ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

DEPARTMENT OF EMERGENCY MEDICINE

CHARACTERISTIC AND OUTCOMES OF MECHANICAL VENTILATED PATIENTS IN PEDIATRIC ICU AT TIKUR ANBESSA SPECIALIZED HOSPITAL ADDIS ABEBA, ETHIOPIA 2018.

BY: NETSANET TSEGAYE (CANDIDATE MSC. EMCCN)

RESEARCH THESIS TO BE SUBMITTED TO ADDIS ABABA UNIVERSITY, COLLEGE OF HEALTH SCIENCE DEPARTMENT OF EMERGENCY MEDICINE FOR THE PARTIAL FULFILLMENT IN REQUIREMENT FOR MASTER OF SCIENCE DEGREE IN EMERGENCY MEDICINE AND CRITICAL CARE NURSING.

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Table of Contents

List of table

List of figure

Acronyms and abbreviations

ARDS…… Acute respiratory distress syndrome

CPAP…… Continuous positive airway pressure

DKA…….Diabetic ketoacidosis

ETT……. Endotracheal tube

FIO2….. Fraction of inspired oxygen

HIV…. Human immune deficiency virus

ICU….. Intensive care unit

IVH…. Intra ventricular hemorrhage

MODS…..Multiple organ dysfunction syndrome

MV…… Mechanical ventilation

NMD….. Neuromuscular disease

ODINS….. Organ dysfunction and/or infection

PEEP…… Peak end expiratory pressure

PES…… post extubation stridor

PICU….. Pediatric intensive care unit

PIM 2…. Pediatrics index of mortality 2

PRISM… Pediatrics risk of mortality

PS…….. Pressure support

SIMV…. synchronized intermittent mandatory ventilation

SPSS… statistical package for social sciences

VAP… Ventilator associated pneumonia

Abstract

Introduction: Mechanical ventilation (MV) is a lifesaving therapy, allowing the support of patients with respiratory failure with the objectives of improving gas exchange and decreasing work of breathing. It is mandatory for the clinicians to understand the events occurring in the pediatric intensive care unit (PICU) and outcome of mechanically ventilated children for improving the quality care of the critically ill children.

Objective: The main objective of this study is to assess the characteristics and outcomes of mechanically ventilated paediatrics patients in Tikur Anbessa referral hospital 2016- 2018.

Methodology: Cross sectional study with retrospective data collection was employed on paediatric ICU patients. Data was abstracted from the patients' medical record by trained health professionals. SPSS version 21 software was used for analysis. The report was depicted descriptively using measures of central tendency, dispersion and displayed through tables and graphs. Bivariate and multivariate logistic regression model was fitted to identify factors associated with outcomes of ventilated patients. p value <0.05 was taken as significant.

Result: From the total of 220 cases (46.4%) from pediatrics emergency department. The commonest admission diagnosis were neurological causes 48(21.8%).The main reason for initiation of mechanical ventilation were respiratory failure 128(58.2%), malignancy was the commonest comorbidity in 39(17.7%). The preferred weaning methods was CPAP alone 54(24.5%).SIMV/PCV 176 (80.0%) was the frequently used mode. Complication occurred in 60(27.3%) of the cases. Being medical patient, cardiac and post op patients, duration on mechanical ventilation, ARDS, central nervous system failure and Higher PIM II score were significant predictors of PICU mortality.

Conclusion and recommendation: In this study mortality rate of mechanically ventilated pediatric patients was high. Respiratory failure was the main indication for initiation of mechanical ventilation. The complication rate was high. It is better to improve the quality of care and use severity score while admitting patients to PICU.

Key word: Mechanical ventilation, Mortality, PICU.

Chapter 1: Introduction

1.1. Background

Mechanical ventilation (MV) is a lifesaving therapy, allowing the support of patients with respiratory failure with the objectives of improving gas exchange and decreasing work of breathing (1). Mechanical ventilation can be delivered via positive-pressure breaths or negative-pressure breaths. Additionally, the positive-pressure breaths may be delivered noninvasively (defined as the use of a mask or nasal prongs to provide ventilator support through a patient's nose and/or mouth) or invasively (ventilator techniques that bypass the patient's upper airway with an artificial airway (endotracheal tube [ETT], laryngeal mask airway, or tracheostomy tube) (2).

Positive pressure mechanical ventilation was proved to it can save lives during poliomyelitis epidemics of 1950s.since that time there has been a growing increase in the use of ventilator support (3).The goal of mechanical ventilation are to provide adequate oxygenation, provide adequate alveolar ventilation, avoid alveolar over distension, maintain alveolar recruitment, promote patient ventilator synchrony, avoid auto PEEP and use the lowest possible FIO2 (4).

There are four modes of mechanical ventilation. Which are assisted/controlled volume cycled ventilation, assisted/control pressure controlled ventilation, synchronized intermittent mandatory ventilation and pressure support ventilation. These modes are either volume-preset or pressure preset. In the volume-preset mode the clinician sets the rate and tidal volume and the ventilator delivers whatever pressure is required to achieve it. In the pressure-preset mode the clinician sets the maximal inspiratory pressure and inspiratory time the ventilator delivers whatever tidal volume is generated by that pressure (5).

Respiratory problems are common in the emergency department and on the general and specialist wards and the need for advanced respiratory support (mechanical ventilator) represents the most common reason for admission to intensive care. An understanding of the approach to patients with respiratory failure and of the principles of respiratory support is thus essential for healthcare professionals, whether nurses, physiotherapists, or doctors (6).

In many cases of respiratory diseases the use of ventilator support is required. Besides that, ventilator support may be needed in other situations, such as in sepsis and septic shock, neuromuscular diseases, during postoperative state and in cases of altered mental status with loss of consciousness. Thus, mechanical ventilation (MV) has become one of the major indications for admission to intensive care units (7).

Pediatric intensive care unit (PICU) has a specific location for management of children with serious and severe diseases. Often these patients need intensive care and respiration with ventilator devices (8). Therefore mechanical ventilation (MV) is a common practice in pediatric intensive care units (PICUs). Its utilization rate, as reported in many researches implied that it varies from 20% to 50% of the patients admitted to these units (9).

Intensive care unit is also one of the sites where medical errors are most likely to occur because of the complexity of the diseases and patients are vulnerable to experience adverse outcomes due to multiple interventions (10, 11). And also MV is particularly challenging in children because of the heterogeneity of this population in terms of age, weight, and pathophysiology (1). Therefore, it is mandatory for the clinicians to understand the events occurring in the PICU and outcome of mechanically ventilated children for improving the quality care of the critically ill children (12).

Mechanical ventilation usage have its own risks among them the main Problems that can develop from using a ventilator include: infections, the ET or tracheostomy tube allows germs (bacteria) to get into the lungs more easily. This can cause an infection like pneumonia. Collapsed lung (atelectasis) and pneumothorax can happen sometimes; a part of the lung that is weak can become too full of air and start to leak. The leak lets air get into the space between the lung and the chest wall , lung damage the pressure of putting air into the lungs with a ventilator can damage the lungs. And also side effects of medications like sedatives and pain medications can cause a person to seem confused or delirious, and these side effects may continue to affect a person even after the medications are stopped and inability to discontinue ventilator support (13).

There are 4 methods of gradual weaning which are single daily T- Tube trial for up to two hours, intermittent mandatory ventilation, Pressure Support and Trials of spontaneous breathing (3).

1.2. Statement of the problem

The frequency of utilizing MV, according to previous studies, varies from 24-60% of all pediatric intensive care units (PICUs) (14). Many studies in developing countries have shown a mortality rate in the range of 40–60% in mechanically ventilated babies and the complications recorded in patients were shock, ventilator associated pneumonia (VAP), pulmonary hemorrhage, hypoglycemia, intra-ventricular hemorrhage(IVH), and pneumothorax. Of these, only shock, pulmonary hemorrhage, and hypoglycemia were significantly associated with mortality (15).

Although MV have indispensable role in patients with acute respiratory failure, its use can also cause harm. The adverse consequences of MV include airway lesions by intubation, pneumonia/sinusitis associated with MV, volutrauma, barotrauma and bio trauma (7). Mechanical ventilation despite its important role, it may exacerbate, or even initiate, lung injury and inflammation and has therefore been identified as a risk factor for poor patient outcome (16).

A Retrospective cohort study which was conducted in PICU of Aga Khan University Hospital in Pakistan found that the mortality rate among the critically ill mechanically ventilated patients was of 30.5% and The complication rate in MV children was 9.4% (29/307) (17). And also the estimated death in research conducted in Nepal revealed that among Forty one children (17.8%) received mechanical ventilation, of which 23 (56%) survived, 14 (34.1%) died but with the advancement in intensive care facilities, there is a dramatic increase in survival of critically ill children (18).

A study conducted in Jima university hospital also reported that the use of mechanical ventilator in ICU is high, among 170 pediatric patients admitted to the ICU, 63 (37.1%) were mechanically ventilated from initial admission to discharge or death (19).

An awareness of the clinical demographics and outcomes of mechanically ventilated patients in the intensive care unit (ICU) is important because it allows for better use of resources and helps in clinical decision making (20).

However the characteristics and outcomes of mechanically ventilated pediatric patients is not dealt in our setting, patients on MV are still the severest of cases requiring PICU admission.MV is employed for a variety of reasons and with different modes and variable outcomes. The extended knowledge of

MV is valuable in various aspects; optimizing its use in critically sick children, and allocation of hospital resources as utilization rate determines the needed number of PICU beds (14).

Therefore this study aimed at assessing the reasons for using MV, clinical characters of the patients, different modes of ventilation, complications rate, the severity score, the outcome and associated factors of mortality of mechanically ventilated sick children. Which is very important and a corner stone in improving our quality of service and decrease the mortality rate of sick children.

As far as my knowledge this is the first study to describe the characteristics and outcome of pediatric patients on MV in our setting, which is most significant in planning training for its use and differentiating and avoiding characters of the patients with poor outcome.

1.3 Significance of the Study

This study is intended primarily to assess the characteristics and outcomes of mechanical ventilation utilization among paediatrics patients in TASH. Since mechanical ventilation is the most important intervention in ICU it's important to assess its outcome and find the determinant factors in order to increase the quality of care. The result will hopefully give us base line data for any intervention to be implemented at hospitals that have an ICU in Ethiopia. This study will also help to clearly picture the problems that have related to the use of mechanical ventilator and gives information about the outcome related to its use. This study can also serve as a baseline for any high scale study to be done at a university level. And also this study was done for first time in our setting.

Chapter 2: Literature review

2.1Characteristics

An institutional based prospective cross sectional study conducted at Niloufer Hospital for Women & Children in India showed that total of 144 (23%) cases admitted in PICU were ventilated over the period of six months. The mean age of ventilated cases was 3 years. Neurological (27.8%) and respiratory (25.6%) causes were found to be the commonest indicators of ventilation in the study. The most commonly used ventilatory mode was synchronized intermittent mandatory ventilation (SIMV). The average ventilator stay was 2.4 days and hospital stay was 9.71 days. Out of 144 cases, 44 (30%) cases were on ventilator for less than 24 hours, 96 (67%) had ventilator stay between 1 to 7 days and only 4 (3%) cases had a prolonged stay between 8 to 30 days. Multiple organ dysfunction syndrome (MODS) was occurred in 11(7.6%) of the cases (12).

Another multicenter prospective cohort study conducted in Latin America revealed that among 2,156 patients admitted to pediatric intensive care units, 1185 (55%) received mechanical ventilation for a median of 5 days (interquartile range 2–8). Median age was 7 months (interquartile range 2–25). Main indications for mechanical ventilation were acute respiratory failure in 78% of the patients, altered mental status in 15%, and acute on chronic pulmonary disease in 6%.Median length of stay in the pediatric intensive care units was 10 days (interquartile range 6–18) (9).

In 2014 a retrospective study in Koirala Institute of Health Sciences in Nepal reported that from 230 children who were admitted to the PICU with male to female ratio of 1.7:1.Forty-one (17.8%) children received mechanical ventilation. 31.3% patients were infants. Diagnoses included respiratory diseases (n=76, 33%), central nervous system diseases (n=43, 18.6%), infectious diseases (n=26, 11.3%), surgical problems (n=18, 7.8%), gastrointestinal diseases (n=17, 7.4%), cardiovascular diseases (n=15, 6.5%), poisonings (n=11, 4.8%), renal (n=9, 3.9%), hematological (n=3, 1.3%) and others (n=12, 5.4%) (18).

According to prospective cohort study in Brazilian high-complexity PICU 2006, from the total of 241 patients admitted, 86 (35.7%) received mechanical ventilation for 24 hours or more. The median age of participants was 32 months and the median length of mechanical ventilation use was 6.5 days. The major indication for mechanical ventilation was acute respiratory failure, usually associated with severe sepsis / septic shock. Pressure ventilation modes were the standard ones. Only 4 of 49 patients (8.16%)

had no chronic status. The most prevalent chronic diseases were as follows: respiratory (n=13; 26.53%), neurological (n=9; 18.37%), hepatic (n=6; 12.24%) and oncological (n=7; 14.28%). The airway was achieved by orotracheal intubation, in most cases. There was no nasotracheal intubation. A total of 5 patients were previously tracheostomized, while another 3 were tracheostomized after 3 weeks of MV. (7).

Multicenter study performed at 16 PICU in United States reported that at least 30% of all children in a heterogeneous cross-section of US PICUs are intubated and mechanically ventilated. The reasons for intubation and mechanical ventilation are quite variable, but close to 50% have primarily respiratory disorders, 30% have primarily cardiovascular disorders, spinal instability 435(5.3%) neuromuscular disease 318 (3.9%) and abdominal wound 262(3.2%) (21).

A prospective survey in Italy by Wolfer A et al in 2015,mentioned the main characteristics of the patients which was on MV as followed, 49.2 % of the total admission required MV among those 34.6% were ventilated for >24 hrs. The median length MV was 4.5 days for all patients. Bronchiolitis, (6.7%), Pneumonia (6.7%) and upper airway obstruction (5.3%) were the most frequent causes of acute respiratory failure, and altered mental status (9.2%) was the most frequent reasons for MV. SIMV was the frequently used modes of ventilator assistance (49%) (22).

Prospective observational study which was conducted in 2014 in two pediatric intensive care units of Cairo University Pediatric Hospital mentioned that a total of 893 children were admitted and 293(32.8%) were mechanically ventilated. Neurological etiology in 101 cases, respiratory in 65 cases, cardiac in 54 cases, sepsis in 34 cases, NMD in 16 cases, renal in 6 cases, post-operative in 2 cases were responsible for PICU admission. ARDS occurred in 26 (8.9%) cases. VAP in 80 (27.3%) (20. 19/1000 ventilation), pneumothorax 31 (10.6%) (7.82/1000 ventilation days), atelectasis 13 (4.4%) (3.28/ 1000 ventilation), and post extubation stridor (PES) 7 (2.4%). Neurologic causes were the most common reasons for initiation of MV, with 114 (38.9%) cases. Duration of mechanical ventilation ranged from 2-90 days (median 9 and IQR = 5-15).The most commonly preferred mode for initiation of MV is SIMV with PS. Complication occurred in 117 (39.9%) of the cases. The occurrence of multiple organ dysfunction syndrome (MODS) was reported in 121 (41.3%). sepsis in 53 cases (40.5%).The most commonly preferred method of weaning was PS with CPAP in 115/154 (74.7%) cases. Duration of mechanical ventilation was significantly longer with neuromuscular diseases, and with the occurrence of complications (p<0.001) (14).

2.2Outcome

An international cohort study done by Farias JA., et al in 2006 showed that the overall mortality rate of mechanically ventilated pediatric patients was 15.6%. Severity of illness, development of acute renal failure PRISM score and severe hypoxemia over the course of MV were the factors associated with lower survival. Patients with PRISM score of > 27 on admission to PICU had a mortality of 43% and development of acute renal failure was associated with mortality of 50% (AOR: 12.7, 95 % CI 6.3 - 25.7 (23).

An observational multicenter study in Czech republic in 2005 revealed that among one hundred and forty four patients who are mechanically ventilated 3.5% were dead and hypoxia was not cause of death an any patients . The severity of illness and length of stay were associated with the mortality (24).

A study conducted by Haque A,et al in Aga khan university hospital ,Karachi 2015 described that the mortality rate they found in their study was 11.9% (25).

A national prospective multicenter survey in Italy 2011 reported that the overall mortality rate from the total admission was 6.7% with the highest rates for heart disease, sepsis, and acute respiratory distress syndrome (26.1%, 22.2%, and 16.7% respectively).Length of stay, associated chronic disease, severity score on admission and PICU mortality were highly associated (22).

A retrospective cohort study done in Aga khan hospital in Pakistan found out that the mortality rate of children mechanically ventilated was 30.3% as compared to the overall mortality rate of in PICU was 16.3%. The complication rate in MV children was 9.4% (29/307). These included lobar atelectasis 4.6% (14/307), ventilator associated pneumonia (3.3%). The long duration (> 10 days) and cardiogenic shock were identified as independent risk factor associated with increased mortality (17).

According to a study conducted in Nelufer hospital in Telanga Out of 144 ventilated cases, 71(49.3%) were discharged, 10(6.9%) cases Left Against Medical Advice (LAMA) and 63(43.8%) cases died. A mortality rate of 82% was found in cases put under ventilator for less than 24 hours which was statistically significant (p <0.05), while 70% of cases with a ventilator stay between 1 to 7 days were successfully discharged. Mortality was significantly more for cases of Hepatic encephalopathy, DKA, MODS, Congenital heart diseases and Poisonings. Neurological cases had a better outcome (64%) among all the cases. MODS on admission had 73% mortality (12).

A multinational prospective cohort study on mechanical ventilation in Korea discovered that PICU mortality was 36%. Midazolam and fentanyl were the preferred sedative and analgesic drugs, respectively. The multiple logistic regression model revealed that the number of failed organs (OR, 2.132; 95% CI, 1.634-2.781; $P < 0.001$) were independently associated with ICU mortality (20).

In Egypt at Cairo University Pediatric Hospital prospective observational study reported that Mortality occurred in 134/293 (45.7%) of patients. There was a significant relationship between mortality and, cardiovascular cases, sepsis, multiple organ dysfunction syndromes (MODS), ventilator-associated pneumonia (VAP), and with barotrauma (14).

Chapter 3: Objectives

3.1 General Objective

The main objective of this study is to assess the characteristics and outcomes of mechanically ventilated paediatrics patients in Tikur Anbessa specialized referral hospital 2016 to 2018.

3.2 Specific Objectives

- To determine the outcomes of mechanically ventilated paediatrics patients in PICU of TASH
- To identify the characteristics of mechanically ventilated paediatrics patients in PICU of TASH
- To identify factors which are associated with poor outcome of mechanically ventilated paediatrics patients in PICU of TASH.

Chapter 4: Methodology

4.1 Study Area and period

This study was conducted at Tikur Anbessa specialized hospital which is the largest referral and teaching hospital in Addis Ababa Ethiopia. This hospital offers diagnosis and treatment for approximately 370,000-400,000 patients a year. And also serves the community with specialities including emergency medicine, internal medicine, general surgery, paediatrics, obstetrics /gynaecology and other medical /surgical specialities. It has 800 beds, around 400 doctors exact number is unknown, 870 nurses and 200 other health related professionals (Laboratory technicians, radiology, etc.). Specifically the study place will be the paediatrics ICU which have a total of 4 beds for all kind of patients (medical and surgical). And it has 16 Nurses and 2 paediatric resident besides the senior Doctors per day. The study was conducted from September 2016 to February 2018.

4.2 Study Design:

An institutional based quantitative retrospective cross sectional study design was employed by using a review of patient's medical cards which were admitted from September 2016 to February 2018.

4.3 Source Population:

All paediatrics patients admitted to paediatrics ICU in Tikur Anbessa specialized hospital and who were on mechanical ventilator.

4.4 Study population

All paediatrics patients admitted to paediatrics ICU in Tikur Anbessa specialized hospital and who were on mechanical ventilator from September 2016 to February 2018.

4.5 Inclusion and exclusion criteria

4.5.1 Inclusion criteria

All paediatrics patients who were mechanically ventilated in paediatrics ICU for at least 24 hours from September 2016 to February 2018.

4.5.2 Exclusion criteria

Those patients with incomplete charts, lost charts and charts with poor hand writing (difficult to read).

4.6 Variables

4.6.1 Dependent variables

Outcome of mechanical ventilated paediatric patients

4.6.2 Independent variables:

Socio- demographic factors (sex, age) reason for initiation of MV, Length of stay on MV, mechanical ventilator mode, complications, Admission diagnosis, investigation, co morbidities, mode of weaning, sepsis, ARDS , MODS ,organ failed in ICU, sedation used, patient bounce back status, CPR done, re intubation and PIM II score.

4.7 Operational definition

Outcome – in this study outcome was interpreted as a paediatric patient after mechanical ventilation whether they were survived or not survived.

Characteristics – what was male to female ratio, the age of mechanically ventilated patients how (in what mode), what was their initial diagnosis while admission to PICU, what was their main indication, what access to the airway was employed, type of sedation used and for how long paediatrics patients used the mechanical ventilator and what was the main complications they developed and also the method of weaning from mechanical ventilator. And also did the patient developed ARDS, sepsis and MODS during the mechanical ventilation period, what was the value PIM II score.

MODS: Failure of 2 or more organs in PICU. And also ODINS criteria were used to differentiate each organ failed.

4.8 Sample size and Sampling procedures

All patients who were admitted at paediatrics ICU from September 2016 to February 2018 and met the criteria were included in this study. 537 patients were admitted but only 220 fulfilled the inclusion criteria. Consecutive sampling technique was used.

4.9 Data Collection tools and materials

Data was collected from the study population using a structured data abstraction tool through detail chart review during the study period.

4.10 Data quality assurance

Properly designed and structured data abstraction tool was used. Data collectors was given 2 days training and closely supervised during data collection and entry. The data collectors were mainly composed of health professionals (BSc nurses and MSc nurses) for better understanding and interpretation of the patients' medical chart. Pre-test was carried out using 14 patient cards of PICU admitted patients in TASH in order to check the completeness and clarity of the tool. And some part of the collection tool was revised and adjusted.

4.11 Data analysis

Clean up and cross-checking of data was done before analysis. Data was checked for completeness and coded manually and entered to SPSS version 21 for analysis. Both descriptive and analytical statistical procedures were utilized. Descriptive statistics like percentage, mean, median standard deviation and Interquartile range (IQR) was used for the presentation of characteristics of mechanically ventilated patients. Tables and graphs were also used for data presentation. PIM II calculator was used in order to know what the predicted mortality rate when admitted to PICU was. Binary logistic regression was used to identify factors associated with outcomes of ventilated patient. Multivariable logistic regression model was fitted to control the possible effect of confounders and finally the variables which had independent association with poor outcomes identified on the basis of OR, with 95%CI and p-value less than 0.05. Model fitness was checked by using Hosmer and Lemeshow goodness of fit test.

4.12. Dissemination of the result

The result of this study was submitted to Addis Ababa University College of Health sciences Department of Emergency medicine and Department of Pediatrics. The copies of this result will also be given to Tikur Anbessa Specialized Hospital PICU and hospital management so they can use the result for planning and implementation of intervention program, attempt to present in different workshop and publish my work in scientific journals will be made.

4.13. Ethical consideration

The ethical clearance was obtained from Addis Ababa University College of health sciences department of emergency medicine and department of paediatrics and child health research and publication committee. Additionally confidentiality of all the data to be gained was seriously respected. Confidentiality was ensured by not mentioning patients names in the questioner and unauthorized individuals was not allowed to access to the data which was collected by using a password protected computer.

Chapter 5: Results

5.1 socio demographic characteristics of mechanically ventilated pediatric patients

There were 537 patients admitted to PICU in the last 2 and half year but in this study 220 patients met the inclusion criteria and included in the study. .Most of the study subjects were in the age range of less than 1 year 80(39.1). 140(63.6) of the participants were males. Majority of them came from Addis Ababa 113(51.4%) **See Table 1**.

Table 1: Socio demographic characteristics of mechanically ventilated pediatric patients in TASH pediatrics ICU (n=220) 2018.

Variables		**Frequency**	**Percent (%)**
Age	<= 1 year	86	39.1
	1-5yr 11 month	74	33.6
	6-12	60	27.3
Sex	Male	140	63.6
	Female	80	36.4
Region	Oromiya	72	32.7
	Addis Ababa	113	51.4
	SNNPR*	14	6.4
	Diredawa	2	0.9
	Amhara	17	7.7
	Tigray	1	0.5
	Gambela	1	0.5

***-Southern Nation Nationality Peoples Republic**

5.2 Characteristics mechanically ventilated patients

5.2.1 History findings

From the history findings 149(67.7%) of the children were screened for HIV and 145(65.9%) became non-reactive and 4(1.8%) reactive, 71(32.3%) were unknown. The source for admission were 102(46.4%) from pediatrics emergency department, 57 (25.9%) from operation room, 47(21.4%) from inpatient units and 14(6.4%) from another hospital. Regarding to the general indication of PICU admission 160(72.7%) were medical patients and 60(23.7%) were surgical patients. For the admission diagnosis **see Table 2.**The reason for initiation of mechanical ventilation were respiratory failure 128(58.2%), neurologic (coma) 61(27.7%), cardiovascular 18(8.2%), sepsis 7(3.2) and post op (airway protection) 6(2.7%). Among the patients with comorbidity malignancy was in 39(17.7%), CHD was 32(14.5%), SAM occurred in 13(5.9%) and HIV was 4 (1.8%).

Table 2: Reasons of admission of mechanically ventilated pediatrics patients in TASH pediatric ICU (n=220) 2018

Variable (n, %)	Sub variable	Frequency	Percent
Neurology (48, 21.8%)	Brain abscess	6	2.7
	Status epilepticus	12	5.5
	TBI	6	2.7
	Meningitis	7	3.2
	Apnea	4	1.8
	Stroke	4	1.8
	Brain tumor	3	1.4
	Uremic encephalopathy	2	0.9
	ICH	2	0.9
	Spinal cord injury	1	0.5
	DKA	1	0.5
Respiratory (42, 19.1%)	SCAP	15	6.8
	Tuberculosis	8	3.6
	FBA	6	2.8
	Aspiration pneumonia	3	1.4
	Lung contusion	2	0.9
	PCP	2	0.9
	HAAD	1	0.5

	HAP	1	0.5
	PTE	1	0.5
	Pulmonary edema	1	0.5
	Severe croup	1	0.5
Cardiac (29, 13.2%)	Post cardiac arrest	14	6.4
	Congenital heart disease	10	4.5
	Congestive heart failure	2	0.9
	SVT	2	0.9
Sepsis (34, 15.5%)		34	15.5
Renal (10, 4.5%)	Acute renal failure	6	2.7
	Chronic renal failure	4	1.8
Neuromuscular (19,8.6%)	GBS	19	8.6
Malignancy (8, 3.6%)	Superior mediastinal mass	5	2.3
	Anterior mediastinal mass	2	0.9
	Tumor lysis syndrome	1	0.5
Other (30,13.6%)	Post op	28	12.7
	Poisoning	2	0.9
Length of stay in days(SD, mean)	1-3 days	n=93	42.3%
	4-7days	n=63	28.6%
	>8days	n=64	29.1%
		SD=13.33	Mean=9.33
PIM 2 score	Range (1-91)	SD=23.9	Mean=20

TBI: Traumatic brain injury, DKA: Diabetic keto acidosis, SCAP: Severe community acquired pneumonia, GBS: Gulian Barrie syndrome, PTE: Pulmonary thrombo embolism, HAP: Hospital acquired pneumonia, HAAD: Hyper active airway disease, PCP: Puemocystic carni pneumonia. SVT: Supra ventricular tachycardia

5.2.2 Physical examination findings

From the physical examinations findings weight in kilogram was mean±SD (12.73±9.12). The GCS of patients at admission was <8 in 73(33.2%) of the patients and >8 in 147(66.8%) of the patients.

5.2.3 Mode and weaning method

The access to airway used was ETT 214(97.3%) and tracheostomy 6(2.7%). Regarding to the modes used while MV support SIMV/PCV 176 (80.0%), SIMV/VCV 19(8.6%), AC/PCV 10(4.5%), BIPAP/CPAP 8(3.6%), AC/VCV 7(3.2%) were used at the initiation of MV support. The length of stay on MV support ranged from (1-90) days with mean (9.3) SD (13.33) median with IQR 4.4 (2-10.3). The weaning methods employed for the survived patients were CPAP alone 54(24.5%), direct oxygen trial 14(6.4%), PS with CPAP 12(5.5%) and accidental extubation 3(1.4%).

5.2.4 Complication and sedation used

From the total study population 60(27.3%) developed complications. The complications were VAP, Pneumothorax, atelectasis and post extubation stridor 41(18.6%), 15(6.8%), 11(5%) and 1(0.5%) respectively. More than one complication occurred in 8(3.6%) patients.113 (51.4%) patients developed ARDS. From the total 205(93.2%) patients used sedation from that the type of sedation used was diazepam 173(78.6%), morphine 67(30.5%), ketamine 21(9.5%), thiopental 7(3.2%) , propofol 3(1.4%) and fentanyl 1(0.5%). 62(28.4%) patients used more than one type of sedation. From the combination of sedations 50(22.7%) of the cases used diazepam and morphine, 3(1.4%) ketamine, morphine and diazepam and 3(1.4%) used diazepam and ketamine.

5.2.5 Organ failure and other characters

Multiple organ dysfunction syndrome (MODS) occurred in 126(57.3%) of the patients. among organs failed lung took 220(100%) followed by CNS 89(40.5%) **see figure 1**. Sepsis occurred in 125(56.8%) patients. CPR was done in 39(17.7%) of the patients admitted. 22(10%) of the patients had bounce back to PICU and 34(15.5%) were re intubated in the course of mechanical ventilation.

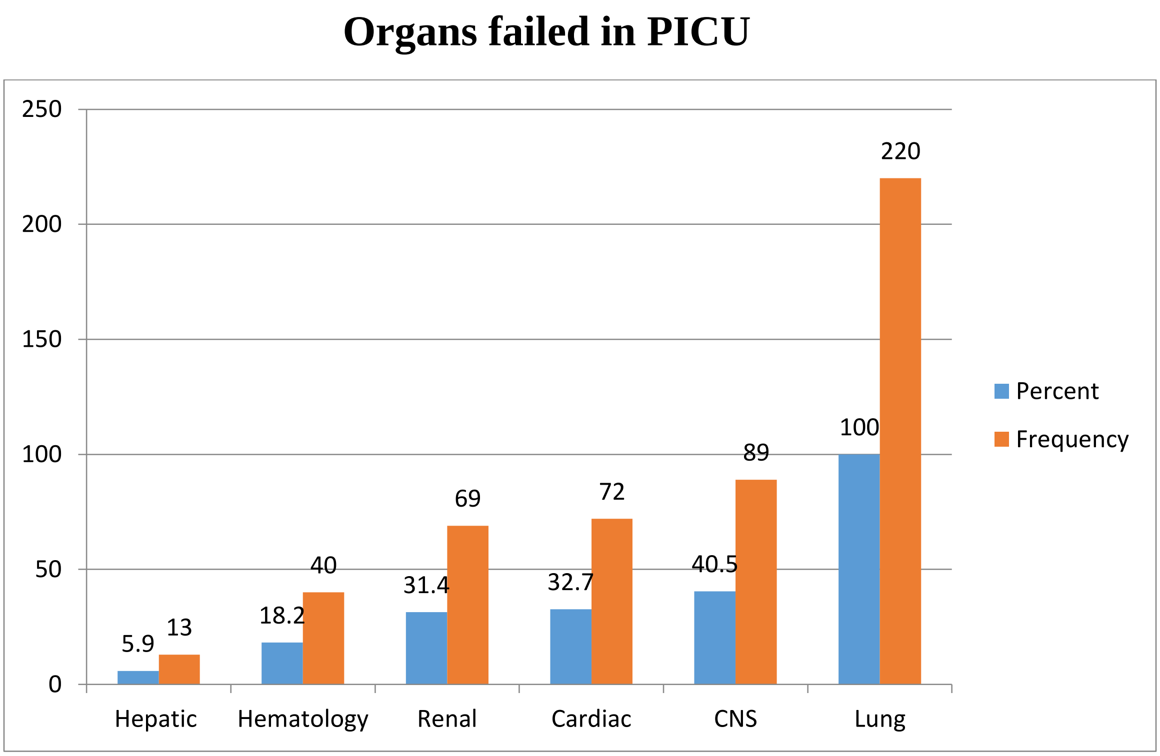

Figure 1: Types of organs failed in mechanically ventilated pediatrics patients in Tikur Anbessa specialized hospital, PICU, Addis Ababa Ethiopia, 2018.

5.3 Outcome

Among the total study participants 130(59.1%) dead and 90(39.9%) survived. From the survived ones 75(34.1%) transfer to ward, 12(5.5%) leave against medical advice and 3(1.4%) discharge. Sepsis was the leading cause of death 59(26.8%) **see table 3**.

Table 3: Outcome of mechanically ventilated pediatric patients in TASH pediatrics ICU (n=220) 2018.

Variable		Frequency	Percent
Outcome	Survived	90	39.9
	Not survived	130	59.1
Cause of death	Sepsis	59	26.8
	ARDS	30	13.6
	Brain death	17	7.7
	Intractable heart failure	12	5.5
	Other**	13	5.9

****Renal failure, Surgical site bleeding, Tension pneumothorax, Blocked ETT, Intracranial hemorrhage.**

5.4 Binary logistic regression results

As bivariate logistic regression showed regarding to the admission source patients from inpatient unit and emergency department showed relationship with mortality p value 0.002 and <0.001 respectively. And also medical patients was associated with mortality (p=0.000). From the admission diagnosis's sepsis, NMD and others (post op and poisoning) showed relationship with mortality (p=0.026, 0.008 and 0.179) respectively. Neurologic (coma), respiratory failure and shock showed relationship with mortality from reasons for mechanical ventilation (p=0.102, 0.008 and0.011 respectively). Patients who stayed less on MV (p=0.001) and stayed above 8 days (p=0.000) were associated with the mortality. Among the complications only VAP was related to mortality (p=0.033).ARDS and MODS were strongly associated with the mortality (p=<0.001) for both. Renal failure organs failed in PICU showed relationship (p= 0.000, COR (4.482) for the others see table 4. Patients with higher PIM II score showed association (p =0.002, COR=2.37).

Table 4: Binary logistic regression analysis of associated factors with mortality in mechanically ventilated pediatric patients in TASH pediatrics ICU (n=220) 2018.

variable		Final outcome		P value	COR(95 % CI)
		Surviv or(n)%	Non-survivor		
Age	Less than 1 year	31	55	0.492	1.267 (0.645,2.492)
	1-6 year	34	40	0.620	0.840 (0.423,1.671)
	6-12 year	25	35	Ref	
Sex	Female	32	48	Ref	
	Male	58	82	0.836	0.943 (0.539, 1.649)
HIV status	Positive	1	3	Ref	
	Negative	63	82	0.474	0.434 (0.044, 4.271)
	Unknown	26	45	0.641	0.577 (0.057,5.836)
Admission source	Post op	36	21	Ref	
	Another hospital	10	4	0.563	0.686 (0.191,2.462)
	Inpatient unit	15	32	0.002*	3.657 (1.617,8.270)*

	Emergency	29	73	0.000*	4.315 (2.167,8.595)*
PICU indication	Medical	48	112	0.000*	5.44(2.849,10.403)*
	Surgical	42	18	Ref	
Admission diagnosis	Neurology	20	28	Ref	
	Respiratory	17	25	0.834	1.094(0.472 ,2.532)
	Cardiac	11	18	0.970	1.018(0.394,2.63)
	Sepsis	6	28	0.025*	3.33(1.164,9.545)*
	Renal	2	8	0.220	2.8(0.539,14.533)
	Neuromuscular	15	4	0.009*	0.19(0.055,0.660)*
	Malignancy	2	6	0.391	2.1(0.386,11.434)
	other	17	13	0.179*	0.535(0.215,1.333)
Indication for MV	Neurology	27	34	0.102*	6.296 (0.694,57.148)
	Respiratory failure	55	73	0.088*	6.636 (0.754,58.436)
	Cardiovascular	3	15	.011*	25(2.095,298.28)*
	Sepsis	0	7	0.999	807737(0.000,0)
	Other(post op)	5	1	Ref	
Length of stay on MV	1-3 days	26	67	Ref	
	4-7	23	40	0.260	0.675 (0.340,1.338)
	>8	41	23	0.000*	0.218 (0.110,0.431)*
	SD=13.33	Mean=9.33		0.001*	0.956 (0.931,0.982)*
Comorbidities	Malignancy	14	25	0.84	1.293(0.639,2.649)
	CHD	13	19	0.972	1.014(0.473,2.174)
	SAM	7	6	0.333	0.574(0.816,1.768)
	HIV	1	3	0.523	2.102(0.215,20.54)
Modes of MV	SIMV/VCV	7	12	Ref	
	AC/PCV	2	8	0.358	2.33 (0383.14.23)
	AC/VCV	1	6	0.288	3.5 (0.346,35.37)
	BIPAP/CPAP	6	2	0.083	0.194 (0.031,1.239)
	SIMV/PCV	74	102	0.662	0.84 (0.302,2.140)
Complications	Yes	33	27	0.01*	0.453(0.248,0.827)
	No	57	103	ref	
VAP	Yes	23	18	0.030*	0.468 (0.236,0.931)*
	No	67	112	Ref	
Pneumothorax	Yes	7	8	0.639	0.778 (0.272,2.226)
	No	83	122	Ref	
Atelectasis	Yes	6	5	0.351	0.35 (0.166,1.894)
	No	84	125	Ref	
PES	Yes	1	0	1.000	0.000 (0.000,0)

	No		89	130	Ref	
ARDS	Yes		30	83	0.000*	3.532 (2.006,6.219)*
	No		60	47	Ref	
MODS	Yes		29	97	0.000*	6.183 (3.418,11.185)*
	No		61	33	Ref	
Organ failed in PICU	RENAL	Yes	13	56	0.000*	4.482 (2.265,8.870)*
		No	77	74	Ref	
	Cardiac	Yes	12	60	0.000*	5.571 (2.770,11.206)*
		No	78	70	Ref	
	CNS	Yes	17	72	0.000*	5.331 (2.836,10.019)*
		No	73	58	Ref	
	Lung	Yes	90	130	0.007*	1.44(0,0)*
		No	0	0	Ref	
	Hematology	Yes	5	35	0.000*	6.263 (2.347.16.716)*
		No	85	95	Ref	
	Hepatic	Yes	2	11	0.073*	0.246 (0.53,1.137)
		No	88	119	Ref	
GCS	3-8		23	50	0.047*	1.821(1.008,3.882)
	9-15		67	80	ref	
Sepsis	Yes		38	87	0.000*	2.769(1.589,4.825)*
	No		52	43	Ref	
CPR before admission	Yes		12	27	0.159*	1.704 (0.812,3.574)
	No		78	103	Ref	
Patient bounce back	Yes		12	10	0.175*	0.542 (0.223,1.314)
	No		78	120	Ref	
Re intubation	Yes		15	19	0.679	0.856 (0.409,1.790)
	No		75	111	Ref	
PIM II SCORE	0-9		54	50	Ref	
	9-91		36	80	0.002*	2.37 (1.366,4.111)*
	(Mean and SD) (20,23.9), MAX/MIN (1-91)				0.000*	1.029(1.013,1.046)*

***p value < 0.2 taken as significant.**

Multivariable logistic regression model was fitted on variables with p value < 0.2 in order to know the significant predictors of mortality. The results showed that being medical patient (p=0.024), cardiac diseases (p=0.004), duration on MV (p=0.02), ARDS (p=0.003), among organ failures CNS (p=0.015) and Higher PIM II score (p=0.025) were significant predictors of PICU mortality. For respective AOR with 95% CI **see table 5**.

Table 5: multivariate logistic regression analysis of associated factors with mortality in mechanically ventilated pediatric patients in TASH pediatrics ICU (n=220) 2018.

Variables	Survivor	Non-survivor	AOD (CI, 95%)	P – value
Admission source inpatient	15	32	0.820(0.165,4.070)	0.809
Admission source emergency	29	73	1.65(0.327,8.408)	0.541
Indication for ICU medical	48	112	6.078(1.272,29.039)*	0.024*
Admission diagnosis cardiac	11	16	0.165(0.028,0.975)*	0.047*
Admission diagnosis sepsis	6	28	0.648(0.011,3.838)	0.632
Admission diagnosis NMD	15	4	0.22(0.026,1.856)	0.165
Admission diagnosis other	17	13	4.549(1.005,20.586)	0.049*
Indication for MV neurologic	27	34	1.374(0.12,15.698)	0.798
Indication for MV respiratory	55	73	0.960(0.078,11.852)	0.975
Indication for MV cardiovascular	3	15	2.764(0.121,63.48)	0.524
Length of stay on MV	SD=13.33	Mean=9.33	0.940 (0.892,0.990)*	0.02*
Complication developed	33	27	0.817(0.276,9.522)	0.794
VAP	23	18	1.621(0.300,5.084)	0.593
ARDS	30	83	4.105(1.637,10.293)*	0.003*
MODS	29	97	0.643(0.146,2.826)	0.559
Organ failed renal	13	56	01.694(0.465,6.172)	0.424
Organ failed cardiac	12	60	3.169(0.810,12.4)	0.098
Organ failed CNS	17	72	4.598(1.349,15.679)*	0.015*
Organ failed hepatic	2	11	1.936(0.209,17.954)	0.561
Organ failed hematology	5	35	1.18(0.256,5.447)	0.832

GCS < 8	23	50	0.827(0.305,2.243)	0.709
Sepsis	38	87	2.345(0.854,6.438)	0.098
CPR done before admission	12	27	1.146(0.297,4.428)	0.843
Bounce back patient	12	10	0.550(0.148,2.0410	0.371
PIM II score >10	36	80	4.401(1.204,16.088)*	0.025*

***p value < 0.05 taken as significant.**

Chapter 6: Discussion

This paper reviewed the characters of mechanically ventilated pediatric patients. During the last two decades ICU service becomes an advanced medical discipline well recognized for its services in the west and then slowly spread out in other parts of the world (26).even though MV is a very lifesaving therapy it is not adequately growing in our country and also there is a high mortality rate related to its use.

In this study the major characteristics of the patients on MV was as follow. Majority of the patients Age was less than 1 year (39.1%) and 63.6 % were male :this result is in line with the study in Latin America and Nepal (9,18) and differs from a study in Indian Nelufer hospital in which the mean age was 3 years(12).

The main reason for PICU admission in this study were neurological 48(21.8%) and respiratory 42(19.1%) which is similar with a study in Cairo with a result of neurological etiology in 101(34.4%) cases, respiratory in 65(22.2%) cases (14). Respiratory failure 128(58.2%) were the main indication for mechanical ventilation in this study other published study with similar reason showed that respiratory failure as indication for MV ranged from (25-78 %) (9, 12, 18, 21).but this result differs from a study in Cairo in which the main indication for MV was neurologic cases (38.9%) (14) .This discrepancy might be due to respiratory diseases like pneumonia are common in our country and also there is poor awareness about respiratory diseases since they mimic the sign and symptoms of common cold they get medical attention once they are complicated.

The most commonly used MV mode was SIMV/PCV (80.0%) , Wolfer A et al also reported that SIMV mode was the most commonly used mode which is also similar with a study in Cairo (49%) and India (14,12).

Length of stay on MV in this study was ranged from (1-90) days with mean (9.3) SD (13.33) median 4.4 days IQR (2-10.3). But a study by Dr. Ayesha et al revealed that average ventilator stay in Telanga Nelufer hospital was 2.4 days (12) which is less than this study and other study in Latin America length of stay was median of 5 days (interquartile range 2–8)(9) which is almost in line with this study. Another study in Brazil PICU showed that the median length of mechanical ventilation use was 6.5 days. (7) This result is higher than our setting. Wolfer A et al described that the median length MV was 4.5 days for all patients (22) which is similar to this study. And also Bassant M et al found out that in Cairo Duration of mechanical ventilation ranged from 2-90 days (median 9 and IQR = 5-15) (14). This result is much higher than this study. The difference in ventilator stay among the other studies might be due to our socio economic status and late admission of patients due to shortage of beds and other facility in our hospital which makes the patients vulnerable to poor outcome and shorter length of stay.

Regarding to the access to airway the most used access was via ETT (97.3%). Similarly airway was achieved by orotracheal intubation in most cases. (7, 14). Because it is the preferable and safest access than others.

In the present study (17.7%) of the patients had different comorbidities. Among this comorbidities malignancy was (17.7%) followed by CHD (14.5%).in a study done in Brazilian PICU Only 4 of 49 patients (8.16%) had no chronic status. The most prevalent chronic diseases were respiratory (26.53%), neurological (18.37%), hepatic (12.24%) and oncological (14.28%)(7).This is because both hospitals are referral hospitals , most of complicated and severe cases are transferred to this hospitals from all over the country so comorbidities might be common as worsening conditions for the patients.

Multiple organ dysfunction syndrome (MODS) occurred in (57.3%) of the cases. From failed organs lung occupied (100%), CNS (40.5%) and cardiac (32.7%). The occurrence of MODS in other studies in India and Egypt was (7.6% and 41.3%) respectively (12, 14). The finding in this thesis is much higher than the both results. This higher discrepancy might be due to delayed admission to PICU and there might be a limited early resuscitation practice in our setting which is a crucial method of preserving organs from failing. And also it might be due to low practice of the health care professional in preserving of the organs in admitted patients.

The rate of ARDS in this study was (51.4%). But in study done in Cairo ARDS occurred in (8.9%) cases (14). There is a big difference in this two results this might be due to the study design used and in most of the patients in this study the admission reason for MV was respiratory failure/respiratory problems but in the Cairo study (14) the cause was neurological cases so for the patients in this study this makes them prone to ARDS since it is one of the consequences of respiratory problems.

Mechanical ventilation’s required adjuvants, such as sedatives and analgesics (27). In that aspect, in this study (93.2%) patients used sedation from that the preferred ones was diazepam (78.6%) followed by morphine (30.5%), but Midazolam and fentanyl were the preferred sedative and analgesic drugs used in a study in Korea by Jeong et al (20).this difference might be due to the store availability of the drugs since our setting have low socioeconomic background.

Regarding to the development of sepsis from the total admitted cases sepsis occurred in (56.8%) patients in this study. And also in other studies in Egypt and Italy the rate of sepsis was (40.5%, 22.2%) respectively (14, 22).since the result in this study is higher than the others the possible explanation might be it's due to low infection prevention practices of the health professionals and improper treatment of infectious diseases since most of the patients are referred from different health care centers their might be late and misdiagnosis of infectious diseases.

Mechanical ventilation is a powerful tool, with both negative and positive effects. It should be clear that mechanical ventilation has many potential and diverse pitfalls. Recently growing body of research shows that mechanical ventilation has the ability to cause pathologies as well. In some cases the produced disease is as bad or worse, than the one being treated (27). In this study (27.3%) of the cases developed complications. From that the complication types were VAP followed by Pneumothorax, (18.6%) and (6.8%) respectively. More than one complication occurred in 8(3.6%) patients. This is higher than a complication rate found by Mukhtar B et al (9.4) with lobar atelectasis 4.6% and ventilator associated pneumonia (3.3%) (17). In other published research the complication rate in Cairo study was (39.9%). Specifically VAP in (27.3%) and pneumothorax (10.6%) (14).which is higher than this study the possible reason might be the study design difference or there might be difference in the quality of care since they have low staffed PICU which is described in their study. But in our setting there staffing system seems good in which the nurse to patient ratio is 3:4.even though the complication rate in our study is lower than the Cairo study. Still there is high incidence of complications in our setting too. Therefore an effort must be added to improve our infection prevention methods and on nursing care practices.

In this thesis weaning methods employed for the survived patients were CPAP alone (24.5%) followed by direct oxygen trial 14(6.4%) unlike that PS with CPAP in (74.7%) cases was preferred method of weaning in Bassant S et al study (14). The difference could be due to the preference of the physicians and patients capacity of maintaining their saturation on both methods.

Reduction in re-intubation rate is clinically significant because of the reported increase in morbidity and mortality rates associated with re intubation (28). 34(15.5%) was the re- intubation rate in this study. And also in a study in Korea (18%) patients were re-intubated which is slightly higher than this thesis's finding. The possible reasons for this slight difference might be the sample size and the uses of appropriate weaning methods since the possible reason for re intubation are failed extubation and accidental extubation.

This study found that the mortality rate of (59.1%). The reported mortality in other studies were Faris et al reported that (15.6%), in Czech Republic (3.5%), Haque A et al found out (11.9%) of mortality, in Italy mortality was (6.7%),in Pakistan (30.3%), Nelufer Telanga hospital it was(43.8%) and in Egypt study mortality was (45.7%) (23, 24, 25, 22, 17, 12, 14). Sepsis (26.4%), ARDS (13.6%), Brain death (7.7%) and Intractable heart failure (5.5%) were the causes of death. This results indicated us the mortality rate in our setting is much higher than the others especially from the developed countries (23, 24, 25, 22). The reason behind our high rate of mortality might be due to late admission of patient's, lack of especially trained ICU specialists, transportation problem for the patients since there is low socioeconomic status of the country, admission problem which means admitting of patients with low survival rate (not using severity score), lack of PICU bed makes the patients wait until they get more critical before admission to PICU. And also sepsis is the main cause of death which is curable and preventable and potentially curable diseases which shows there is a gap in immunization and infection prevention methods.

Multivariate logistic regression results showed that the odds of mortality among PICU patients who were medical patients were nearly 6 times higher as compared with those of surgical patients(AOR=6.078; 95% CI:1.272,29.039). Patients with cardiac diseases as an admission indication had less mortality when we compared to the others with AOR/95% CI value of (0.169/0.028, 0.975). But patients with poisoning and post op as an admission indication had 4.5 times higher mortality than others (AOR=4.549; 95% CI: 1.005, 20.58). Patients who stayed less on MV had higher mortality (AOR=0.94; 955 CI: 0.892, 0.990). Patients who developed ARDS had around 4 times more mortality rate than who didn't develop ARDS (AOR=4.15; 95% CI: 1.637, 10.29). Patients with CNS failure had around 5 times higher mortality than the others (AOR=4.598; 95% CI: 1.349, 15.679). Patients with higher PIM II score had more than 4 times of mortality than the lower ones with AOR=4.4; 95% CI: 1.206, 16.08). Generally significant predictors of mortality in this study were being medical patient, poisoning and post op as an admission indication, length of stay on MV, ARDS, CNS failure, and PIM II score. Severity score, length of stay and ARDS were predictors of mortality in other studies done in

Pakistan (12), Egypt (14), Italy (22), Czech (24), and a study by Faris JA et al (23). The possible reason for the differences might be the study design difference and socioeconomic status

Chapter 7: Limitation and strength

The findings in this study are subjected to some limitations. First it was better if the thesis was done in prospective study design. Since the using secondary data is so difficult in getting all the necessary data which are important for the study like anthropometry measurements and blood gas analysis.

Secondly study area was limited to only TASH which make it difficult for generalization.

Like the limitations this study also has its own strength like it tried to include most of the pertinent character of the patients on MV and also tried to point out independent predictors of PICU mortality.

Chapter 8: Conclusion

The mortality rate of mechanically ventilated pediatric patients in Tikur Anbesa specialized hospital was high (59.1%). The main reason for admission was neurologic causes. Respiratory failure was the indication for MV. Commonly used ventilator mode was SIMV/PCV. Being medical patient, cardiac and postop patients, duration on MV, ARDS, CNS failure and Higher PIM II score were significant predictors of PICU mortality.

Chapter 9: Recommendation

To hospital management

- It's better if there is rapid transfer/referral of patients to advanced care facility before they got complicated and end up in bad outcome.
- To prepare special trainings for the PICU staff about MV usage and complications related to it.
- It's better to increase the number of beds in PICU since it can decrease late intubation and MV support which can also increase the mortality rate

To Tikur Anbesa specialized hospital PICU

- To prevent delayed admission and revise their admission criteria.
- Its better and also helpful if they use severity indicator scores in this study PIM 2 is validated and recommended.
- Its better if they improve their ARDS management protocol since its one of the strong predictor of PICU mortality in this study
- To give special concern for the patients with organ failure and previous comorbidities
- To preserve organs from failing in PICU as much as possible.
- To strengthen their sepsis management protocol.
- To give emphasis in cardiac patients
- It's better to improve the quality of care since the mortality is high.

To researchers

- It is better they conducted a research in prospective manner in order to find out the incidence of MV.
- For giving better generalization it will be best if they add other hospitals in their study

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Annex 1: data abstraction tool for mechanical ventilator characteristics and outcome in pediatrics ICU.

PICU PATIENT DATA COLLECTION TOOL					
AGE					
SEX					
Place					
anthropometry	BMI	Head circumference	Height	Weight	
Sero status for HIV	Positive	negative			
Admission source	A. Post op	B. Another hospital	C. Inpatient unit	D. Pedi ED	
Date and time of admission to picu					
Indication for ICU	medical	surgical			
A.Neurological	B.Respiratory	C.Cardiac	D.Sepsis	E.Renal	F.Neuromuscular
Indication for MV	A.Neurological(coma)(Safe airways)	B. Respiratory failure	C..Cardiovascular failure(shock)- 1.cardiogenic 2.noncardiogenic	D.Sepsis	E.Other
Comorbidity	A .Malignancy	B.SAM	C.CHD	D.HIV	
Investigation					
Date of MV					
Duration on mechanical ventilation					

The access to airways		A.ETT tube	B.Tracheostomy		
Modes of MV	A.SIMV/VC	B.AC/PCV	C.AC/VCV	D.BIPAP /CPAP	E.SIMV/PC
complications.	A.YES	B.NO			
Complication type	A.VAP	B. Pneumothorax	C.Atelectasis	D.Post extubation strider	
ARDS	A.yes	B. NO			
Weaning method	A.PS with CPAP	B.CPAP alone	C. T-TUBE	D.Accidental extubation	
weaning started date					
Date of discharge from mechanical ventilation					
MODS	A.YES	B. NO			
Organ failed	A.Renal	B.Cardiac	C.CNS	D.Hematologic	E.Hepatic
GCS at admission					
Sedation used	A.Diazepam	B.ketamin	C. Morphine	D.Thiopental	E.propofol
SEPSIS	A.YES	B. NO			
FINAL outcome	A,DEATH	B.Discharge	C. LAMA	D.Transfer to ward	
Cause of death	A.SEPSIS	B. Heart disease	C. brain death	D.ARDS	E. Hepatic failure
F .other					
CPR with in 24 hour before Picu admission			A.YES	B.NO	
The patient is bounce back		A. YES	B .NO		
Date and time of discharge or death from ICU:					

PIM 2 SCORE

1. Systolic blood pressure, mmHg (unknown=120)
2. Pupillary reactions to bright light (>3 mm and both fixed=1, other or unknown=0)
3. PaO2, mmHg (unknown=0)FIO2 at the time of PaO2 if oxygen via ETT or head box (unknown=0)
4. Base excess in arterial or capillary blood, mmol/l (unknown=0)
5. Mechanical ventilation at any time during the first hour in ICU (no=0, yes=1)
6. Elective admission to ICU (no=0, yes=1)
7. Recovery from surgery or a procedure is the main reason for ICU admission (no=0, yes=1)
8. Admitted following cardiac bypass (no=0, yes=1)
9. High risk diagnosis. Record the number in brackets.If in doubt record 0.
   - [0] None
   - [1] Cardiac arrest preceding ICU admission7
   - [2] Severe combined immune deficiency
   - [3] Leukaemia or lymphoma after first induction
   - [4] Spontaneous cerebral haemorrhage8
   - [5] Cardiomyopathy or myocarditis
   - [6] Hypoplastic left heart syndrome9
   - [7] HIV infection
   - [8] Liver failure is the main reason for ICU admission
   - [9] Neuro-degenerative disorder
10. Low risk diagnosis. Record the number in brackets.If in doubt record 0.
   - [0] None
   - [1] Asthma is the main reason for ICU admission
   - [2] Bronchiolitis is the main reason for ICU admission
   - [3] Croup is the main reason for ICU admission
   - [4] Obstructive sleep apnoea is the main reason for ICU admission
   - [5] Diabetic keto-acidosis is the main reason for ICU admission

Annex 2: Details of the PIM II scoring system

PIM2 is calculated from the information collected at the time a child is admitted to ICU. Because PIM2 describes how ill the child was at the time you started intensive care, the observations to be recorded are those made at or about the time of first face-to-face (not telephone) contact between the patient and a doctor from your intensive care unit (or a doctor from a specialist paediatric transport team). Use the first value of each variable measured within the period from the time of first contact to 1 h after arrival in ICU. The first contact may be in ICU,jn emergency department, a ward in the hospital, or in another hospital (e.g. on a retrieval). If information is missing (e.g. base excess is not measured) record zero, except for systolic blood pressure, which should be recorded as 120. Include all children admitted to ICU (consecutive admissions).

1. Systolic blood pressure, mmHg (unknown=120)
2. Pupillary reactions to bright light (>3 mm and both fixed=1, other or unknown=0)
3. PaO2, mmHg (unknown=0)FIO2 at the time of PaO2 if oxygen via ETT or headbox (unknown=0)
4. Base excess in arterial or capillary blood, mmol/l (unknown=0)
5. Mechanical ventilation at any time during the first hour in ICU (no=0, yes=1)
6. Elective admission to ICU (no=0, yes=1)
7. Recovery from surgery or a procedure is the main reason for ICU admission (no=0, yes=1)
8. Admitted following cardiac bypass (no=0, yes=1)
9. High risk diagnosis. Record the number in brackets.If in doubt record 0.
   - [0] None
   - [1] Cardiac arrest preceding ICU admission7
   - [2] Severe combined immune deficiency
   - [3] Leukaemia or lymphoma after first induction
   - [4] Spontaneous cerebral haemorrhage8
   - [5] Cardiomyopathy or myocarditis
   - [6] Hypoplastic left heart syndrome9
   - [7] HIV infection
   - [8] Liver failure is the main reason for ICU admission
   - [9] Neuro-degenerative disorder
10. Low risk diagnosis. Record the number in brackets.If in doubt record 0.
    - [0] None

[1] Asthma is the main reason for ICU admission

[2] Bronchiolitis is the main reason for ICU admission

[3] Croup is the main reason for ICU admission

[4] Obstructive sleep apnoea is the main reason for ICU admission

[5] Diabetic keto-acidosis is the main reason for ICU admission

Annex 3: coding rules.

These rules must be followed carefully

For PIM2 to perform reliably:

1. Record SBP as 0 if the patient is in cardiac arrest, record 30 if the patient is shocked and the blood pressure is so low that it cannot be measured or 120 if normal or unknown .

2. Pupillary reactions to bright light are used as an index of brain function. Do not record an abnormal finding if this is due to drugs, toxins or local eye injury.

3. Mechanical ventilation includes mask or nasal CPAP or BiPAP or negative pressure ventilation.

4. Elective admission. Include admission after elective surgery or admission for an elective procedure (e.g. insertion of a central line), or elective monitoring, or review of home ventilation. An ICU admission or an operation is considered elective if it could be postponed for more than 6 hour without adverse effect.

5. Recovery from surgery or procedure includes a radiology procedure or cardiac catheter. Do not include patients admitted from the operating theatre where recovery from surgery is not the main reason for ICU admission (e.g. a patient with a head injury who is admitted from theatre after insertion of an ICP monitor; in this patient the main reason for ICU admission is the head injury).

6. Cardiac bypass. These patients must also be coded as recovery from surgery.

7. Cardiac arrest preceding ICU admission includes both in-hospital and out-of-hospital arrests. Requires either documented absent pulse or the requirement for external cardiac compression. Do not include past history of cardiac arrest.

8. Cerebral haemorrhage must be spontaneous (e.g. from aneurysm or AV malformation). Do not include traumatic cerebral haemorrhage or intracranial haemorrhage that is not intracerebral (e.g. subdural haemorrhage).

9. Hypoplastic left heart syndrome. Any age, but include only cases where a Norwood procedure or equivalent is or was required in the neonatal period to sustain life.

10. Liver failure acute or chronic must be the main reason for ICU admission. Include patients admitted for recovery following liver transplantation for acute or chronic liver failure.

11. Neuro-degenerative disorder. Requires a history of progressive loss of milestones or a diagnosis where this will inevitably occur.

12. Bronchiolitis. Include children who present either with respiratory distress or central apnoea where the clinical diagnosis is bronchiolitis.

13. Obstructive sleep apnoea. Include patients admitted following adenoidectomy and/or tonsillectomy in whom obstructive sleep apnoea is the main reason for ICU admission (and code as recovery from surgery).

Annex 4: PIM II calculator

Scoring systems for ICU and surgical patients:

PIM 2 (Pediatric Index of Mortality)

Variables (help)	Values (1 if Yes, 0 otherwise)	Beta
Elective admission		0
Recovery post procedure	No	0
Cardiac bypass		0
High risk diagnosis		0
Low risk diagnosis		0
No response of pupils to bright light (> 3 mm and both fixed)		0
Mechanical ventilation (at any time during first hour in ICU)		0
Systolic Blood Pressure (mmHg)	120	0.01395
Base Excess (mmHg) (arterial or capillary blood)	0	0.1040
FiO2*100/ PaO2 (mmHg)	0	0.2888

Predicted Death Rate :

0 Clear

Logit = (-4.8841) + (values * Beta) + (0.01395 * (absolute(SBP-120))) + (0.1040 * (absolute base excess)) + (0.2888 * (100*FiO2/PaO2))

Predicted death rate = $e^{Logit}/(1+e^{Logit})$

Annex 5: ODINS criteria

Organ system dysfunction	Criteria
Respiratory	Pao_2 < 60 Torr (FIO_2 =0.2) or need for ventilatory support
Cardiovascular	SBP < 90 mmHG with signs of peripheral hypo per fusion, continuous infusion of vasopressor or inotrope agent to maintain > 90 mmHG SBP.
Renal	Serum creatinine >300 µmol/L or urine output < 500ml/24h or <180 ml/8h or need for hemodialysis or peritoneal dialysis
Neurologic	GCS < 6(in the absence of sedation at any time in the day) or sudden onset of confusion or psychosis
Hepatic	Serum bilirubin > 100 µmol/L or alkaline phosphatase > 3 times from the normal value
Hematologic	Hematocrit < 20% or TLC <2000/mm^3 or platelet count < 40000/mm^3
Infectious	2 positive blood cultures or presence of gross pus in a closed space or source of infection determined during hospitalization or at autopsy in case of death within 24 hour