poor availability of equipment. As described above, the study will take all necessary measures to safeguard the collected data.

Limitations

This study will only assess a limited list of equipment instead of the comprehensive list as stipulated in the Western Cape expert consensus report for Standards of Paediatric Emergency Care.⁽¹²⁾ The selected equipment represents the most essential pieces of equipment to adequately manage the acutely ill small paediatric patient. We will take care to limit generalisation of the study results to the relevant equipment.

The availability of equipment will be based on the presence of just one piece of functional equipment on the resuscitation trolley; something that might not be deemed adequate in clinical practice. However, due to limited space on the resuscitation trolleys it is physically impossible to stock multiple quantities of all pieces of equipment. In the clinical setting, it would be appropriate to have multiple quantities of certain equipment (e.g. endotracheal tubes) but not others (e.g. laryngoscope handle). The scope of this study is not to determine the quantities of equipment but rather to assess the preparedness of the trolley to ensure delivery of acute paediatric care.

The study only includes hospitals at a district level and higher. This will again impact the generalizability of the studies result as primary healthcare facilities also provide paediatric emergency care. Future research is thus needed to evaluate the equipment requirements at these facilities.

The mere presence of a piece of equipment doesn't relate to the appropriate use of it. Follow-up studies will be needed to determine the actual knowledge and practical skills of healthcare personnel regarding the equipment.

Lastly, only the principal investigator will be involved with the data collection and there is a possibility that mistakes could be lead to information bias. This risk will be minimised by cross referencing electronic entries with a paper based copy of the same data collection tool.

Reporting and implementation of results

Results of individual emergency centres will be made available to the management team of the relevant healthcare facility. The results will also be shared with the Western Cape Provincial Clinical Governance Committees for both Child Health and Emergency Medicine. If all study hospitals reflect poor compliance to essential emergency paediatric equipment, it may suggest that the standard of care be reviewed although this is beyond the scope of this study. It is further anticipated that the results will be reported in a peer reviewed journal.

Resources

Available resources

The study will be self-funded.

Budget

Personnel Compensation	R0
Principal investigator	R0
Co-investigators	R0
Consulting Services	R0
Statistical services (R400/hour)	R0
Travel	R1 854
Transport	R1 854
Equipment and furniture	R100
Stationary	R100
Other	R200
Telephone, cellphone, fax	R0
Internet & email	R200
Printing & copying	R0
Total Cost	R2 154

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Appendices

Appendix 1 - Paediatric resuscitation trolley equipment list according to “Standards for Paediatric Emergency Care: Expert Consensus Report for Emergency Centres in the Western Cape”

Paediatric Resuscitation Equipment

Part A: Paediatric Resuscitation Trolley Equipment

AIRWAY		
Laryngoscope	Sizing	
	Macintosh (curved) blades 0-4	
	Miller (straight) blades 0-4	
Endotracheal Tubes	2.5- 8 cuffed & uncuffed	
KY Jelly		
Introducer/ stylet	Adult & paediatric (2mm / 3.5mm)	
Bougie	Adult & paediatric (5 Ch / 10 Ch)	
Securing Strapping/ tape		
MCagills forceps	Adult & Paediatric	
Bag-Valve Mask Device	Adult +- 1000ml	
	Infant 500 ml	
	Neonatal 250ml	Only for neonates(<1/12)
Face Mask for BVM	Round – 00/0/1/2 Anatomical range of sizes	
Oropharyngeal Airway	000,00, 0,1, 2, 3, 4,5 and 6	Tongue depressor
Laryngeal Mask Airway	0/ 1/ 1.5/ 2/ 2.5/ 3/ 4/ 5	
Suction Catheter	5F, 6F, 7F, 8F, 10F, 12F	
Yankauer catheter tip	paediatric and adult	size Mini 15 FG Midi 18 FG
OXYGEN DELIVERY DEVICES		
Nasal prongs	neonate/ child / adult	Max flow: <1 year 1l/min – 24-40% 1 year 2 l/min – 24-30%
Simple Oxygen mask	infant, child and adult	Non-venturi, delivers 35-50%
Venturi mask	28%/ 35-40%/ 60% infant, child and adult	28%/ 35-40%/ 50%
Non rebreather mask/	infant, child and adult	60-90%
ASTHMA		
Nebulizer mask	infant, child and adult	
Spacer for MDI delivery	appropriate size for device & patient	
IV ACCESS & SUPPLIES		
Intravenous Cannulae	14G to 24 G	26G for Neonate only
Strapping/ securing for IV		Alcohol swabs
Fluid administration set	suitable for infusion pump used/ 60 dropper / blood administration	
Volume control device	150 ml/ 50ml	eg Buretrol
Rate control device		Ed Dial-a-flow
IO needles	(in order of preference) Mechanical device eg. EZY-IO drill or Bone Injection Gun Custom made IO needle – eg. Cooke needle BM aspiration needle (eg. JamShedi)	

	LP needle 18G x 1.5" (SHORT) pink If nothing else available use plain 21G needle	
Needles	15-25G	
Syringes	1,2,5,10,20, 50 ml	
Insulin Syringe	0.5ml, 1ml	
Extension sets	T-piece /Y connector – flexible/ short/ lightweight	
	Short Set 75cm - for infusions such as inotropes	
	Long Set 150cm - for infusions such as inotropes	
3 way tap		
OTHER		
Scissors		
Stethoscope		
Blood Tubes	Xmatch/ haem/ chem/ blood culture	
Weight/ height estimation tool	Broselow/ Pawper	
Universal precautions	Gloves/ goggles/ mask/ gown	
Electrodes	Neonate, paediatric & adult	
Medications & Fluids	As per Medication & Fluids Chapter	
ANCILLARY EQUIPMENT/ SUPPLIES TO RESUS TROLLEY		
Monitors	Oxygen Saturation	Probes infant/ child/ adult
	Heart Rate	
	Blood Pressure	Cuffs for all ages
	ECG tracing	Electrodes adult/ child
	Respiratory Rate (Capnography)	Probes/ leads
Oxygen	Wall mounted (humidified) Portable cylinder	
Suction units	With tubing	
Defibrillator	With paediatric paddles, gel	

Part B: Emergency Centre General Equipment for Paediatrics

* for Level 3 only

EQUIPMENT	DETAILS
GENERAL	
Scales	Baby Scale/ Standing/ Sitting Scale
Weight estimation devices:	Formula /Broselow/ Pawper weight
Pain assessment scale include non-verbal	
Eye Chart {Snellen}	
X-Ray Viewing box/ screen for PACS	
Wall clocks:	Reception, Triage, Treatment room and Resuscitation
Resuscitation Stretcher with cots sides	
Trolleys for setting procedure	

Fridge with thermometer reading	for medication
PERSONAL PROTECTIVE GEAR	
Goggles eye protection	
Gloves:	All sizes sterile and unsterile
Aprons	
Surgical Masks and N95 Mask	
DIAGNOSTIC	
Diagnostic otoscope/ fundoscope set:	with different sizes ear pieces
Scissors	
L P: needles	22G X 1.5 & Inch and 22G X 3.5
Laboratory Blood Tubes	(neonate and adult)
Blood Cross Match Tubes	
Microbiology specimen containers	
Doppler with vascular probe	*
WARMING DEVICES	
Space blanket	
Fluid warmer	
Blood warmer	*
Warming device one or more of following e.g. Incubator open or closed Warming device (eg. Bair Hugger/Warm Touch/ Mistral air warmer)	NOT overhead heaters (burn risk)
AIRWAY	
CPAP Machine	with different sizes CPAP Prong
Oxygen High flow machine	with prongs sizes neonates/ infant / paediatric
Oxygen flow meter	with appropriate connector
Suction unit wall and portable	with appropriate suction tubing
DIFFICULT AIRWAY: Laryngeal Mask Airway sizes 1-5 Needle Cricothyriodotomy equipment Surgical Airway Kits / Sets	
Paediatric Ventilator / Tubes/ Connectors/ Filters/ Humidifiers	
Surgical airway sets	
Tracheostomy Tubes sizes: Neonates 3-6 Paediatric 3 -6	
ETT Tubes sizes 2,5-8,5 cuffed & uncuffed	
IV/ FLUID/ DRUG ADMINISTRATION	
Needles all sizes	G25/26; G23; G22; G21; G20 & G15
Butterfly sizes	22G to 25G/26G
IV catheters	16G to 24G
IO needles	As per resus cart

Syringes sizes	1ml, 2ml, 5ml, 10ml, 20ml, 50ml and 50 ml catheter tip.
Intravenous line giving set	NB Suitable for specific infusion pumps
Three way Tap	
Infusion controller:	Infusion pump/ syringe driver/ controller
Arm boards	
CVP packs	
Venous cut-down pack and supplies	
NASOGASTRIC SUPPLIES	
Naso-gastric tubes	Feeding tubes: 5/ 8/ 10/ 12 FrG (fluid only) Levin stomach tubes 10/12/14/16 (permit lavage)
Enteral feeding pump or flow controller (for administration of ORS via NGT)	Or in line flow control device (eg. Dialaflow) used <i>backwards</i>
Enteral giving set connector (pump specific)	Eg. Applix/ Fresenius
Feeding bottles	200ml/ 250ml with hangers
MONITORS & DEFIBRILLATOR	
Monitor – multifunction or individual for: Temperature – probes – skin/ rectal (paediatric) O2 saturation - neonatal/ infant/ child/ adult probes Heart Rate ECG trace – electrodes neonatal & paediatric Respiratory Rate Blood Pressure - leads and cuffs with neonatal, infant, child adult cuffs Capnography – probes/ leads	
ECG Machine	With paper/ ink/ electrodes/ gel
Defibrillator	with paediatric paddles and pacing capability / gel
Thermometer	axillary, tympanic
Thermometer low reading	
Glucometer & strips	
Hb Meter & stris	
MISC CONSUMABLES	
Lubricating Gels:	KY/ remicaine and defibrillator
Orange sticks	
Cotton wool and Swabs	
Tongue depressor spatula	
Foley's catheter sizes	6F, 8F, 10F, 12F and 14 F
Nose plugs all sizes	(4.5/ 8 cm) (or BIPP/ ribbon gauze
Strapping:	Elastoplast, Zinc Oxide, Micro-pore
TRAUMA / SURGICAL EQUIPMENT & DRESSINGS	
Suture packs	
Suture material: nylon, non-absorbable chromic 1/2 -0/4-0	
Steri-streps	
Skin Glue	
Surgical Blades	
Stitch cutter	
Bandages / Dressing selection	

Burn dressing selection	
Ring / wire cutter	
Intercostal drain set – ICD pack	Thoracic catheter sizes 8 -14 Fr Tubing Under water drain bottles
Incision and drainage packs	
Thoracotomy pack / Tray	
TRAUMA IMMOBILIZATION	
Cervical collars – hard	sizes infant , child and adult
Head blocks/ rolls to mobilize head	
Spine board	
Extremity splints various	
Femoral Thomas splints	various sizes
Fracture immobilization apparatus:	ortho-wool plaster of paris/ fiberglass POP saw/ scissor/ splitters
Collar and cuff [or strip cotton]	
Tubigrip body bandage	
Crutches various sizes	
SPECIALIST: Halter neck traction * Pelvigrip [pelvic #] *	[torticollis]
MISC PACKS AND SETS	
New-born Kit	Umbilical clamps, Umbilical vein catheters 3,5 and 5 Bulb syringe Towels
Gastro kit – ORS / NG rehydration set	
Rape Kit	

Appendix 2 – Summary of Equipment

Summary of Equipment	
Airway	Endotracheal tubes Introducer/Stylet Bougie McGill forceps Bag-valve mask device (BVM) Facemask for BVM Oropharyngeal airway
Breathing	Nasal prongs Simple oxygen mask Venturi mask Non rebreather mask Nebuliser mask
Circulation	Intravenous cannulas Volume control device (e.g.: buretrol) Rate control device (e.g. dial-a-flow) Intraosseous (IO) needles
Disability	Weight/height estimation device Defibrillator Electrodes

Addendum 3: Ethics approval letters



Health Research Ethics Committee (HREC)

Approval Notice

Response to Stipulations

13/04/2018

Project ID :1992

HREC Reference # S17/11/273

Title: A Cross Sectional Study of the Availability of Paediatric Emergency Equipment in 24 hour Cape Town Emergency Centres

Dear Dr Lauren Lai King,

The Response to Stipulations received on 10/04/2018 13:06 was reviewed by members of Health Research Ethics Committee 2 (HREC2) via expedited review procedures on 13/04/2018 and was approved.

Please note the following information about your approved research protocol:

Protocol Approval Period: This project has approval for 12 months from the date of this letter.

Please remember to use your Project ID [1992] on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review

Please note you can submit your progress report through the online ethics application process, available at: Links Application Form Direct Link and the application should be submitted to the HREC before the year has expired. Please see [Forms and Instructions](#) on our HREC website (www.sun.ac.za/healthresearchethics) for guidance on how to submit a progress report.

The HREC will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility, permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Please consult the Western Cape Government website for access to the online Health Research Approval Process, see: <https://www.westerncape.gov.za/general-publication/health-research-approval-process>. Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.

For standard HREC forms and instructions, please visit: [Forms and Instructions](#) on our HREC website <https://applyethics.sun.ac.za/ProjectView/Index/1992>

If you have any questions or need further assistance, please contact the HREC office at 021 938 9677.

Yours sincerely,

Francis Masiye ,

HREC Coordinator,

Health Research Ethics Committee 2 (HREC2).

National Health Research Ethics Council (NHREC) Registration Number:

REC-130408-012 (HREC1)-REC-230208-010 (HREC2)

Federal Wide Assurance Number: 00001372



UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee



Room E53-46 Old Main Building
Groote Schuur Hospital
Observatory 7925
Telephone (021) 406 6336
Email: ethics@uct.ac.za
Website: www.health.uct.ac.za/fhs/research/humanethics/forms

29 November 2018

HREC REF: S20/2018

Dr B Cheema
Emergency Medicine
F51
OMB

Dear Dr Cheema

PROJECT TITLE: A CROSS SECTIONAL STUDY OF THE AVAILABILITY OF PAEDIATRIC EMERGENCY EQUIPMENT IN 24 HOUR CAPE TOWN EMERGENCY CENTRES (MMed Candidate Dr LY Lai King)

Thank you for submitting your study to the Faculty of Health Sciences Human Research Ethics Committee.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study via a reciprocal review process with Stellenbosch University HREC Reference # S17/11/273.

Approval is granted for one year until the 30 November 2019.

Please submit a progress form, using the standardised Annual Report Form if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.

(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal Investigator.

Please note that for all studies approved by the HREC, the principal Investigator **must** obtain appropriate Institutional approval, where necessary, before the research may occur.

The HREC acknowledge that the MMed student, Dr Lauren Veronica Lai King, will also be involved in this study.

Please quote the HREC REF in all your correspondence.

Yours sincerely

✶

UBurgess

PROFESSOR M BLOCKMAN
CHAIRPERSON, FHS HUMAN RESEARCH ETHICS COMMITTEE