Clinical epidemiology, management and outcomes of paediatric patients with respiratory compromise at Muhimbili National Hospital in emergency medicine department 2017

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CLINICAL EPIDEMIOLOGY, MANAGEMENT AND OUTCOMES OF PAEDIATRIC PATIENTS WITH RESPIRATORY COMPROMISE AT MUHIMBILI NATIONAL HOSPITAL IN EMERGENCY MEDICINE DEPARTMENT 2017

By

Biita Muhanuzi

A Dissertation Submitted in Partial Fulfilment of the Requirement for the Degree of Master of Medicine in Emergency Medicine of the

Muhimbili University of Health and Allied Sciences

October, 2018

CERTIFICATION

The undersigned certify that they have read and hereby recommend for examination by Muhimbili University of Health and Allied Sciences a dissertation titled **"Clinical epidemiology management and outcomes of paediatric patients with respiratory compromise at Muhimbili National Hospital in emergency medicine department 2017** in fulfilment of the requirement for the degree of Master of Medicine in Emergency Medicine of Muhimbili University of Health and Allied Sciences.



Said S. Kilindimo, MD, MMed, FCEM (SA)

(Supervisor)

_____

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(Supervisor)

_____

Date

DECLARATION AND COPYRIGHT

I, **Biita Muhanuzi**, declare that this **dissertation** is my original work and that it has not been presented and will not be presented to any other university for a similar or any other degree award

Signature..... **Date**.....

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DEDICATION

To the beloved family of Mr and Mrs. Theophil Biita for their love, prayers, guidance and encouragement over the years.

I would like to dedicate and express my deepest appreciation to my family for believing in me, loving me and always reminding me that I can do all things through Christ who strengthens me.

ABSTRACT

Background: Respiratory compromise is the common causes of paediatric emergency visits and is the leading cause of cardiac arrest among paediatric patients. In Tanzania, as in other low-income countries, little is documented about the clinical epidemiology, management and outcomes of paediatric patients with respiratory compromise attending in acute care settings.

Aim of the study: To describe the clinical epidemiology, management and outcomes of paediatric patients with respiratory compromise presenting to the Emergency Medicine Department (EMD) of Muhimbili National Hospital (MNH)

Material and methods: This was a prospective cohort study of consecutive paediatric patients (below the age of 18 years) with respiratory compromise presenting to EMD-MNH from July 2017 to November 2017. Informed consent was obtained prior to being enrolled in the study. A standardized case report form with in built online data capture software was used to record study information, including demographics, relevant clinical characteristics and overall patients' outcomes. The study data was summarized with medians and interquartile ranges, counts and proportions as appropriate.

Results: We enrolled 165 (3.3 %) children with respiratory comprise from 5041 children who presented to EMD-MNH during the study period. The median age was 12 months (Interquartile range: 4-36 months), and 90 (54.4%) were male. Overall 92 (55.8%) of children were in respiratory failure upon arrival to EMD, and the rest 73 (44.2%) were in respiratory distress. Oxygen therapy was initiated at EMD for 143 (86.7%) children, while 21 (14.7%) children received assisted ventilation. Blood gases analysis was done to 90 (54.5%) children at EMD. Also 18 (10.9%) children developed cardiac arrest in the EMD, and only 2 (11.1%) of them survived to hospital discharge. Majority 147 (89.1%) of children were admitted to the hospital, while 14 (8.5%) children died in the EMD. The overall hospital mortality was 51(30.9%)

Conclusion and recommendation: In a cohort of paediatric patients presenting to EMD with respiratory compromise was associated with significant morbidity, as evidenced by the need for assisted ventilation, antibiotics, intubation and high rate of cardiac arrest. The observed mortality rate was 31%. Future studies should focus on identification of predictors of poor outcomes among children with respiratory compromise in EMD.

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ABBREVIATIONS

ABG …… Arterial Blood Gases

APCU ……. Acute paediatric care unit

AVPU ……. Alert-Verbal-Pain-Unresponsive

CHD …… Congenital Heart Disease

ECG …… Electrocardiogram

EMD ……. Emergency Medicine Department

ICU ……. Intensive Care Unit

LAMA ……. Leaving Against Medical Advice

MNH …… Muhimbili National Hospital

MUHAS …… Muhimbili University of Health and Allied Sciences

DEFINITION OF KEY TERMS

Respiratory compromise

Respiratory emergency which is a continuum from respiratory distress to respiratory failure and respiratory arrest.

Respiratory failure:

A clinical state of inadequate oxygenation, ventilation, or both (1)

Respiratory distress

A symptom picture of increased respiratory rate, effort and work of breathing (1,2).

Respiratory arrest

Complete cessation of breathing with cardiac activity present(1)

Tachypnea

Abnormally high respiratory rate, above the upper limit of the normal range specific to the patient's age group (3)

Bradypnoea

Abnormally low respiratory rate, below lower limit of the normal range specific to the patient's age group(3)

Tachycardia

Abnormally high heart rate, above the upper limit of the normal range specific to the patient's age group (3)

Bradycardia

Abnormally low heart rate, below the lower limit of the normal range specific to the patient's age group (3)

1.0 INTRODUCTION

1.1 BACKGROUND

Respiratory compromise is a life-threatening continuum of respiratory distress, respiratory failure and respiratory arrest. A patient with respiratory compromise has breathing that is not matching the metabolic demand for oxygenation or carbon dioxide removal. Respiratory compromise is not a disease but indicates the presence of primary disease which may originate within the respiratory system or from elsewhere, such as from the cardiovascular, central nervous, endocrine/metabolic, gastrointestinal or haematological system(4). Children with respiratory compromise can quickly decompensate to cardiac arrest and death if not identified early and intervened upon aggressively by emergency care providers(4,5). The management of respiratory compromise includes urgent evaluation of airway, breathing and circulation, followed by supplemental oxygen and ventilator support if indicated(1,2,4,6). Despite the high mortality of respiratory compromise, early identification, early intervention and close monitoring can mitigate against poor outcomes (4,5,7).

Respiratory compromise is more common in children than in adults because of children's relatively smaller airways, higher metabolic demands, lower respiratory reserves and poor compensatory mechanisms(3,13). The five (5) most common causes of respiratory compromise worldwide in adults are chronic obstructive pulmonary disease, asthma, acute respiratory infections, tuberculosis and lung cancer(9–11). Globally, causes of respiratory compromise in paediatric patients are most often infectious diseases such as pneumonia, tuberculosis and sepsis(8–10,12,13). Respiratory compromise due to pneumonia is the leading cause of death worldwide, especially in children below the age of 5 years (14,15). Throughout the world, non-infectious causes of respiratory compromise in children include asthma, acute chest syndrome (in sickle cell disease), congenital heart disease, rheumatic heart diseases and trauma (1,12). Some causes of respiratory compromise can be prevented by vaccination against infectious diseases like measles, streptococcus pneumonia and tuberculosis(12). Diagnostic workup includes arterial blood gases (ABG) and chest radiography(1,6,13). After stabilization, effort is made to identify the underlying cause of respiratory compromise and

initiate specific treatment immediately. Poor outcomes of respiratory compromise can be mitigated by early recognition and early and aggressive intervention in acute care settings (1,2,6,12).

Hundred millions of people globally suffer from respiratory compromise regardless of their age, sex, race and economic status and four million of them die prematurely each year(2,6,12). Globally, respiratory compromise is one of the main complaints to acute care settings by paediatric patients. Respiratory compromise is the leading cause of cardiac arrest worldwide in paediatric patients (2,6). Respiratory compromise accounts for 10% of emergency paediatric visits and 20% of their hospital admissions, and carries a mortality of over 30% and increases ICU admission by 50% (2,4–7). Worldwide, the cost of managing respiratory compromise is high to the patient and to the hospital because of increased need of ICU admissions, increased need of ventilator support, high mortality and increased duration of stay in the hospital(5,7,16). Throughout the world millions die due to lack of vaccinations, medication, resuscitation equipment and shortage of emergency care providers (12). In United States, out of 220 paediatric patients with acute respiratory failure managed by extracorporeal life support, only 102 (41%) survived to discharge between 1982 - 1991(17). In Canada the overall mortality of acute respiratory failure was 27% between 2001-2004 among paediatric patients admitted to paediatric ICU and the leading cause of respiratory compromise was pneumonia followed by sepsis(18).

Most of the deaths in children due to respiratory compromise are from developing countries(9). The few published studies suggest infectious diseases are the most common cause of respiratory compromise (9,12,19–21). In India, mortality rate for paediatric patients with respiratory compromise was 14.4% in 2013, and the leading aetiology of deadly cases was bronchopneumonia(13). Infants and children suffer from respiratory compromise mostly due to lower respiratory infections(10). In low income countries (LICs) children suffer higher rates of morbidity and mortality from respiratory compromise due to lack of ventilator support, medications, immunization, late presentation and emergency care providers, all of which slow or prevent effective early identification and intervention. In Africa there is limited data on respiratory compromise.

Respiratory compromise is the leading cause of emergency calls to emergency medical services and cardiac arrest in children globally. The emergency care provider has a role to be called upon to urgently evaluate for airway compromise, breathing compromise and circulatory compromise, and to initiate urgent interventions before progression to cardiac arrest which has poor outcomes(2,4,6,7,12).

Emergency conditions that can be intervened upon in emergency care settings include upper airway obstruction, tension pneumothorax, shock and cardiac tamponade(8). Poor outcomes of respiratory compromise can be mitigated by emergency care providers by early identification and immediate aggressive interventions like needle decompression, defibrillation / cardioversion, supportive oxygen therapy and mechanical ventilation if needed(1,4).

In Tanzania, respiratory compromise is one of the reasons for emergency visits to casualties and emergency departments, and one of cause of death in these acute care areas is respiratory compromise due to lower respiratory infection and heart failure(15,22). Lack of gold standard diagnostic tool (Arterial Blood Gases machine) for respiratory failure in low-income countries may result into under diagnosis of respiratory compromise. Emergency care provider may depend only on signs of severe respiratory distress to suspect respiratory failure and initiate immediate intervention to children with respiratory compromise and mostly used clinical tool is paediatric early warning signs.(1). Emergency departments or casualties are the first place to be visited by acutely ill patients and the good outcomes of patients with respiratory compromise depends on the ability of emergency care provider to identify the signs of respiratory compromise by evaluating airway, breathing, and circulation and executing immediate and aggressive intervention if airway, breathing or circulation is compromised. Most of the complications of respiratory compromise are preventable. Because of suspected high cost of care of respiratory compromise in low income countries like Tanzania the only feasible option may be close monitoring and early intervention of respiratory compromise before it progresses to cardiac arrest which has poor outcomes and require ICU admissions which are not available. Emergency Medicine Department is the right place where respiratory compromise can be identified early and immediate and aggressive interventions executed to children with respiratory compromise to mitigate the poor outcomes(22).

1.2 LITERATURE REVIEW

Respiratory failure is a common cause of death worldwide, according to the World Health Organization, respiratory failure due to pneumonia were the third leading causes of death in 2004(13). Respiratory compromise in children is the leading cause of emergency visits, admissions, cardiac arrest and death, this is according to Advanced Paediatric Life Support (PALS) user manual and the study done by Schneider et al on acute respiratory failure in children (1,23). Respiratory compromise is more common in the paediatric age group than adults, Respiratory compromise due to acute respiratory infections is among the top three leading cause of death globally below 5 years of age according to Madhi and Klugman 2006 (9).

According to the Respiratory Compromise Institute website, respiratory compromise is among the top 3 causes of high cost of care to patients and hospitals. For example, in the United State USD $7.8 billion was spent by hospitals in 2007 for respiratory compromise, and the costs have progressively risen .In a retrospective study done in United States among paediatric patients with respiratory failure treated with extracorporeal life support by Moler et al, the mortality was found to be 59%(17). In another study done in Canada by Daniel et al among paediatric patients aged 1 month to 18 years admitted to paediatric ICU, he found the overall mortality to be 27% and the leading cause was pneumonia followed by sepsis and trauma(18). Most of the deaths in children due to respiratory compromise are from developing countries(9). The study done by Thomas et al in 2013 on the global burden of respiratory diseases found acute respiratory infections to be the leading cause of death in developing countries especially below the age of five(12).

In India, Singh and colleagues found that paediatric patients admitted to a tertiary care hospital with respiratory compromise in 2013 had a mortality of 14.4% and the leading cause of respiratory compromise was bronchopneumonia(13). The incidence of respiratory compromise among children aged 1month to 15 in this study decreased with age, peaking in infants followed by under 5 (13).

In Africa limited data suggests respiratory compromise is the leading cause of visits to emergency departments and mortality especially among newborn, neonate, young infants,

infants and patients under 5 years of age. In a study done in Nigeria between 2007 and 2012, Tagbo et al found that respiratory compromise accounted for 24% of all paediatric admissions(20) Another Nigerian study of paediatric patients admitted to a paediatric ward from emergency department with respiratory illnesses in 2005-2010 by Ezeonu et al found that mortality was 7.5% and the leading cause of mortality was bronchopneumonia (21). In South Africa, a 2005 study by Lee et al study of workload and case mix, found that the major presenting complaints to Emergency departments by paediatric patients was respiratory compromise (24). In Tanzania, the 2013 report of Global Burden of Disease (GBD) reported respiratory compromise due to pneumonia was the second leading cause of death in all age groups after HIV (15).

Respiratory compromise is more common in the paediatric age group than in adults(1,25). As noted previously in a study by Singh in India among children aged 1 month to 15 years, the incidence of respiratory compromise decreased with age, peaking in infants followed by under 5 (13). In children with acute respiratory compromise, the clinical presentation varies depending on the underlying causes. Margrid et al did a study in Toronto Canada among paediatric patients presenting to EMD because of out of hospital arrests, and he found respiratory arrest to be 21% among all arrests and the common presentation was trauma followed by seizures(26). The study done in India among children with acute respiratory failure aged 1month to 15 years by Singh et al in 2013 found that the most common presenting symptom was fever (68.7%) followed by irritability (67.83%) and the commonest sign was tachypnoea and nasal flaring (89.57%) followed by chest retraction (86.09%), head bobbing (72.17%) and cyanosis (30.43%)(27). In the same study, the most common cause of mortality was bronchopneumonia followed by sepsis, status epilepticus and diabetic ketoacidosis with cerebral oedema. According to Paediatric Life Support by American Heart Association, signs of respiratory distress includes grunting, stridor, hypoxia of 91-94% on room air, tachypnoea, and inability to lie flat because of distress, while signs of respiratory failure includes hypoxia of SPO2 less than 91% on room air, cyanosis, decreased level of consciousness, bradypnoea, apnoea and need of high flow oxygen

American Thoracic Society (ATS), European Respiratory society and American Heart Association (AHA) have all suggested similar algorithms for the evaluation and management of respiratory compromise which begins with immediate assessment of airway, breathing and circulation, followed by supplemental oxygen and ventilator support if indicated(1,2,4,6). From Paediatric Advanced Life Support (PALS) user manual by American Heart Association, the initial diagnostic workup includes; arterial blood gases, non-invasive end tidal carbon monoxide monitoring, oxygen saturation measurement, complete blood count, chest radiography, followed by other investigations depending on the initial findings(1).

Management of respiratory compromise may involve invasive treatments like chest tube insertion, intubation, tracheostomy and cardioversion. In the study done in India by Singh et al among paediatric patients with acute respiratory, it was found that ventilator support was required in 33.9%(13). Another study done by Adeyi et al in Nigeria to describe the indications and outcomes of paediatric tracheostomy between 2000 and 2008, found that 87% of tracheostomies were performed as an emergency and the most common indication was upper airway obstruction(28).

Non-invasive ventilation, such as Continuous Positive Airway Pressure (CPAP), may be used as well in management of respiratory compromise. A study done in Portugal by Abadesso et al, to assess the clinical efficacy of non-invasive ventilation among paediatric patients admitted to the paediatric ICU between 2006-2010 found that, non-invasive ventilation was used due to acute respiratory failure patients in 95.7% with the success rate of 77.5% (29).

Outcomes of respiratory compromise that have been studied include mortality, cardiac arrest, ICU admission and length of hospital stay. In the study done in Portugal 2006-2010 by Abadesso et al among paediatric patients who required assisted ventilation in the paediatric ICU due to respiratory compromise, the median duration of hospital stay was 8 days(29). In United States, Moler et el found the survival rate of paediatric patients with respiratory failure treated with extracorporeal life support to be 41% from 1982-1991(17) The mortality of paediatric patients who presented to emergency with out of hospital respiratory arrest was 57% in Toronto Canada as from a study of Margrid et al(26). In the study done in India among children with acute respiratory failure aged 1month to 15 years by Singh et al in 2013,

mortality was 14.4% and about 34% of children with acute respiratory failure required mechanical ventilation and ICU admission(13). A cross-sectional autopsy study in paediatric inpatient at Zambia national referral centre done by Mathew et al, to determine the burden of respiratory tract infections, found that pulmonary causes of death accounted for 92% and bacterial pneumonia was the commonest by 50%(30).

In the study done in Nigeria among paediatric patients with respiratory illness in 2005-2010 by Ezeonu et al, mortality was 7.5% (21)

2. PROBLEM STATEMENT

Respiratory compromise constitutes one of the most common chief complaints of paediatric patients in EMD and carries high mortality without early identification and intervention (2,6,30). The incidence and mortality is highest in limited income countries. In Tanzania, the opening of a full capacity emergency departments in public and private hospitals (EMD-MNH inclusive) is providing the opportunity for early diagnosis of life threatening conditions, timely lifesaving interventions immediately after arrival to hospital, and proper disposition of patients with respiratory compromise (22). However, despite the ongoing advancement in the development of the emergency care infrastructure in Tanzania, there is a general lack of data to guide development of specific clinical guidelines for training, management and resources required to treat paediatric patients with respiratory compromise in acute care settings. Specifically, there is insufficient data on the frequency of this presentation, the clinical epidemiology, management strategies and outcomes in acute care settings in low and middle income countries such as Tanzania.

3. RATIONALE OF THE STUDY

This study sought to describe the clinical epidemiology, management and outcomes of paediatric patients in Tanzania presenting with respiratory compromise. Findings from this study can be used to develop new clinical protocols in acute care settings so that respiratory compromise can be identified promptly and interventions initiated early before progression to cardiac arrest, which have poor outcomes. The study also is providing missing data to policy makers who can use these data to improve availability of emergency care providers, medications and vaccination programs (7,12). This could result in decreases in ICU admissions, hospital duration of stay, costs, and mortality due to respiratory compromise (2,6). EMD-MNH was a good place to conduct this study because it is was the first hospital with a fully developed emergency medicine department, and leads the way with regard to establishing protocols for emergency care in the rest of Tanzania (22). Also MNH is the tertiary referral hospital, receiving patients from all corners of the country and thus enrolled patients are representing a broad cross section of the Tanzanian population (22).

4. RESEARCH QUESTION

What are the clinical epidemiology, management and outcomes of paediatric patients presenting with respiratory compromise to the Emergency Medicine Department of Muhimbili National Hospital, Dar es Salaam Tanzania 2017?

5. OBJECTIVES

5.0 BROAD OBJECTIVE

To describe the clinical epidemiology, management and outcomes of paediatric patients with respiratory compromise presenting to the EMD-MNH

5.1 SPECIFIC OBJECTIVES

1) To determine the proportion of paediatric patients with respiratory compromise presenting to EMD-MNH
2) To describe the clinical presentation of paediatric patients with respiratory compromise presenting to the EMD-MNH
3) To describe the diagnoses among paediatric patients attending the EMD-MNH with respiratory compromise.
4) To describe the diagnostic workup and treatments received by paediatric patients with respiratory compromise in the EMD-MNH
5) To describe the outcomes of paediatric patients with respiratory compromise attending the EMD-MNH

6. METHODOLOGY

6.0 Study design

This was a prospective cohort study of paediatric patients with respiratory compromise presenting to the Emergency Medicine Department (EMD) of Muhimbili National Hospital (MNH) from July 2017 to November 2017.

6.1 Study setting

Muhimbili National Hospital is a tertiary hospital located in Dar es Salaam, Tanzania. It has a bed capacity of 1,500 with around 1,000 to 1,200 inpatient admissions per week. EMD is the first public emergency department in Tanzania, and was opened in 2010. The EMD at MNH is staffed with emergency physicians, postgraduate students in emergency medicine training program, medical officers (registrars), critical care nurses and nursing officers. The emergency department at MNH is equipped with diagnostic facilities including arterial blood gas machines, bedside ultrasound machines, portable x-rays, cardiac monitors, ventilator machines and other point of care tests.

Acutely ill patients at MNH are received in the EMD where they receive resuscitation and diagnostic workup before being disposed to appropriate ward, which may include disposition to ICU and Acute Paediatric Care Unit (APCU). Some patients may be referred to the Cardiac Institute. Paediatric patients with respiratory compromise who require ventilator support are intubated while in emergency department and then disposed to ICU when a bed is available. However, ventilator support for paediatric patients in the EMD is limited.

MNH is staffed with specialists and super specialists including pulmonologists, endocrinologist, surgeons and neurologists who may be consulted when needed in management of patient with respiratory compromise. Also MNH has central Pathology Laboratory (CPL), electrocardiogram machines, echocardiogram machines, and bronchoscope services which may be needed in patient care.

Department of Paediatric and Child Health at MNH is staffed with paediatricians, residents in paediatric training program, medical officers (registrars) and nurses.

Paediatric patients with respiratory compromise who need ICU, acute paediatric care unit (APCU) admission or major surgical interventions are reviewed by respective specialist on call before leaving EMD.

6.2 Target Population

Paediatric patients aged 1 month to less than 18 years with respiratory compromise attending acute care settings in low resource sub-Sahara African countries.

6.3 Accessible Population

Paediatric patients with respiratory compromise presenting to the EMD-MNH between July 2017 and November 2017

6.4 Study population

Paediatric patients with respiratory compromise presenting to the EMD-MNH between July 2017 and November 2017 meeting the inclusion criteria at the time when the research assistant was available to enrol them

6.5 Sampling design

We enrolled a consecutive convenience sample of paediatric patients presenting to the EMD with respiratory compromise who met inclusion criteria at times when the research assistant was scheduled for enrolment.

6.6 Subjects, recruitment and data collection

Any paediatric patient aged 1 month to less than 18 years with any sign of respiratory distress, respiratory arrest or respiratory failure as defined by American Heart Association (AHA) was included in the study. Paediatric Early Warning Sign parameters were used as a reference for tachypnoea, bradypnoea, tachycardia and bradycardia in different age groups (3). Neonates were excluded because they bypass the EMD and are seen in the neonatal ward and delivery ward. The research assistant asked the treating emergency physician about whether a child had signs of respiratory compromise and if the child met the criteria, the research assistant approached the parent to ask for consent to include the child in the study. Research assistant was available to enrol patients into the study in 6 days a week from 7am to 7pm

Respiratory distress was defined by AHA as increased work of breathing (chest wall retraction, tachypnoea, grunting, stridor, and SPO2 between 91 and 94%) but not meeting

criteria for respiratory failure. Also paediatric advanced life support by AHA defined respiratory failure as the presence of any one of the following; SPO2< 91% in room air, cyanosis, decreased level of consciousness, bradypnoea or severe tachypnoea with reference to PEWS parameters (1,3). If a child is not alert, he or she was considered to have decreased level of consciousness according AVPU scale and thus respiratory failure. Respiratory arrest was defined by absence of respiratory effort but with presence of cardiac activity. (See criteria below)

Inclusion criteria

Respiratory compromise inclusion criteria; age 1 month to less than 18 years and any of the following

Respiratory distress – any of the following

- Abnormal airway sounds – stridor, wheezing, grunting
- Increase in respiratory effort – nasal flaring , retractions
- Inability to lie flat due to respiratory distress
- SPO2 91- 94% on room air
- Tachypnoea or bradypnoea (refer to table below)

Respiratory arrest inclusion criteria – any of the following

- No breathing effort with cardiac activity or pulse present

Respiratory failure inclusion criteria – any of the following

- Bradypnoea or tachypnoea (refer to table below)
- SPO2 less than 91% breathing in room air
- Apnoea
- Cyanosis
- Bag Mask Ventilation (BVM)
- Intubation
- Low oxygen saturation despite oxygen therapy (SPO2 < 95% on O2)
- Any sign of respiratory distress plus decreased level of consciousness

Paediatric Early Warning Sign (PEWS) parameters for respiratory distress and probable respiratory failure:

	RESPIRATORY RATE (RR)		
AGE	**RESPIRATORY FAILURE**	**RESPIRATORY DISTRESS**	**RESPIRATORY FAILURE**
0-3 months	**< 20**	20-25 or 61-75	**>75**
4-11months	**< 20**	20-24 or 56-70	**>70**
1-4 years	**< 16**	16-19 or 41-55	**>55**
5-11 years	**< 13**	13-15 or 35-46	**>46**
12 years and above	**< 10**	10-13 or 27-34	**>34**

Exclusion criteria

1. Arrived in EMD while in cardiac arrest or cardiopulmonary resuscitation is going on
2. No informed consent

Data sources and Variables

The treating physician and the patient's proxy was used as sources of data. Data was recorded at the time of enrolment by research assistant who either asked physician for the data (patient information) or looking on patient electronic record for complaints suggestive of the signs of respiratory compromise.

Demographics, clinical presentation (main complaints, co-morbidities, duration of illness, vital signs) the diagnostic workup done, treatment given, admitting diagnosis, duration of stay, type of disposition, arrests and death of the patient while at EMD was recorded by a research assistant while the patient was in EMD. Outcome data which was collected while the patient is in the ward includes death, duration of hospital stay and discharge diagnosis. All the information was recorded to special case report form.

Outcome variables

Primary outcome was hospital mortality. Secondary outcomes was cardiac arrest in EMD, need of ICU admission, EMD mortality, 24 hours mortality after admission and length of stay both in EMD and hospital.

6.7 Sample size

The sample size calculations was based on mortality estimates among paediatric patients with respiratory compromise in low-income countries.

In the study done in India the mortality of among paediatric patients with respiratory compromise was 14%

Minimum sample size (N);

$N = 4P(1-P)/E^2$

Where:

Z= 1.96 ..... 95% Confidence interval

P =14%..... Mortality of paediatric patients with respiratory compromise admitted to Department of Paediatrics at Dayanand Medical College and Hospital, Ludhiana, a tertiary care teaching institute in north India.

E ..... margin of error = P/2 = 7%

The sample size will be;

$$N = 4 \text{ X } 14(100\text{-}14) / 7 \text{ X } 7$$

$$= 4 \text{ X } 14\text{X } 86 / 49$$

$$= \mathbf{98}$$

By considering loss to follow-up about 10%

Minimum sample size required was 98 + (10% x 98) = **108**

6.8 Statistical methods and data analysis

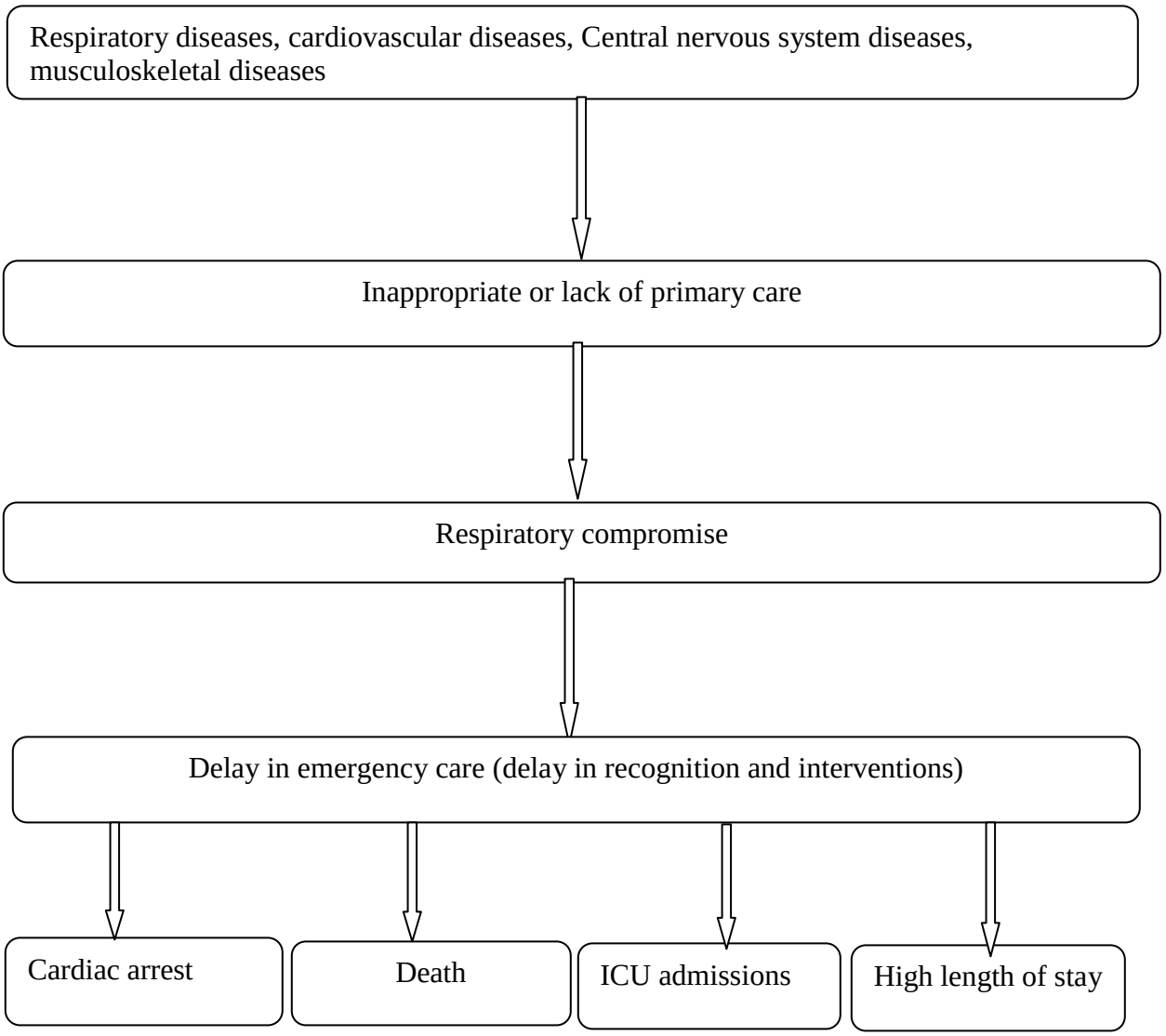
Data from REDCap (Version 7.2.2, Vanderbilt, Nashville, TN, USA) was exported to Statistical Package for Social Science (SPSS version 22.0 IBM Ltd, Carolina, USA) for analysis.

Median, proportion, interquartile range and counts, was used to summarise the data. Proportion of patients with respiratory compromise was obtained by dividing number of paediatric patients meet inclusion criteria of respiratory compromise by total number of paediatric patients attended to EMD during the whole period of the study.

6.9 Ethical Clearance

This study was conducted after approval from the Muhimbili University of Health and Allied sciences Institution Review Board (IRB) and permission from MNH. Although this was a prospective cohort study, no intervention or invasive procedure was done to patients beyond usual care. A verbal consent was requested from the patient's parents or proxy. Data collection was only undertaken after the patient's proxy has consented to participate. Patient data was entered into Redcap and identified by serial numbers and patient's medical record number and not patient's name. The use of medical record number was for tracking patient information related to the study in case needed to revisit the medical record of a certain patient for missing information or correctness. The completed questionnaires were not shared with anyone.

7. CONCEPTUAL FRAMEWORK



Lack of primary care on respiratory, cardiovascular, central nervous system and musculoskeletal diseases will result in respiratory compromise. After arrival to emergency department any delay in recognition of life threatening conditions causing respiratory compromise, and delay in life saving interventions will result in poor outcomes including need of ICU admission and increased length of hospital stay (LOS), cardiac arrest, and death.

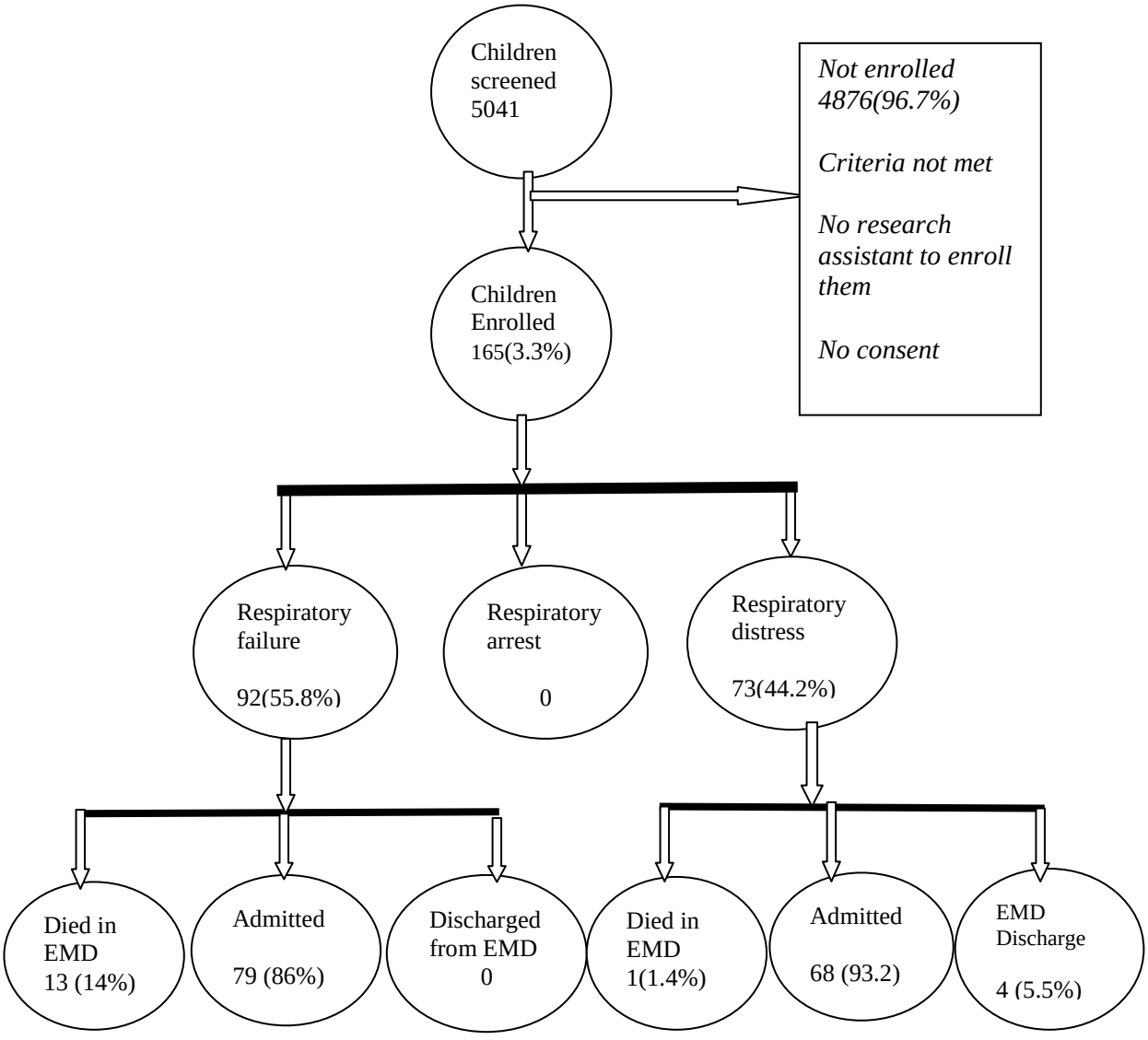
8.0 RESULTS

8.1 Enrolment and prospective cohort flow chart of paediatric patients with RC

We screened 5041 paediatric patients and enrolled 165(3.3%) children who had respiratory failure 92 (55.8%), respiratory distress 73 (44.2%) and no paediatric patient had respiratory arrest during enrollment (Figure 1**).** The most common signs of respiratory failure were hypoxia 79(85.9%) in room air (SPO2 < 91%) followed by decreased level of consciousness 42(45.6%). (Table 2)

Among paediatric patients with respiratory failure on arrival 13(14.1%) of them died in EMD while 1(1.4%) child with respiratory distress on arrival died in EMD. All four discharged children had respiratory distress. (Figure 1)

Figure 1: Flowchart of children presented with respiratory compromise to the EMD



8.2 Demographics, referral status and top five comorbidities of children with respiratory compromise

Among the 165 children included in the study, 90 (54.5%) were male, and median age was 12 months (IQR = 4-36 months).

The majority of children 132 (80.0%) who presented with respiratory compromise were under five years of age *(Table 1).*

Table 1: Gender, age, referral status, top five comorbidities

SEX	**N= 165**	**n/N (%)**
Male	90	(54.5)
Female	75	(45.5)
AGE GROUPS	**N = 165**	**n/N (%)**
0-<1 years	83	(50.3)
1-<5 years	49	(29.7)
5-<10 years	10	(6.1)
10-<18 years	23	(13.9)
REFERRAL STATUS	**N = 165**	**n/N (%)**
Referred	114	(69.1)
Self-referral	51	(30.9)
Comorbidities	**N= 80**	**n/N (%)**
Congenital heart disease	33	(41.25)
Cerebral Palsy	10	(12.5)
Human Immunodeficiency Virus	8	(10.0)
Valvular heart disease	4	(5.0)
Asthma	2	(2.5)

8.3 Top five presenting complaints and initial vital signs of children with respiratory compromise in EMD

Table 2: Presenting complaints and initial vital signs

PRESENTING COMPLAINTS	**N = 165**	**n/N (%)**
Difficulty in breathing	153	(92.7)
Fever	89	(53.9)
Cough	73	(44.2)
Decreased level of consciousness	42	(25.5)
Convulsions	18	(10.9)
INITIAL VITAL SIGNS	**N = 165**	**n/N (%)**
Hypoxia (SPO2 < 91% on room air)	79	(48.2)
Tachycardia*	59	(35.8)
Tachypnea*	54	(32.7)
Temperature < 35 or > 37.8 C	39	(23.6)
Bradypnoea*	11	(23.6)
Bradycardia *	9	(5.5)

Some patients had more than 1 presenting complaints.
** According to age*

8.4 Investigations performed in the EMD among children with respiratory compromise

Point of care random blood glucose was assessed in all children enrolled in the study and 16(9.7%) of them had hypoglycemia of less than 3mmol/L (*Table 3 and 8).*

Urgent blood grouping and typing was performed in 19(11.5%) children and 15(78.9%) of them received blood transfusion in EMD (Table 3 and 9)

Table 3: EMD diagnostic tests performed among children with respiratory compromise

TESTS PERFOMED IN EMD	NUMBER OF TESTS N = 165		ABNORMAL RESULTS	
	n	(%)	n	(%)
Random blood glucose	165	(100)	16	(9.7)
Malaria rapid diagnostic test	117	(70.9)	8	(6.8)
Complete blood count	96	(58.2)	42	(43.8)
Blood gases analysis	90	(54.5)	64	(71.1)
Serum electrolytes	78	(47.3)	20	(25.6)
Serum lactate	72	(43.6)	41	(56.9)
Point of care hemoglobin level	68	(41.2)	60	(88.2)
Blood slide for malaria	31	(18.8)	8	(25.8)
Blood grouping and crosshatching	19	(11.5)	-	
Chest x-ray	61	(37.0)	18	(29.5)

8.5 Diagnoses among paediatric patients with respiratory compromise in the EMD

Table 4: Top 10 final EMD diagnosis among children with respiratory compromise

Emergency department diagnosis	**TOTAL** **N = 165**	**n/N(%)**
Pneumonia	90	(54.5)
Congenital heart disease	58	(35.2)
Sepsis	42	(25.5)
Severe anemia	13	(7.9)
Severe malaria	12	(7.3)
Severe acute malnutrition	11	(6.7)
Meningitis	7	(4.2)
Cerebral palsy	7	(4.2)
Down syndrome	7	(4.2)
Acute watery diarrhea	6	(3.6)

8.6 Treatments initiated in the EMD for children with respiratory compromise

Common treatments initiated in EMD were oxygen therapy 143(86.7%), and 18(10.9%) received cardiopulmonary resuscitation in the EMD. (Table 7)

Table 5: Interventions initiated in the EMD for children with respiratory compromise

INTERVENTIONS	**TOTAL** **N = 165**	**n/N (%)**
Oxygen therapy	143	(86.7)
Antibiotics	119	(72.1)
Intravenous fluids	99	(60.0)
Bronchodilators /nebulization	25	(15.2)
Electrolyte replacement	20	(12.1)
Nasogastric tube insertion	19	(11.5)
Suctioning	18	(10.9)
Endotracheal intubation	18	(10.9)
Cardiopulmonary resuscitation	18	(10.9)
Airway adjunct insertion	16	(9.7)
Blood transfusion	15	(9.1)
Inotropes	14	(8.4)

8.7 Outcomes of children with respiratory compromise in EMD

Table 6: EMD outcomes and in-hospital Outcomes by age

Outcome	TOTAL N = 165	< 5 years N = 132	≥ 5 years N = 33	p value
	n (%)	n (%)	n (%)	
Admitted to general ward	127 (77.0)	104 (78.8)	23 (69.7)	0.2681
Admitted to ICU/APCU	20 (12.1)	17 (12.9)	3 (9.1)	0.5512
Discharged from EMD	04 (2.4)	2 (1.5)	2 (6.1)	0.1252
Died in EMD	14 (8.5)	12 (9.1)	2 (6.1)	0.5816
Died within 24 hours after EMD disposition	09 (5.5)	8 (6.1)	1 (3.0)	0.4853
Inpatient mortality	37 (22.4)	31 (23.5)	6 (18.2)	0.5152
Overall mortality	51 (30.9)	43 (32.6)	8 (24.2)	0.3518

Length of stay

The range of length of stay at EMD and in the wards was 1-27 hours and 1-55 days respectively and the median length of stay at EMD was 5 hour and 8 days in the wards. Among those children who died, their median length of stay at EMD before death was 6 hours (IQR = 2.3 -8.5 hours) and 3 days (IQR = 1-4 days) in the wards. Median age of those who died were 8 months (IQR 4-24 months)

Table 7: Clinical presentation, abnormal laboratory results and their outcomes

	Overall	**Died N=51**	**Survived N=114**	**RR (95%CI)**
	n/N	**n (%)**	**n (%)**	
Clinical presentation				
Difficult inbreathing	153/165	40(78.4)	113 (99.1)	0.3 (0.2-0.4)
Fever	089/165	24(47.1)	65(57.0)	0.8 (0.5-1.2)
Cough	073/165	13(25.5)	60 (52.6)	0.4 (0.2-0.7)
Decreased consciousness	042/165	22(43.1)	20(17.5)	2.2 (1.4-3.4)
Convulsions	018/165	8 (15.7)	10(8.8)	1.6 (0.9-2.8)
SPO2 < 91%	079/165	36(70.6)	43 (37.7)	2.6 (1.6-4.4)
Bradypnoea	011/165	11(21.6)	0	3.9 (2.9-5.0)
Compromised airway	011/165	4 (7.8)	7 (6.1)	1.2 (0.5-2.7)
Compromised circulation	031/165	14(27.5)	17 (14.9)	1.6 (1.0-2.6)
Disability	046/165	24(47.1)	22 (19.3)	2.4(1.6-3.7)
Abnormal EMD results				
RBG < 3mmol/L	016/165	7 (13.7)	9 (7.9)	1.5 (0.8-2.7)
Hemoglobin < 7g/dl	022/124	8 (15.7)	14 (12.3)	1.2 (0.7-2.2)
WBC (> 11 K/uL)	042/96	8 (15.7)	34 (29.8)	0.5 (0.3-1.1)
Malaria positive	008/117	2 (3.9)	6 (5.3)	0.8 (0.2-2.7)

Table 8: EMD treatments and outcomes

Intervention	**Total N=165**	**Died N=51**	**Survived N=114**	**RR (95%CI)**
	n (%)	**n (%)**	**n (%)**	
Oxygen therapy	143 (86.7)	41(80.4)	102(89.5)	0.6 (0.4-1.1)
Antibiotics	119 (72.1)	29(56.9)	70(61.4)	0.9 (0.6-1.4)
Nebulization	025 (15.2)	07(13.7)	18(15.8)	0.9 (0.5-1.7)
Nasogastric tube	019 (11.5)	15(29.4)	4(3.5)	0.9 (0.4-2.0)
Intubation	018 (10.9)	14(27.5)	4(3.5)	3.1(2.1-4.5)
CPR	018 (10.9)	16(31.4)	2(1.8)	3.7 (2.7-5.2)
Airway adjunct	016 (9.7)	16(31.4)	0	4.8(3.2-5.7)
Blood transfusion	015 (9.1)	06(17.8)	9(7.9)	0.1 (0.01-2.3)
Pleural tapping	002 (1.2)	0	2(1.8	0.5 (0.4-6.7)
Chest tube insertion	002 (1.2)	0	2(1.8)	0.5 (0.4-6.7)

CPR = Cardiopulmonary resuscitation. CI = Confidence interval

Causes of respiratory compromise and their outcomes

Table 9: Top five diagnosis and their outcomes

Top 5 EMD diagnosis	Total N = 165 n (%)	Died N = 51 n (%)	Survived N =114 n (%)	RR (95% CI)
Pneumonia	90 (54.5)	16 (31.4)	74 (64.9)	0.4 (0.2-0.6)
CHD	58 (35.2)	06 (11.8)	52 (45.6)	0.2 (0.1-0.5)
Sepsis	42 (25.5)	10 (19.6)	32 (28.1)	0.7 (0.4-1.3)
Severe anaemia	13 (7.9)	0	13 (11.4)	0.1 (0.01-1.6)
Severe malaria	12 (7.3)	02 (3.9)	10 (8.8)	0.5 (0.1-1.9)

CHD = Congenital heart disease, RR = Relative risk, CI = Confidence interval,

9.0 DISCUSSION

Globally respiratory compromise in paediatric population is the leading cause of emergency visits, cardiac arrest, ICU admission and prolonged hospital length of stay (7,16). In Tanzania the burden, clinical epidemiology, management and outcomes of acute respiratory compromise among paediatric population attending acute care settings has not being documented (31)

In this study the proportion of children with respiratory compromise were lower than the proportion of children with respiratory illness attending paediatric emergency in China and Nigeria, this may be due to the fact that in my study only more sicker children with respiratory illness were studied, and some children were missed because enrollment was only during the day (20,32). Also this study was single centered in tertiary level hospital, mostly seeing referred patients from regional and district hospitals. The situation would be different if the study was done at primary or secondary level hospital in which many children would have meet inclusion criteria.

On arrival to the EMD more than half of the children were in stage of respiratory failure and this could be due to existing referral system where a patient should start at lower level health facility, absence of a formal prehospital care services, low health seeking behavior and poor infrastructure, however my study was not powered to look on these factors. A high proportion of paediatric patients with hypoxemic respiratory failure which was found in this study was also found in previous studies in India and China (13,32,33).

Among the enrolled children with respiratory compromise, the predominant age group was children under 5 years of age. Similar findings have been reported in India, China, Zambia, and Nigeria(13,20,31,33,34). Children under five years are more likely to develop respiratory compromise than other age groups because of their small airway, underdeveloped central nervous system, less energy store and other anatomical differences compared with older children(35). They also have higher risk of Respiratory Syncytial Virus infection especially those below one year of age(36)

Comorbidities were observed in about half all paediatric patients with respiratory compromise in this study. Paediatric patients with some comorbidities like heart disease, cerebral palsy, sickle cell disease and HIV infection are likely to develop respiratory compromise than their counterparts because they have increased risk of heart failure, aspiration and immunosuppression respectively(25). Trachsel et al found that 59.5% of paediatric patients with acute respiratory failure had comorbidities like immunosuppression and sickle cell anemia (18).

In this this study congenital heart disease comorbidity accounted high, probably because of recently opened Institute of Cardiology within the compound of Muhimbili National Hospital.

Top five presenting complaints to EMD were difficult in breathing, fever, cough, decreased level of consciousness and convulsions. In the study done in India by Sing et al and in Hong Khong by Tsung et al, similar presenting complaints was reported among children with respiratory failure and respiratory illness respectively(13,33). The presenting complaints are either representing the underlying cause of respiratory compromise or the complications of respiratory compromise. Fever, difficulty in breathing and cough in children implies pneumonia according to WHO, and convulsions and decreased level of consciousness which were more common in under five children may be indicating complications of brain hypoxia from respiratory failure.

All paediatric patients with respiratory compromise in this study had compromised breathing (B) but some other children also had other types of compromise like airway compromise (A), Circulation compromise (C) and disability (D). Either this may be indicating that respiratory compromise in these children was due to causes outside the pulmonary system, or cardiovascular compromise or disability was the complications of respiratory failure. Other studies has reported similar findings like the study which was done in India by Sing et al in 2014 reported that paediatric patients with acute respiratory failure presenting in EMD had signs of shock like pale skin (100%) and prolonged capillary refill (73%) of more than 3 second. In the same study he found that pulmonary causes of acute respiratory failure

accounted 62.6% and the rest was due to nervous disease 23.5%, cardiovascular causes 4.34% and sepsis 9.56% (13)

Top 5 laboratory diagnostic workups done by emergency care providers in EMD among children with respiratory compromise during the study were point of care blood glucose, malaria rapid test, complete blood count, blood gas analysis, and serum electrolytes. Random blood glucose was done to all children with respiratory compromise, this can be explained by the fact that both low and high blood glucose are associated with respiratory distress, respiratory failure, respiratory arrest, and cardiac arrest. Also low blood glucose (hypoglycemia) especially in children can develop as a complication of respiratory distress due to increased work of breathing which utilize all less available energy store (1,34)

In this study blood gas analysis was done to about half of paediatric patients with respiratory compromise but in the study done in India among children with acute respiratory failure in EMD, blood gas analysis was done to all paediatric patients (13). This is either due to unaffordable cost or limited resources (reagents) in low income countries which leads to intermittent availability of point of care tests in EMD as it was reported in the study done in Ghana in 2014 by Kennedy et al about availability of resources for emergency care, he reported that reagents for point of care tests was intermittently available in emergency department (37). Less proportion of doing blood gas analysis among paediatric patients with respiratory compromise seen in this study implies that relaying on blood gas analysis to diagnose acute respiratory failure is not always practical in low income countries and thus emergency care providers should depend on clinical presentation to diagnose respiratory failure. Sawe et al in 2011 reported unavailability of blood gas analyzer machines in all main referral hospital ICUs in Tanzania(38).

There were low proportion of performing chest radiography among children with respiratory compromise than that observed in the study done in Hong Kong China by Tsung et al, who reported chest radiography was done in 81% of the children with respiratory illness. One reason of doing chest radiography to less number of children with respiratory compromise can be the fact that majority of children were very sick and thus not stable enough to go to

radiology department for imaging as it was observed that majority of children with respiratory compromise were on oxygen therapy in EMD. Poor quality of bedside chest radiography in our department probably contributed to less number of ordering even mobile chest radiography in the EMD by attending physician.

The most common 3 treatments initiated in EMD for paediatric patients with respiratory compromise was oxygen therapy, intravenous antibiotics and intravenous fluids. Tsung et al in Hong Kong China he reported that antibiotics was the leading treatment given to pediatric patients with respiratory illness in EMD by 21% and oxygen therapy accounted 1%, but the proportion of oxygen therapy and antibiotics in this study is higher than that found in Tsung et al, probably there were more sick hypoxic children with respiratory compromise than in Tsung study and also the leading cause of respiratory compromise in this study was infection and thus more children received antibiotics(33).

Lower proportion of children received mechanical ventilation compared to that observed in India by Sing et al in which mechanical ventilation was required to 33.9% of children with respiratory failure in EMD. This difference may be due to low resources in our EMD and less ICU bed capacity at MNH and limited availability of ventilators which can support paediatric patients at EMD-MNH (38)

Admission rate in this study was higher than that reported by Ziad et al in a systematic review of emergency care in low and middle income countries who reported admission of pediatric patients in Sub Saharan Africa to be between 20.6 – 65.2% (39). High hospitalization in this study is because majority arrived in the EMD in respiratory failure state.

In this study the 2 leading cause of EMD mortality was reported to be pneumonia and sepsis which is tallying with WHO death estimates which reported pneumonia to be leading cause of death in children Tanzania(40). About one third of paediatric patients with respiratory compromise died before hospital discharge and risk of mortality was statistically significant among children who presented to the EMD with loss of consciousness, bradypnoea, hypoxia, circulation compromise and disability.

The three leading causes of overall mortality in the current study were pneumonia, sepsis and congenital heart disease. In previous studies done in Nigeria and Zambia among children with respiratory illness, Mathew et al and Oguonu et al respectively reported pneumonia to be the leading cause of death (20,30). Almost a similar hospital mortality of 27% among paediatric patients with acute respiratory failure was reported by Daniel et al in Canada in 2006(18). In another similar study in India by Singh et al reported almost similar 3 causes of death including bronchopneumonia (50%), sepsis (14.29%) and diabetic ketoacidosis (14.29%). Compared with the study by Singh, which is the most comparable in terms of patient population, overall mortality was higher in the current study. There are several potential reasons for this: in our study, few children with respiratory compromise were admitted to the ICU while in the Singh et al study, all children were admitted to the ICU (13). In Canada all paediatric patients with respiratory failure were admitted to ICU from EMD (18). The low ICU admission rate result from a lack of special paediatric ICU and less ICU bed capacity at MNH main ICU (26,38).

In addition, mechanical ventilation was initiated in fewer patients in our study compared with Singh et al study, likely due to the lack of ventilators in the EMD and in hospital main ICU. MNH has only one medical ICU used for both children and adult patients which has 13 bed capacity but no special paediatric ventilator. In this study children who were intubated in the EMD had increased risk of death and was statistically significant. Also children who needed airway adjunct insertion had higher risk of dying than those who did not require airway adjunct and it was statistically significant.

In Canada the survival rate of children presenting to EMD with out of hospital cardiac arrest was reported by Margrid et al to be 7.5% in 2001(26). In my study the survival rate is higher than that reported in Canada by Margrid et al because it was in hospital cardiac arrest. Cardiopulmonary resuscitation in emergency department in this study was associated with high risk of mortality and was statistically significant. Also initial low blood glucose and low haemoglobin in EMD was associated with increased risk death but was not statistically significant.

In this study the duration of stay in EMD was shorter than that observed in previous studies. In Brazil, Silva et al reported median duration of EMD stay among paediatric patients with respiratory complaints was 12 hours (41). In the studies done in Nigeria by Oguonu et al and Hong Khong by Tsung et al including paediatric patients presenting with respiratory illness in EMD they reported median length of hospital stay of 2 and 3 days respectively and with range of 1-8 days (20,33). The shorter length of stay in this study can be explained by limited space in our EMD where there is only one paediatric resuscitation room with only two oxygen ports. The median length of hospital stay in this study was longer than in China and Nigeria because my study population was confined to paediatric patients with respiratory compromise, who are sicker than those studied in China and Nigeria. Median duration of hospital stay before death were shorter than 9.8 days reported by Trachsel et al in Canada among paediatric patients presenting to EMD with acute respiratory failure in 2006(18). This short duration of stay before death in this study in comparison with Trachsel et al study in Canada can be explained by limited access to ICU admission at EMD-MNH while in Canada all paediatric patients in their study was admitted to ICU and received assisted ventilation and thus they survived longer before death. Most common 5 causes of paediatric respiratory compromise as it was stated at the time of disposition from EMD included pneumonia, sepsis, severe malaria, congenital heart disease and severe acute malnutrion. These findings are almost similar to findings reported in Nigeria by Oguonu et al, Hong Khong China by Edmund et al, India by Singh et al and Teri et al in Tanzania(13,20,31,32,42)

During the study period the quality of emergency care in our setting could have been affected by several factors including intermittent availability of reagents for point of care tests (for example blood gases), economical constrain of the patients, poor quality of portable chest radiography necessitating the critically ill patient to go outside the emergency department for imaging thus some patients miss the service, low ICU capacity at MNH for children, less number of ventilator machines for paediatric patients at EMD/MNH and absence of pediatric respiratory compromise clinical protocol

10. LIMITATIONS:

- Some patients did not get arterial blood gases analysis but SPO2 was obtained to all children assessing oxygenation as a surrogate of blood gas analysis
- The sample of paediatric patients may not be representative because MNH is a tertiary referral hospital and thus the patients may be sicker than children at a non-referral hospital. Self-referral cases were included in the study to counteract this limitation
- This was a single centre study. But results are accepted because this is a public tertiary hospital with only 24 hours full capacity EMD receiving referral from all hospitals in the country with case mix
- Not all children with respiratory compromise were included in the study. The research assistant was scheduled during the day shift from 7am to 7pm. Thus we were unable to study patients with respiratory compromise presented at times when the research assistant was not present. Thus, the proportion of paediatric patients who with respiratory compromise may be underestimated. More patients was anticipated to come to EMD during the day and this was crosschecked by reviewing the number of children with respiratory compromise presenting at night.

11. CONCLUSION

In a cohort of pediatric patients presenting to EMD with respiratory compromise was associated with significant morbidity, as evidenced by the need for assisted ventilation, antibiotics, intubation and high rate of cardiac arrest. The observed overall mortality rate was 31%. Future studies should focus on identification of predictors of poor outcomes among children with respiratory compromise in EMD

12. RECOMMENDATIONS

- Further research to be done
    - to identify the predictors of poor outcomes among pediatric patients presenting to EMD with respiratory compromise
    - to identify the initial EMD interventions which can mitigate the poor outcomes in EMD among pediatric patients with respiratory compromise
- Pediatric patients with respiratory compromise should be transferred earlier to tertiary hospitals in order to receive appropriate treatment before deterioration to respiratory failure

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14. APPENDIX

14.1 CONSENT FORM (English version)

CLINICAL EPIDEMIOLOGY, MANAGEMENT AND OUTCOMES OF PAEDIATRIC PATIENTS WITH RESPIRATORY COMPROMISE AT MUHIMBILI NATIONAL HOSPITAL IN EMERGENCY DEPARTMENT 2017

ID NO……..

PERMISSION FOR YOUR CHILD TO TAKE PART IN RESEARCH

Study title: CLINICAL EPIDEMIOLOGY, MANAGEMENT AND OUTCOMES OF PEDIATRIC PATIENTS WITH RESPIRATORY COMPROMISE PRESENTING TO EMERGENCY MEDICINE DEPARTMENT AT MUHIMBILI NATIONAL HOSPITAL, DAR ES SALAAM TANZANIA

Introduction:

Your child is being asked to take part in this study because I am looking at the clinical epidemiology, management and outcome of paediatric patients with respiratory compromise presenting to emergency medicine department of Muhimbili national hospital. Your decision whether or not to take part will have no effect on the quality of medical care that your child will be given.

Please ask questions if there is anything about this study you do not understand.

What is the purpose of this study?

The purpose of this study is to describe the clinical epidemiology, management and outcome of paediatric patients with respiratory compromise presenting to the emergency medicine department of Muhimbili national hospital.

Will you benefit from taking part in this study?

You will be a volunteer and might not personally benefit from being in this research study. However, results from this study are expected to be a baseline for knowing the characteristics of patients who have are in settings like this. As such respiratory compromise they can later be used to improve service provision to all patient with respiratory compromise regardless to whether they participated in this study or not.

What does this study involve?

Some information about you that have recorded in your treatment chart will be recorded in a special form for the purpose of this study. Your name will not be recorded. You may be asked some questions about you if that kind of information could not be obtained from your treatment chart. If blood tests have been done results will be recorded too. No treatment or any intervention will be done.

What are the options if you do not want to take part in this study?

Your child's participation in this study is completely voluntary. Your child will continue to receive regular care regardless of whether you participate in the study.

What are the risks involved with taking part in this study?

Since no intervention of any kind will be done we anticipate no risks to your child's health.

Leaving the study:

You may choose to stop taking part in this study at any time for any reason. If you decide to stop taking part, it will have no effect on your child's) medical care.

New Information

New information related to this study and specifically new information about your child will be made known to you when it becomes available.

How will your privacy be protected?

Information about your child as well as the test results will be kept strictly confidential. The study information will be stored in protected computer files and in paper records stored in locked filing cabinets. Only study staff will have access to the information.

The information will be maintained indefinitely.

Who may use or see your health information?

By signing this form, you allow the research team to use your child's health information and give it to others involved in the research. The research team includes the principle investigator, supervisor, research assistant and MUHAS staffs that will be involved in reviewing my research report.

Your permission to use your child's health information for this study will not end until the study is completed. You may ask for your child's study data at any time.

It is possible for a court or government official to order the release of study data including information about your child.

What if you decide not to give permission to use and share your personal health information?

If you do not allow use of your child's health information for this study, you may not take part in this study.

If you choose to stop taking part in this study, you may cancel permission for the use of your child's health information. You should let the researcher know if you want to cancel your permission. The study team will assist you in putting your wishes in writing. Information collected for the study before your permission is cancelled will continue to be used in the research.

Whom should you call about this study?

If you have questions about this study or need to report a study related injury, you can call your doctor or the principle investigator for this study: Dr. BIITA MUHANUZI (0784-15-20-30) during normal working hours. If you have questions about your rights as a participant, you may contact, **DR. BRUNO SUNGUYA, Director of Publications and Research**, M**uhimbili University of Health and Allied Sciences, Research and Publication Committee, P. O. Box 65001, Dar es Salaam, Telephone number 2150302-6**

What about the costs of this study?

There will be no costs for you if you agree to have your child participate in the study. All study costs will be supported by the research team and MUHAS.

Will you be paid to take part in this study?

There will be no payment to your child for participation in the study.

If you agree that your child take part in this study and you sign this consent form, you are not giving up any of your legal rights.

CONSENT

I have read the above information about;

"**Clinical epidemiology, management and outcome of pediatric patients with respiratory compromise presenting to emergency medicine department at muhimbili national hospital**" and have been given time to ask questions. I agree to take part in this study and I have been given a copy of this signed consent form.

Researcher or Designee Signature and Date Printed Name

Patient or Legally Authorized Representative signature and Date Printed Name

CONSENT FORM (Swahili version)

RIDHAA YA KUSHIRIKI KWENYE UTAFITI HUU

Namba ya Utambulisho ……

CLINICAL EPIDEMIOLOGY, MANAGEMENT AND OUTCOME OF PAEDIATRIC PATIENTS WITH RESPIRATORY COMPROMISE, PRESENTING TO EMERGENCY MEDICINE DEPARTMENT OF MUHIMBILI NATIONAL HOSPITAL, DAR ES SALAAM TANZANIA

Utangulizi:

Unaombwa kushiriki katika utafiti huu kwa sababu ninafanya uchunguzi wa epidemiologia, matibabu na matokeo ya watotoawagonjwa wenye mataizo ya upumuaji wanaopata matibabu katika idara ya dharula ya Hospitali ya Taifa ya Muhimbili. Uamuzi wako wa motto wako kushiriki au kutoshiriki hautakua na athari zozote kwenye ubora wa huduma atakayopewa. Tafadhali uliza swali kama kuna kitu usichokielewa kuhusu utafiti huu.

Je dhumuni la utafiti huu ni lipi?

Dhumuni la utafiti huu ni kuchunguza hali, mikakati ya vipimo na matibabu na matokeo ya watoto wagonjwa wenye wenye matatizo ya upumuaji, wanaotibiwa katika idara ya dharula ya Hospitali ya Taifa ya Muhimbili.

Je utafaidika kwa kushiriki kwenye utafiti huu?

Inawezekana kuwa motto wako binafsi asifaidike kwa kushiriki kwenye utafiti huu. Lakini matokeo ya utafiti huu yanategemewa kuwa msingi wa kujua sifa za watoto wagonjwa wa matatizo ya kupumua. Kwa kujua sifa hizo huduma zinazotolewa kwa wagonjwa kama hao zinaweza kuimarishwa siku za mbeleni.

Je Utafiti huu unahusisha nini?

Taarifa zako zilizohifadhiwa kwenye faili lako la matibabu zitarekodiwa kwenye fomu maalum ya utafiti huu. Inawezeka ukaulizwa maswali kadhaa pale taarifa hizo zitakapooneka hazijakamilika. Taarifa za baadhi ya vipimo vyako zitarekodiwa pia.

Je itakuwaje kama hutataka kushiriki kwenye utafiti huu?

Kushiriki kwa mtoto wako kwenye utafiti huu ni hiari kabisa. Ataendelea kupata huduma bila kujali kama ameshiriki kwenye utafiti ama la.

Je kuna athari gani za kushiriki katika utafiti huu?

Hakuna tiba itakayotolewa au vipimo vitakavyofanyika kwa lengo la utafiti huu. Kwa hiyo hakuna athari inayotegemewa kutokana na utafiti huu.

Kuondoka kwenye utafiti:

Unaweza kuamua kusitisha kuendelea kushiriki kwa motto wako kwenye utafiti huu muda wowote na kwa sababu yoyote. Kama utaamua mtoto wako aache kushiriki haitaathiri huduma za afya kwake.

Maelezo mapya:

Utajulishwa maelezo mapya kuhusiana na utafiti huu mara tu yatakapokuwa yamepatikana.

Utunzaji wa siri?

Taarifa zako na majibu ya vipimo yatakayorekodiwa yatatunzwa kwa usiri mkubwa. Habari zihusuzo utafiti zitatunzwa kwenye kompyuta zenye ulinzi na rekodi, zilizopo kwenye makaratasi zitatunzwa kwenye makabati yanayofungwa. Ni wafanyakazi wanaohusika na utafiti tu ndio watakaoweza kuona taarifa, na taarifa hizi zitatunzwa siku zote.

Ninani anaweza kutumia au kuona taarifa zako za afya?

Kwa kuweka sahihi kwenye fomu hii umeruhusu watafiti kutumia taarifa za afya ya mtoto wako na kuwapatia wengine wanaohusika na utafiti huu. Watafiti ni pamoja na mwendesha utafiti pamoja, msaidizi wa utafiti, msimamizi wa utafiti na wengine wanaohusika na utafiti huu ambao wapo chuo kikuu cha sayansi na tiba cha Muhimbili.

Ruhusa ya kutumia taarifa za afya yako itaisha wakati utafiti utakapokamilika. Unaweza kuomba taarifa za mtoto wako wakati wowote.

Inawezekana mahakama au afisa wa serikali akaamuru kuonyeshwa kwa taarifa za utafiti ikiwa ni pamoja na taarifa zako.

Je itatokea nini kama utaamua kutotoa ruhusa ya kutumia na kushirikisha wengine taarifa zako za afya?

Kama hautaruhusu taarifa za afya ya mtoto zitumike, hautaweza kushiriki kwenye utafiti huu. Kama utachagua kuacha kushiriki katika utafiti huu, unaweza kufuta ruhusa ya matumizi ya taarifa za afya ya mtoto wako. Watafiti watakusaidia kuweka matakwa yako kwenye maandishi. Taarifa zitakazokuwa zimekusanywa kabla ya kufuta ruhusa zitaendelea kutumika kwenye utafiti.

Je utampigia nani kuhusu utafiti huu?

Kama una maswali kuhusu utafiti au ukiwa na haja ya kuripoti athari zitokanazo na utafiti, unaweza kumpigia daktari wako au mwendesha utafiti huu: **Dr BIITA MUHANUZI (**0784-15-20-30**) muda wa masaa ya kazi.** Kama una swali kuhusu haki zako kama mshiriki unaweza kuwasiliana na **DR. BRUNO SUNGUYA, Mkurugenzi wa Kamati ya Kitengo cha Utafiti, Chuo Kikuu Cha Sayansi na Tiba Cha Muhimbili, S.L.P 65001, Dar es Salaam, Namba ya Simu 2150302-6**

Je kuna gharama juu ya tafiti huu?

Hakuna gharama kama utakubali kushiriki kwenye utafiti huu. Watafiti na Chuo kikuu cha Muhimbili watasaidia gharama zote za utafiti.

Je utalipwa kwa kushiriki kwenye utafiti:

Hapatakuwa na malipo kwako au mtoto wako kwa kushiriki kwenye utafiti

Kama utakubali mtoto wako ashiriki kwenye utafiti huu na ukasaini fomu hii ya ridhaa, haujiondolei haki yoyote ya kisheria.

Ridhaa

Nimesoma maelezo hapo juu kuhusu uchunguzi wa epidemiologia ya matokeo ya wagonjwa wenye sepsisi kali wanaopata matibabu katika idara ya dharula ya Hospitali ya Taifa ya Muhimbili, Tanzania na nimepewa muda wa kuuliza maswali. Nakubali kushiriki katika utafiti huu na nimepewa fomu ya ridhaa hii iliyowekwa sahihi.

Sahihi ya mtafiti au kaimu na tarehe Jina kamili

Sahihi ya mshiriki au mwakilishi wa kisheria na tarehe Jina kamili

14.2 QUESTIONARE

DEMOGRAPHICS AND ENROLLMENT

Record ID _____

MR number _____

Patient initials _____

Sex of the patient

- Male
- Female

Date of birth _____

Age of patient in years _____

Age of infant in months _____

Patient's address _____

Guardian's phone number _____

Date of EMD care _____

Arrival time at EMD _____

Referral

Yes

No

Referring facility _____

Mode of arrival at EMD

Ambulance

Public transport

Private transport

Other

TYPE OF RESPIRATORY COMPROMISE

Respiratory distress

- Abnormal airway sounds - stridor, grunting, wheezes
- Increased respiratory effort - chest retractions, nasal flaring
- Inability to lie flat because of shortness of breath
- SPO2 in 91-94% on room air
- Tachypnoea

Respiratory distress

- PO2 < 91% on room air
- Bradypnoea
- Apnoea
- Cyanosis
- On BVM
- Intubated
- On O2 but SPO2 < 95%
- Any sign of respiratory compromise with decreased level of consciousness

Respiratory arrest

- No breathing effort but cardiac activity is present

INITIAL VITAL AT EMD

SBP _____

DBP _____

HR _____

SPO2 on room air _____

SPO2 on oxygen _____

Oxygen delivery mode - on arrival

- NRBM
- Nasal prong
- BVM
- CPAP

TEMP _____

RBG _____

Body weight (kgs) _____

AVPU SCORE

- Alert
- Response to voice
- Response to pain
- Unresponsive

CHIEF COMPLAINTS

- Difficulty in breathing
- Cough
- Fever
- Convulsions
- Decreased level of consciousness
- Abdominal distension
- Chest pain
- Paralysis
- Others – List

Duration of illness (days) _____

Duration of pre ED treatment (days) _____

COMORBIDITIES

- Asthma
- Sickle cell disease
- Congenital heart disease Rheumatic heart disease
- HIV
- Cerebral Palsy
- Diabetic mellitus
- Epilepsy
- Mention others

PRIMARY SURVEY

AIRWAY (A)

- Normal
- Compromised

Causes of compromised airway

- Secretions
- Foreign body
- Blood
- Tongue
- Others

BREATHING (B)

- Normal
- Compromised

Findings of Compromised Breathing

- Tachypnoea
- Bradypnoea
- Chest retractions
- Reduced chest movement on one side
- Asymmetrical chest
- Reduced air entry to one side
- Crackles
- Wheezes
- Cyanosis

CIRCULATION (C)

- Normal
- Compromised

Findings of compromised circulation

- Cold extremities
- Prolonged capillary refill > 2 second
- Diaphoresis
- Weak pulse
- Dry mucous membrane

DISABILITY (D)

- Decreased level of consciousness
- Abnormal pupil size and reaction
- Low RBG < 3.0 g/dl

EXPOSURE (E) - Abnormal Finding _____

EXPOSURE (E) - Abnormal Finding _____

EXPOSURE (E) - Abnormal Finding _____

SECONDARY SURVEY

HEENT - Abnormal finding _____

HEENT - Abnormal finding _____

HEENT - Abnormal finding

_____

RESPIRATORY SYSTEM (RS) - Findings

- Chest deformity
- Abnormal breath sounds
- Sand crepitus
- Palpable rib fractures distended neck veins

CARDIOVASCULAR SYSTEM – Findings

Raised JVP

- Precordial bulging
- Precordial hyperactivity
- Displaced apex
- Distant heart sounds
- Heart murmur

CNS - Abnormal findings

- Semi consciousness / coma
- Abnormal pupil - pinpoint, dilated, unequal
- Focal neurological deficit
- Bilateral paralysis
- Others

ABDOMEN (P/A) - Abnormal findings

- Distended
- Mass
- Fluid thrill
- Tense
- Tender
- Others

MSS - Abnormal findings _____

MSS - Abnormal findings _____

MSS - Abnormal findings _____

EMD INITIAL DIAGNOSIS, INVESTIGATIONS AND TREATMENTS

Initial EMD diagnosis _____

Initial EMD diagnosis _____

Initial EMD diagnosis _____

LABOTORY TESTS DONE AT EMD

- RBG
- MRDT
- HIV POC
- UPT
- Urinedipstick
- ABG
- VBG
- Electrolytes
- CBC
- BS
- Grouping and crossmatch
- Sickling test
- RFT
- HB
- Others - mention

RBG result _____

MRDT result

- Positive
- Negative

HIV POC result

- Positive
- Negative

UPT Result

- Positive
- Negative

URINE DIPSTICK results

Turbid

- Leukocytes
- Nitrate
- Rbc
- Ketone
- Negative
- Protein

OTHER RESULTS

- PH _____
- PCO2 Result _____
- PO2 Result _____
- HCO3 Result _____
- Lactate _____
- HB _____
- WBC _____
- Platelet results _____
- BS results _____

RADIOLOGICAL TESTS PERFORMED

- ☐ CXR
- ☐ Utrasound
- ☐ Chest CT scan
- ☐ Brain CT scan
- ☐ ECG
- ☐ Others

- CXR findings _____
- USS Findings _____
- Chest CT findings _____
- Brain CT findings _____

TREATMENT RECEIVED AT EMD

EMD supportive treatment received

- Positioning
- Suctioning
- Oxygen therapy by CPAP
- Oxygen therapy by NRBM
- Oxygen therapy by nasal prong
- Oxygen therapy by BVM
- Oxygen therapy by ETT - Intubation
- NO oxygen therapy given
- Airway adjunct
- NGT

Specific treatments at EMD

- IV fluids
- Antifailure
- Ionotropes
- Thrombolytics
- Analgesics
- Anticoagulants
- Steroids
- Antiarrhythmic drugs
- Electrolyte replacement - K, Na,
- IV Antibiotics
- Anticoagulant
- Blood transfusion
- External pacing
- Nebulisation
- CPR

- Needle decompression
- Intubation
- Pleural tapping
- Ascetic tapping
- Underwater Seal Drainage - Chest tube
- Synchronized Cardioversion
- Defibrillation
- Pericardiocentesis
- Other

DISPOSITION, OUTCOMES AND FINAL DIAGNOSIS

EMD disposition

- Discharged home
- Mortuary
- Admitted to general ward
- Admitted to APCU / HDU
- Operating theatre - OT
- Admitted to ICU
- Transferred JKCI
- Transferred MOI
- LAMA

Date and Time of disposition from EMD _____

Duration of stay at EMD - In HRS _____

(from time of arrival to time of leaving EMD)

OUTCOMES AT EMD

- Arrests - Cardiac / Respiratory
- Death
- Survived

Outcomes within 24 hours after disposition

- Death
- Survived
- LAMA

Outcomes after 24 hours

- Survived
- Died
- LAMA

Final ward diagnosis _____

Final ward diagnosis _____

Final ward diagnosis _____

Date of death

Date of discharge