Artikel Penelitian

# Children Mortality in Pediatric Intensive Care Unit (PICU): An Overview

Asma Danisa Hasmuddin[1], Tuti Seniwati[2], Titi Iswanti Afelya [3]

## Abstrak

**Latar Belakang:**  *Pediatric Intensive Care Unit (PICU),* merupakan bangsal perawatan yang dikhususkan bagi anak yang memiliki kondisi medis yang kritis. Kondisi kritis yang dialami oleh anak yang dirawat di *PICU* tidak terlepas dari keadaan darurat dan dapat beresiko terjadinya kematian. Meskipun angka kematian anak mengalami penurunan setiap tahun, namun kejadian mortalitas di ruang PICU masih menjadi kontributor besar kematian pada anak-anak untuk saat ini. **Tujuan Penelitian:** Untuk mengidentifikasi karakteristik kematian pada anak di ruang PICU Rumah Sakit Dr. Wahidin Sudirohusodo Makassar. **Metode:** Penelitian ini merupakan survei analitik menggunakan desain *cross-sectional* dengan teknik *purposive sampling.* **Hasil:** Penelitian terhadap 53 catatan medis anak menunjukkan rata-rata responden dengan usia 59 bulan (SD 69,29) mengalami kematian, rata-rata lama hari rawat responden yang mengalami kematian yakni 7,94 hari (SD 9,69), rata-rata status neurologis pasien diawal masuk menunjukkan nilai 11,43 (SD 4,496). Pasien dengan diagnosis sepsis menunjukkan frekuensi kematian terbanyak pada penelitian ini. **Kesimpulan:** Responden dengan kategori usia *infant*, kategori status neurologis ringan, pemakaian ventilator mekanik, memiliki frekuensi paling banyak mengalami kejadian mortalitas di ruang PICU. Saran pada peneltian ini yaitu diharapkan bagi peneliti lain dapat meneliti variabel-variabel yang berhubungan dengan kematian anak di *PICU* untuk dapat diungkap secara keseluruhan.

**Kata kunci**: Mortalitas anak, karakteristik, anak, perawatan kritis, PICU

## *Abstract*

***Introduction:*** *Pediatric Intensive Care Unit (PICU), is unit of care spesifically for children who have critical medical condition. Critical condition experienced by children treated at PICU are inseparable from emergencies and can be at risk of death. Even though the child mortality rate has decreased every year, the incidence of mortality in the PICU is still a large contributor to the death of children at this time.* ***Objective***: *To identify characteristics of children mortality in the PICU hospital unit Dr. Wahidin Sudirohusodo Makassar.* ***Method***: *This study was an analytic survey using a cross-sectional design with purposive sampling.* ***Results***: *The study of 53 children medical records showed that the average respondent aged 59 months (SD 69.29) experienced death, length of stay of respondents who experienced death was 7.94 days (SD 9,69), the neurological status of patients at the beginning of admission shows the value of 11.43 (SD 4,496). Patients with a diagnosis of sepsis showed the highest mortality in this study.* ***Conclusion***: *Respondents with infant categories, mild neurological status at the admission of PICU, used mechanical ventilators as oxygen devices, have the highest frequency of mortality in PICU. Hence, this study suggested to the other researcher to examine the variables that relate to child mortality in PICU for revealed as a whole.*

***Keywords***: *Children mortality, characteristics, critical care, PICU*

**Affiliasi penulis** : 1 Student of Nursing Study Program, Faculty of Nursing, Hasanuddin University, Makassar. 2 Department of Pediatric Nursing, Faculty of Nursing, Hasanuddin University, Makassar. 3 Department of Medical Surgical Nursing, Faculty of Nursing, Hasanuddin University, Makassar. 3 Department of Medical Surgical Nursing, Faculty of Medicine, Cendrawasih University
**Korespondensi** : "Tuti Seniwati" tutiseniwati@unhas.ac.id
Telp: +6281354915399

## INTRODUCTION

Pediatric intensive care unit (PICU) is a ward of care specifically for children who have chronic and complex medical conditions [1]. The purpose of this intensive care unit is to prevent death in children by intensively caring and monitoring patients with critical conditions that have unstable airway, inability to oxygenate (O2 Sat less than 90% on oxygen requirements> 50%, inability to ventilate with increased PCO2, Scale Scores Glasgow Coma (GCS) <8 or score suddenly dropped> 2 points, the critical value of the vital sign parameter)[2]and at risk of death[3].

Based data from the World Health Organization(WHO)[4], child mortality were grouped into three age groups including, children aged ≤ 5 years with the number of deaths reaching 5.4 million in 2017, children aged 5-14 years with the number of deaths reaching 18% of the age mortality of ≤ 5 years, and children aged 16 -18 which is categorized as a teenager with 1.8 million deaths in 2017. From 1999 to 2017 the child mortality rate has decreased significantly

from 12.6 million to 5.4 million occurrences of child deaths in the world[5]. In line with these data, the child mortality rate in Indonesia has also decreased in recent years. The latest data obtained from 2000 to 2017 the mortality rate for children under 5 years decreased by 25.40% per 1000 births with a total of children who died for 2017 as many as 125,213, while for birth rates aged 5-14 years were 5 % per 1000 birth rates with an overall total death toll estimated at 23,974 cases[6]. Although the prevalence of child mortality every year has decreased, the mortality rate is still a problem in some countries in the world including in developing countries like Indonesia.

About half of deaths among children in the United States aged one to nineteen occur in hospitals, and the majority of deaths in hospitals occur in the intensive care section[7]. The PICU mortality rate in United States is estimated to be around 20% of patients per year (1 in 5 or the equivalent of 500,000 children treated at PICU per year)[8]. Based on researcher observation, in Indonesia, there is no specific data related to mortality in critical ill patients. The data available is only general child mortality. Therefore, it is very important to know the characteristics of children mortality while being treated at PICU to assist nurses in providing appropriate treatment at the beginning of care.

## METHOD

This study used a descriptive method, with a cross-sectional study. The population was all children who died in the PICU of Dr. Wahidin Sudirohusodo hospital from January 2017 to December 2018. The sampling technique used purposive sampling and total sample of 53 respondents was obtained from the medical record. The inclusion criteria were children who died in PICU room. Samples collected were only 53 respondents' medical record data, due to some data not included in the inclusion criteria such as data obtained showing respondents who had recovered and respondents who were not treated at PICU but were only treated on the ward, as well as some medical records that were not present at the time research.

Data collection was performed using secondary data recap sheets containing variables that would be examined including age, sex, length of stay, type of surgical or non-surgical illness suffered by the patient, oxygenation equipment used, duration of use of the ventilator and assessment of the child's neurological status by using GCS and FOUR Score. This sheet has been created by the authors, which is preceded by patient demographic data, and assessment of research variables. The variables studied have several objective criteria that have been determined by researchers based on previous research, and observe preliminary data in hospital management before the study conducted.

Objective criteria in this study, including the age categories of infants, toddlers, pre-schools, schools, and teen, variable type of disease including surgical and non-surgical, previous studies have shown causes of death that occur in PICU differ from surgical or non-surgical types[9], variable final diagnosis based on observations that have been obtained by researchers, the disease most suffered by PICU patients is in the case of sepsis. In this case the neurological status can be determined by using the Glasgow Coma Scale (GCS) or Full Outline of Unresponsiveness (FOUR) score which is a scale used to determine the patient's neurological status when first treated in the PICU room which is listed in the medical record with objective criteria include severe neurological status, if the GCS score is ≤ 8 and the FOUR score is ≤ 7, moderate neurological status, if the GCS score is 9-13 and the FOUR score is 8-14, mild neurological status, if the GCS score is 14-15[10] and FOUR Score is 15-16[11].

## RESULTS

Based on table 1 shows that most of the pediatric patients who died in the PICU room were male, 32 respondents (60.4%), the most age category was children aged 0-1 years around 28 respondents (52.8%) with mean of respondent aged was 1 year. Type of disease with the non-surgical category has the highest frequency of 52 respondents. Sepsis shows the final diagnosis which mostly affect patients who died at PICU. For neurological status variables, the average GCS / FOUR score of patients at the initial admission PICU showed 11, with mild neurological status with GCS values 14-15 and FOUR scores 15-16 having the most frequencies of 27 respondents. The type of oxygenation device most widely used at the beginning of

admission to the PICU room was 23 respondents used Mechanical Ventilator.

**Table 1. Characteristic of respondents**

| Characteristics of Respondents | Frequency (n) | Percentage (%) | Mean | SD | Min-Max |
|---|---|---|---|---|---|
| **Age (**year**)** | | | 1.073 | 0.814 | 0-18 |
| Ages 0-1 Years | 28 | 52.8 | | | |
| Ages 1-3 Years | 3 | 5.7 | | | |
| Ages 3-6 Years | 4 | 7.5 | | | |
| Ages 6-12 Years | 9 | 17.0 | | | |
| Ages 12-18 Years | 9 | 17.0 | | | |
| **Gender** | | | | | |
| Boys | 32 | 60.4 | | | |
| Girls | 21 | 39.6 | | | |
| **Types of diseases** | | | | | |
| Surgical | 1 | 1.9 | | | |
| Non-Surgical | 52 | 98.1 | | | |
| **Final Diagnosis** | | | | | |
| Sepsis | 27 | 50.9 | | | |
| Non- Sepsis | 26 | 49.1 | | | |
| **Neurological Status enters PICU** | | | 11.43 | 4.496 | 3-15 |
| Mild Neurological Status | 27 | 50.9 | | | |
| Moderate Neurological Status | 12 | 22.7 | | | |
| Severe Neurological Status | 14 | 26.4 | | | |
| **The type of oxygenation device enters PICU** | | | | | |
| Mechanical Ventilator | 23 | 43.4 | | | |
| O2 Face Mask | 16 | 30.2 | | | |
| O2 Nasal | 8 | 15.1 | | | |
| Not Using | 6 | 11.3 | | | |

Table 2 shows that the distribution of respondents based on the incidence of mortality reported that most of them died > 48 hours as many as 43 respondents with a percentage of 81.1%.

**Table 2. The distribution of respondents based on time of death in PICU**

| Time of death | Frequency (n) | Percentage (%) |
|---|---|---|
| < 48 hours | 10 | 18.9 |
| > 48 hours | 43 | 81.1 |

Table 3 shows that the average length of stay of patients until they die is 7.94 days (SD 9.69), and the average length of use of ventilators in the PICU room is 51.80 hours (SD 45.91).

**Table 3. The distribution of respondents based on length of stay and length of use mechanical ventilator**

| Variable | Mean | SD | Min-Max |
|---|---|---|---|
| **Length Of stay** (Day) | 7.94 | 9.69 | 0-56 |
| **Length of use mechanical ventilator** (Hour) | 51.80 | 45.91 | 5-168 |

**DISCUSSION**

This study showed that the age of patients 0-1 years has a higher incidence of death. The previous studies have shown that patients aged around 0-5 years are higher population death than 5-18 years, although statistical values do not show a significant relation[12]. This is due to several factors, one of which is growth and development factors in children. The physiological immaturity of the

body's systems in younger children can increase the risk of infection and spread of the disease[13]. Early-life infection is a significant cause of global morbidity and mortality. Distinct immune function in infants is a significant contributor to infection risk[14].

The result of this study indicates that male respondents had the highest frequency of death. This statement was in line with research Mcevoy & Shander[15] which states patients with male sex show a higher population experiencing death in the intensive care room. One study showed that sex would differentiate immune responses, male subjects could often experience more severe disease conditions due to an increase in pro-inflammatory mediators was TNF, IL-6, IL-10, and female subjects were found many anti-inflammatory mediators [16].

Patients with non-surgical diseases experienced higher mortality than the types of surgical diseases. The results of this study are supported by previous studies conducted[9] which states that there was a significant correlation between types of disease, with the incidence of mortality, patients with non-surgical diseases have seven times higher risk of death. After that, the severity of the disease greatly affects death in patients and had significant correlation with mortality of children[3]. Meanwhile, the age group of infants is the most age group with a diagnosis of sepsis, which is 70.6% [17]. However, the incidence of sepsis will reportedly decrease with increasing age of the child[18]. This is due to the physiological maturity especially the immune system in children that age is still immature so that during the disease process occurs, it can attack complex tissues, the immune system, and endothelial cells and disorders in the microcirculation that can cause organ dysfunction or even failure that causes death high in these patients[16]. The average length of stay of patients who died in this study was indicated on the 7th day. This research was in line with other studies that have shown an average length of stay of 7 days with the lowest quartile lasting less than 1.5 days and the longest quartile lasting for 20 to 394 days[19]. The effect of length of stay on mortality has a high degree of association in critical pediatric patients who has a chronic disease as comorbid[20]. Length of stay was used as a measure to assess the level of morbidity or mortality in the treatment room.

The longer days of treatment show the severity of the condition of the patients being treated[19].

The largest population death in this study were patients with mild neurological status, with GCS and FOUR> 8. Most of the patients who entered at the beginning in PICU had not experienced a decrease in consciousness. By contrast on other research [21] showed the highest number of patients admitted to intensive care has decreased consciousness. This could be due to the assessment of the patient's neurological status in this study only taken at the beginning of the treatment, but at the end of the treatment not taken, it could have been shown to decrease the value of neurological status from mild to severe. Conditions of decreased consciousness can occur quickly (acute) or slowly[22].

Oxygenated patients at the beginning of treatment at PICU had a high mortality rate especially in the use of mechanical ventilators. The use of oxygenation devices has a significant relation with mortality in the PICU room with a value of p = 0.002, in previous studies, the use of ventilators has more mortality than the use of other oxygenation devices[13]. It is also suitable in this study which shows the use of ventilator devices has a high mortality rate, although in this study the use of oxygenation devices with the type of ventilator-associated with mortality did not have a significant relation. Mangku et al. (2017) revealed  improper administration of oxygen will cause disease severity including respiratory acidosis, organ failure, coma, and even death[23].  And in this study found about 80% of patients who died using oxygenation devices.

There are several types of mechanical ventilators used in this study including Assist/Control (A/C), pressure-controlled Ventilation (PCV), Synchronized Intermitten Mandatory Ventilation (SIMV), Contionous Positive Airway Pressure (CPAP), and Bilateral Positive Non-Invasive (BiPAP). However, the use of ventilators with pressure-controlled Ventilation (PCV) mode that is most used by respondents. Several studies have shown that, Neurally Adjusted Ventilatory Assist (NAVA) has been recently proposed as an alternative to PCV or PSV[24]. NAVA are safe, feasible, and have equivalent a spontaneous breathing trial (SBT) success rates when compared to PSV[25]. In this study,

the average FiO2 setting in the use of mechanical ventilators was given as much as 86%. The lowest value is around 43% and the highest is 100%. The use of FiO2 with high concentrations (≥50%) and in the long term (more than 24 hours) showed can be at risk of experiencing oxygen toxicity and can also be at risk of life-threatening on ventilator users[26].

Variable  length of ventilator use showed a significant length of stay of patients treated in intensive care and the risk of death in children[27]. The statement was in line with other research [28] showed the median on the third day of use of a mechanical ventilator showed an association between the outcomes of patients who died with a p-value <0.001.  The risk posed by the duration of the use of a mechanical ventilator is based on the clinical care provided. A study of the operational risks of mechanical ventilators shows that the effects are quite numerous and affect several systems in the body. This is related to clinical care which consists of endotracheal intubation, administration of sedative drugs, a setting of the ventilator mode, and humidification system.

## CONCLUSION

It can be concluded that the characteristics of children mortality in the PICU is largely dominated by patients under the age of 5 years associated with immaturity of the immune system which can accelerate the process of spread and severity of the disease. In addition, Oxygenated patients at the beginning of treatment at PICU had a high mortality rate especially in the use of mechanical ventilators. Assessment of the patient's neurological status in this study only taken at the beginning of the treatment, but at the end of the treatment not taken, it could have been shown to decrease the value of neurological status from mild to severe. Hence, this study suggested to the other researcher to examine the variables that relate to child mortality in PICU for revealed as a whole.

## REFERENCES

1. Kyle. *Buku ajar keperawatan pediatrik.* (EGC, 2014).
2. Av, L. *et al.* iMedPub Journals Pediatric Intensive Care Unit Admissions from the Emergency Departments in India - The 2018 Academic College of Emergency Experts Consensus Recommendations. 1–10 (2019).
3. Qiu, J. *et al.* Comparison of the pediatric risk of mortality, pediatric index of mortality, and pediatric index of mortality 2 models in a pediatric intensive care unit in China. *Med. (United States)* **96**, 3–8 (2017).
4. WHO. Children: reducing mortality. (2018).
5. WHO. Levels and trends in child mortality report 2018. (2018).
6. UNICEF. UN Inter-agency Group for Child Mortality Estimation. (2018).
7. Bunney, P. E., Zink, A. N., Holm, A. A., Billington, C. J., & Kotz, C. M. End-of-Life and Bereavement Care in Pediatric Intensive Care Units. *Physiol. Behav.* **176**, 139–148 (2017).
8. Stratton RJ, King CL, S. M. "Malnutrition Universal Screening Tool" predicts mortality and length of hospital stay in acutely ill". *Nutrition* **30**, 325 (2011).
9. Gratya, R.-, Martuti, S. & Salimo, H. Pengaruh Hipomagnesemia Terhadap Mortalitas Pasien Anak di Ruang Rawat Intensif. *Sari Pediatr.* **18**, 308 (2017).
10. Dewi, R., Mangunatmadja, I. & Yuniar, I. Perbandingan Full Outline of Unresponsiveness Score dengan Glasgow Coma Scale dalam Menentukan Prognostik Pasien Sakit Kritis. *Sari Pediatr.* **13**, 215 (2016).
11. Akavipat, P. Endorsement of the FOUR score for consciousness assessment in neurosurgical patients. *Neurol Med Chir* **49**, 565–71 (2009).
12. Haftu, H., Hailu, T., Medhaniye, A. & Gtsadik, T. Assessment of pattern and treatment outcome of patients admitted to pediatric intensive care unit, Ayder Referral Hospital, Tigray, Ethiopia, 2015. *BMC Res. Notes* **11**, 11–16 (2018).
13. Sudarmadji, S., Wati, D. K. & Sidiartha, L. Faktor Risiko pada Lama Rawat dan Luaran Pasien Perawatan di Unit Perawatan Intensif Anak RSUP Sanglah Denpasar. *Sari Pediatr.* **17**, 455 (2016).
14. Amélie Collinsa, Jörn-Hendrik Weitkampb & James L. Wynnc, D. Why are preterm newborns at increased risk of infection? *Arch. Dis. Child. - Fetal Neonatal Ed.* **103**, F391–F394 (2018).
15. Mcevoy, M. T. & Shander, A. Cause of

death of infants and children in the intensive care unit: Parent's recall vs chart review. *Am. J. Crit. Care* **24**, 474–479 (2015).

16. Angele, M. K., Pratschke, S., Hubbard, W. J. & Chaudry, I. H. Cardiovascular and immunological aspects. *Landes Biosci.* **5**, 12–19 (2014).

17. Wati, D. K., Hartawan, I. N. & Suparyatha, I. B. G. Profil Sepsis Anak di Pediatric Intensive Care Unit Rumah Sakit Umum Pusat Sanglah Denpasar Bali. **21**, (2019).

18. Rachmawati, R. I., Widodo, D. P., AAP, B. T. & Pudjiadi, A. H. Fungsi Adrenal pada Sepsis di Unit Perawatan Intensif Pediatrik. *Sari Pediatr.* **12**, 426 (2016).

19. Truog, R. D. Epidemiology of Death in the Pediatric Intensive Care Unit at Five U.S. Teaching Hospitals. **42**, 2101–2108 (2015).

20. Dewi, R. & Fatimatuzzuhroh. Profil Pasien Sakit Kritis yang Dirawat di PICU RSCM berdasarkan sistem skoring PELOD -2. *Sari Pediatr.* **21**, 37–43 (2019).

21. Rudini, D. Efektifitas Antara Alat Ukur Coma Recovery Scale- Revisied (CRS-R), Full Outline Unresponsiveness (FOUR)Score, Dan Glasgow Coma Scale (GCS) Dalam menilai Tingkat Kesadaran Pasien Di Unit Perawatan Intensif RSUD Raden Mattaher Jambi. *J. Ilm. Ilmu Terap. Univ. Jambi* **2**, 6–11 (2018).

22. Sumarno, S., Hidajat, M. & Rini, I. S. Komponen Glasgow Coma Scale (GCS) Dan Saturasi Oksigen Sebagai Prediktor Kematian Pada Pasien Cedera Kepala Di RSUP Dr. Kariadi Semarang. *Medica Hosp. J. Clin. Med.* **6**, 1–6 (2019).

23. Mangku, G. & Senapathi. *Buku Ajar Ilmu Anastesi Reanimasi*. (2017).

24. Langer, T. *et al.* Severe diaphragmatic dysfunction with preserved activity of accessory respiratory muscles in a critically ill child: A case report of failure of neurally adjusted ventilatory assist (NAVA) and successful support with pressure support ventilation (PSV). *BMC Pediatr.* **19**, 2–6 (2019).

25. Ferreira, J. C. *et al.* Neurally Adjusted Ventilatory Assist (NAVA) or Pressure Support Ventilation (PSV) during spontaneous breathing trials in critically ill patients: A crossover trial. *BMC Pulm. Med.* **17**, 1–9 (2017).

26. Mbaubedari, S. Formula penilaian Resiko Operasional Ventilator Mekanik bagi perawat. *Pascasarj. UI* (2011).

27. Conti, G. & Piastra, M. Mechanical ventilation for children. *Curr. Opin. Crit. Care* **22**, 60–66 (2016).

28. Verlaat, C. W. *et al.* Retrospective cohort study on factors associated with mortality in high-risk pediatric critical care patients in the Netherlands. *BMC Pediatr.* **19**, 1–6 (2019).