

**PAEDIATRIC MORTALITY REVIEW:
A SINGLE INSTITUTION EXPERIENCE**

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FULFILLMENT OF THE REQUIREMENTS FOR THE
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I hope that anyone who reads this study will find it useful and that it will help us provide better care for children in some way.

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LIST OF ABBREVIATIONS

CCC	Complex chronic conditions
CI	Confidence Interval
DNR	Do Not Resuscitate
HDU	High Dependency Unit
ICU	Intensive Care Unit
LLI	Life limiting illness
MLR	Multiple Logistic Regression
NICU	Neonatal Intensive Care Unit
OR	Odds Ratio
PICU	Paediatric Intensive Care Unit
PPC	Paediatric Palliative Care
SLR	Simple Logistic Regression
USM	Universiti Sains Malaysia
WWMT	Withholding or withdrawal of medical treatment
2 S	2 Selatan (Paediatric Surgical Ward)
6 S	6 Selatan Ward (General Paediatric Ward)
6 U	6 Utara Ward (Paediatric Oncology Ward)

ABSTRAK

Pengenalan

Pengauditan kematian kanak-kanak jarang dinilai di hospital negara berpendapatan rendah/ sederhana, walaupun ia penting untuk meningkatkan kualiti rawatan yang disediakan di mana-mana kemudahan kesihatan. Memandangkan Perkhidmatan Paliatif Pediatrik baru diwujudkan di Hospital USM, adalah penting untuk mengkaji ciri-ciri kematian kanak-kanak sebelum penubuhan perkhidmatan tersebut.

Objektif

Menghuraikan ciri-ciri kematian kanak-kanak yang dimasukkan ke Hospital USM yang merangkumi ciri-ciri demografi dan klinikal. Faktor yang berkaitan dengan lokasi kematian (ICU dan kematian wad) juga dikaji.

Metodologi

Kes kematian kanak-kanak berumur antara 29 hari hingga 18 tahun pada masa kematian yang berlaku dari tahun 2013 hingga 2020 di Hospital USM, Kubang Kerian yang memenuhi kriteria inklusi dimasukkan dan nota kes disemak. Untuk statistik deskriptif, pembolehubah kategori dinyatakan sebagai perkadaran. Analisis statistik telah dijalankan menggunakan *Multiple Logistic Regression* untuk menilai faktor ke atas lokasi kematian.

Keputusan

544 kes daripada jumlah 841 kematian kanak-kanak berlaku dalam tempoh kajian telah didaftarkan dalam kajian ini. Jantina lelaki mempunyai kadar yang lebih tinggi (1.4:1). Umur median (IQR) ialah 56 bulan dengan bayi (29 hari hingga 1 tahun) merupakan kumpulan umur yang dominan. Tempoh median (IQR) tinggal di hospital ialah 10.5 hari. Lebih separuh

daripada subjek (58.3%) menghadapi *life-limiting illness (LLI)*. Majoriti pesakit mendapat perintah DNR (wad am/ HDU 70.5%, ICU 81.6%, wad lain 79.1%). Pesakit menggunakan mesin bantuan pernafasan (POR 3.421, 95% CI 1.947, 6.012) adalah peramal penting untuk kematian wad dalam kalangan subjek kajian.

Kesimpulan

Untuk meningkatkan penjagaan dan pengurusan pesakit kanak-kanak, adalah penting untuk mengetahui ciri-ciri kematian kanak-kanak dan faktor-faktor yang berkaitan dengan lokasi kematian.

ABSTRACT

Introduction

Auditing of paediatric deaths has rarely been evaluated in low/middle-income countries hospitals. The aim of the study is to describe the characteristics of paediatric death among the hospitalized children in Hospital Universiti Sains Malaysia (USM) and explore the factors associated with location of death.

Methodology

Paediatric mortality cases for children aged between 29 days to 18 years old at the time of death and met the inclusion criteria were included. These cases were those from the year 2013 until 2020 which had occurred at Hospital USM. Case notes were reviewed, and data were captured retrospectively. For descriptive statistics, the categorical variables were expressed as proportions. Multiple Logistic Regression was used to assess predictors of the location of death.

Results

Out of 841 paediatric deaths identified during the period of the study, 544 cases were enrolled. Male gender has higher proportion (1.4:1). The median (IQR) age was 56 months with infancy being the predominant age group. The median (IQR) length of hospital stay was 10.5 days. More than half of the cases (58.3%) had underlying life-limiting illnesses. Majority of the patients had DNR order (general ward/ HDU 70.5%, ICU 81.6%, other wards 79.1%). Being on ventilator (POR 3.421, 95% CI 1.947, 6.012) was the significant predictor for the ward death among the cases.

Conclusion

It is vital to understand the characteristics of child death and the factors associated with death location in order to enhance paediatric care and management.

275 words

Keywords: mortality, death, place of death, paediatrics, life-limiting illnesses

INTRODUCTION

Although it is critical that the quality improvement on the care of paediatric patients especially related to treatment delivery in any health facility, auditing on paediatric deaths has been rarely studied in hospitals of the low/middle-income countries. The published experience with child death audits is limited to a few countries, and some of these reports were retrospective descriptions of case mix and common causes of death rather than an evaluation of the death process itself. Even fewer reports are available on the factors influencing the location of death in the hospital setting.

Paediatric Palliative Care Service has been established at Hospital Universiti Sains Malaysia (USM) in 2012¹. Therefore, it is important to study on the characteristics of paediatric mortality cases while running the palliative care service simultaneously. By understanding this, we aimed at providing a better service and ensuring terminally ill patients and parents understand their rights for a quality care depending on the location of death.

The World Health Organization (WHO) defines Palliative Care as “an approach that improves the quality of life of patients and their families facing the problems associated with life-threatening illness, through the prevention and relief of suffering by means of early identification and impeccable assessment and treatment of pain and other problems, physical, psychosocial and spiritual”². The palliative care goal is to improve quality of life for both the patient and the family.

The goal of this study was to explore the characteristic of hospital death at Hospital USM. The specific objectives include comparing on the proportion between cancer versus non-cancer death, proportion of Intensive Care Unit (ICU) versus ward death, to measure overall

mortality rate among the paediatric population and to explore factors associated with ICU and ward death.

Khalid et al. reviewed the national hospital admissions database and found that majority of the terminal admissions were to the general ward³. Nearly half (44.4%) of total deaths were of children with life-limiting illnesses and about one third (32%) of the remaining deaths were the non-neonatal age group with neoplasms. While majority of the terminal admissions were to the general ward, there were also children from the non-neonatal age group who died outside paediatric wards (14.2%).

A cross-sectional study by Dussel et al. was conducted with aim to look at the determinants and effects of planning a child's location of death⁴. Opportunity to plan location of death (LOD) is associated with high quality palliative care. In 63% of planned child's LOD and 97% had successfully accomplished their plan. The study concluded that planning location of death was associated with more home deaths and fewer hospital admissions. Among the non-home deaths, more deaths occurring in the ward than in the intensive care unit and less likely to have been intubated in the last 24 hours of life.

Burns et al. performed a prospective study to determine the epidemiology of death in PICU of 5 teaching hospitals in the United States⁵. The study found that patients who died beyond one week length-of-stay in the PICU were more likely to have pre-existing diagnoses, to be technology dependent prior to admission, and to have died following the withdrawal of life-sustaining treatment. Only 64% of the patients who died following the withholding or withdrawing of life support had a formal DNR order in place at the time of their death.

A multicenter cross-sectional retrospective study by Lago et al. was done to evaluate the incidence of life support limitation and medical practices in the last 48 hours of life of children in seven Brazilian pediatric intensive care units (PICUs)⁶. Older age ($p = .025$) and longer PICU stay ($p = .001$) were associated with do-not-resuscitate orders. In just 52.5% of the patients with DNR orders, the decision was clearly recorded in the medical chart and no ventilatory support were provided in 14 cases. Inotropic drug infusions were maintained or increased in 66% of patients with DNR orders. The study found that even practicing with the DNR orders, there was scarce initiatives for withdrawing or withholding life support measures.

There is a scarcity of information in Malaysia regarding factors that would have influenced on the location of paediatric patients' death. The local studies have looked at the demographic and clinical aspects of paediatric death without delving deeper into the predictors of death site^{3,7,8}. The goal of this study was to discover the determinants on the location in paediatric patients' death at Hospital USM and, as a result, hopefully this would enhance paediatric patient care and management in the future.

Research title: 8 Year Paediatric Mortality Review: A Single Institution Experience

Principal investigator: Dr Nur Amirah binti Saulius (MPM 60338)

Supervisor: Dr Fahisham bin Taib (MPM 48787)

Introduction

Auditing of paediatric deaths has rarely been evaluated in hospitals in low/middle-income countries, although it is vital for improving the quality of care provided in any health facility. The published experience on child death auditing is limited to a few countries only, and some of these reports are retrospective descriptions of case-mix and common causes of death rather than an evaluation of the death process itself; even lesser on the factors affecting the location of death.

As Paediatric Palliative Care Service is being established in Hospital USM, it is important to explore the characteristics of paediatric mortality prior to the establishment of the service. By understanding this, we are aiming at providing better service and ensuring terminally ill patients and parents will be benefited from the service.

Problem statement & Study rationale

This study aimed to give implications for future improvement around palliative care and end-of-life decision making.

Research Question(s)

1. What are the factors associated with ICU or ward death?

Objectives

General: To describe the characteristic of hospital death at Hospital USM

Specific:

1. To compare the proportion between cancer vs non cancer death, proportion of ICU vs ward death and overall mortality rate
2. To explore factors associated with location of death (ward death)

Literature review

A local study by Khalid et al. was conducted by reviewing the national hospital admissions database. It was found that majority of the terminal admissions were to the general ward. 44.4% of total deaths were of children with life limiting illness while 32% deaths of non neonatal age group were caused by neoplasms. While majority of the terminal admissions were to the general ward, there were also children from the non neonatal age group who died in non paediatric wards (14.2%).

A retrospective study by Amy et al. found that most deaths in a children's hospital occur in ICUs after the withdrawal of life-sustaining technology (40.2%) followed by non- escalation (25.6%) and failed resuscitation (22.8%). The study reviewed the medical records and resuscitation notes, and subsequently the 5 modes of death were assigned to each patients.

Another study that was conducted by Manon et al. aimed to identify changes over 10 year period of deaths following withdrawal and withholding of medical treatment (WWMT). Medical records of all paediatric inpatient deaths at the Royal Children's Hospital, Melbourne from April 2015 to April 2016 were reviewed and results were compared to 2007 data. 87% of deaths followed WWMT and 85% of deaths occurred in children with pre-existing chronic conditions. There was also increased in paediatric palliative care (PPC) involvement and advance discussions around WWMT over the 10 year period and both were associated with death outside intensive care unit.

A cross-sectional study by Dussel et al. was conducted with aim to look at the determinants and effects of planning a child's location of death. Opportunity to plan location of death (LOD) is associated with high quality palliative care. 63% planned the child's LOD and 97% accomplished their plan. The study concluded that planning location of death was associated with more home deaths and fewer hospital admissions. Among the non-home deaths, more deaths occurring in the ward than in the intensive care unit and less likely to have been intubated in the last 24 hours of life.

A prospective case studies by Burns et al. was conducted to determine the epidemiology of death in PICU of 5 teaching hospitals in the United States. The study found that patients who died beyond one week length-of-stay in the PICU were more likely to have pre-existing diagnoses, to be technology dependent prior to admission, and to have died following the withdrawal of life-sustaining treatment. Only 64% of the patients who died following the withholding or withdrawing of life support had a formal DNR order in place at the time of their death.

A study by Feudtner et al. was carried out to describe the demographics of children who die in children's hospitals, to describe the prevalence of complex chronic conditions among these cases, and to test the hypotheses that cases with a greater number of complex chronic conditions (CCC) diagnoses experience longer periods both of mechanical ventilation and of hospitalization before death. Based on all the discharge diagnoses recorded for each case, 40% had no underlying CCC, 44% had one CCC while the remaining had more than one underlying CCC. Cases with CCCs were more likely than non-CCC cases to have been mechanically ventilated (52% vs 46%), and to have been ventilated longer (mean: 11.7 days

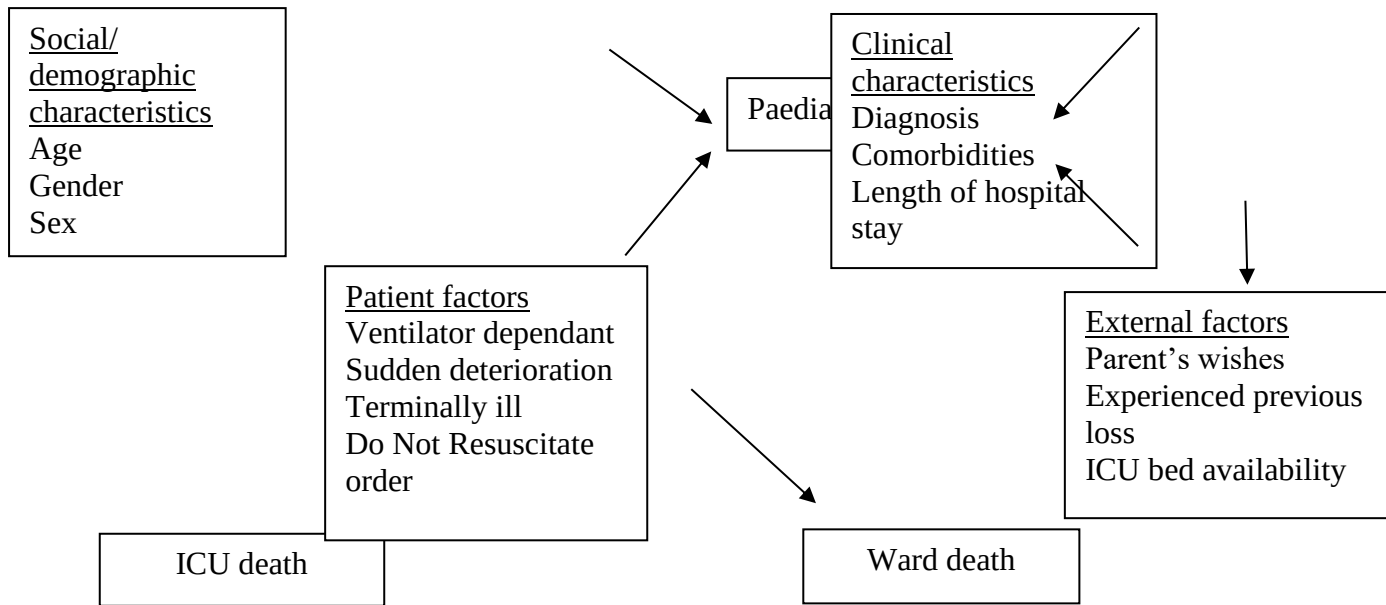
for CCC cases vs 4.8 days for non-CCC cases) hence it was concluded that children who die in the hospital with CCCs are more likely to experience longer periods of mechanical ventilation and hospitalization before death.

A cross-sectional multicenter retrospective study based on medical chart review by Lago et al. was conducted to evaluate the incidence of life support limitation and medical practices in the last 48 hrs of life of children in seven Brazilian pediatric intensive care units (PICUs). Older age and longer PICU stay were associated with do-not-resuscitate orders. In just 52.5% of the patients with DNR orders, the decision was clearly recorded in the medical chart and no ventilatory support was provided in 14 cases. Inotropic drug infusions were maintained or increased in 66% of patients with DNR orders. The study found that DNR orders are still the most common practice, with scarce initiatives for withdrawing or withholding life support measures.

Another retrospective review of the medical records of 50 consecutive inpatient deaths by Stark et al. in The Royal Children's Hospital, Australia performed with the aim to understand the circumstances of inpatient deaths at a tertiary paediatric hospital and current practices regarding the timing and documentation of discussions concerning the withholding and withdrawing of life-sustaining medical treatment. 74% of patients had an underlying life-limiting or life-threatening condition and death was documented as having been expected in the short term in 88% of patients. Life-sustaining treatment was either withdrawn or limited prior to death in 84% of cases. There was documented family involvement in the decision-making process in 98% of cases. Although medical staff frequently documented the outcome of these discussions, the content, clarity and accessibility of documentation varied widely. In

conclusion, the majority of inpatient deaths at The Royal Children's Hospital occur in acute circumstances and involve patients with chronic conditions. In most cases, death follows withdrawal or withholding of medical treatment (WWMT).

Conceptual framework



*Outcome will be location of mortality either in ICU or ward. Since we are interested in ward death, coding for ICU = 0 and ward = 1.

Methodology

Study Design

Retrospective study

Study Period

This study will be conducted from 2013 and 2020

Study Location

This study will be conducted in Hospital USM, Kubang Kerian

Study Population

Reference population – Paediatric population who was admitted to Hospital USM, Kubang Kerian

Source population- Children aged between 29 days to 18 years who had died between 2013 and 2020 who were admitted to Hospital USM, Kubang Kerian

Subject criteria

Inclusion criteria:

Children aged between 29 days to 18 years who had died between 2013 and 2020 who were admitted to Hospital USM, Kubang Kerian.

Exclusion criteria:

Patients who were declared dead immediately after arrival to the Emergency Department were excluded.

Sample size estimation

Sample size: We have utilized the two-proportion formula for the second specific objective.

$$n = \frac{P_1(1 - P_1) + P_2(1 - P_2)}{(P_1 - P_2)^2} (z_\alpha + z_\beta)^2$$

n = required sample

P₁ = estimated proportion of study outcome in the exposed group

P₂ = estimated proportion of study outcome in the unexposed group

z_α = 1.96 for α=0.05 (two-tailed) or 2.58 for α=0.01 (two-tailed)

z_β = 0.84 for 80% power or 1.28 for 90% power

PS Software was used in which the highest sample size obtained was 356 patients.

Sampling method and subject recruitment

All patients aged between 29 days until 18 years who were admitted and pronounced dead at Hospital USM from 2013 to 2020 will be recruited.

Operational definition

Unsuccessful resuscitation: death despite administration of resuscitation procedures and medications, that is, unsuccessful cardiopulmonary resuscitation.

Brain death: formal determination of brain death in accord with institutional criteria.

Withdrawal or withholding of medical treatment (WWMT)

- Withholding treatment: not initiating or not increasing a life-sustaining intervention.
- Withdrawal of treatment: discontinuing a life-sustaining intervention that was already in place in anticipation of death.

Do Not Resuscitate Order (DNR Order): Defined by National Cancer Institute (NCI): A type of advance directive in which a person states that healthcare providers should not perform cardiopulmonary resuscitation (restarting the heart) if his or her heart or breathing stops.

Terminally ill: patient with disease that cannot be cured or adequately treated and is reasonably expected to result in death of the patient.

Sudden deterioration: rapid or unexpected deterioration while undergoing active treatments or investigations.

Ventilator dependant: the failure to wean the patient from the ventilator while hospitalized in the intensive care unit or respiratory care center, in conjunction with continued use of a ventilator according to hospital discharge status.

Parent wishes: documented wishes as per their preferences when they were given choices.

Unexpected death: death which would not have been reasonably expected to occur 24 hours previously and in whom no pre-existing medical cause of death is apparent.

Data collection

Mode of data collection: This study involves secondary data collection. Data will be collected from Hospital USM Death Registry. All information/data will be collected using a Proforma forms based on required variable including age, gender, diagnosis, length of hospital stay, admission ward, place of death, DNR order.

Proforma

Code			
DOB			
Gender	Male	Female	
Diagnosis of illness			
	Cancer		
	Early stage (localised)		
	Advanced (metastasis/ refractory)		
	Non-cancer		
	Cardiac		
	Surgical		
	Sepsis/Infection		
	Neurology		
	Respiratory		
	Trauma		
	Others		
Does the patient have LLI?	Yes	No	
If yes, LLI condition:			
Cause of death (ICD)			
Date of last admission (DOLA)			
Date of death (DOD)			
Length of hospital stay prior to death (DOD – DOLA)			
Age at the time of death			
Is this an unexpected death?	Yes	No	
Place of death	General ward/HDU	ICU/ NICU	Others
Reason for ICU admission			
Patient's factors			
Ventilator dependent			
Sudden deterioration			
Terminally ill			
Others			
Parent's factors			
Parental wishes			
Experienced previous loss			
Others			

Mode of death

Unsuccessful resuscitation

Brain death

Withdrawal/ withholding medical treatment

DNR status

Yes

No

In patient with LLI

Parental/Family/ Child wish to die at home

Yes

No

Advance Care Planning

Yes

No

Discussion of palliative/ end of life

Yes

No

In patient needing ICU

Needing inotropes

Yes

No

Needing antibiotics

Yes

No

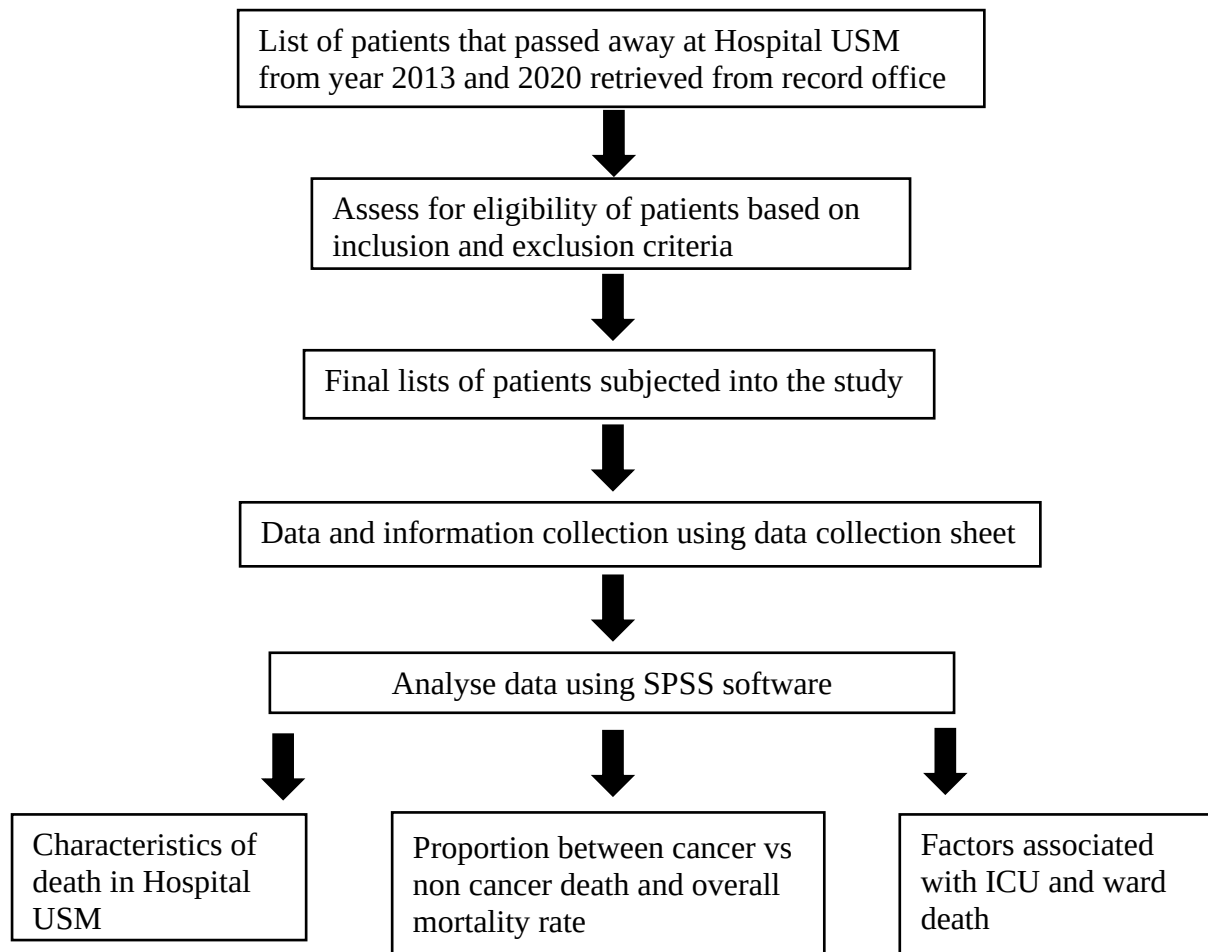
Needing ventilator

Yes

No

Remarks (if any):

Study flowchart



Data analysis

Data will be entered and analysed using Statistical Package for Social Sciences (SPSS) version 22. Descriptive statistics will be calculated according to patient's age, diagnosis, length of hospital stay, location of death, DNR order. Categorical variables will be compared by Pearson χ^2 tests or Fisher Exact test as appropriate. Multiple logistic regression will be used to identify factors affecting location of death. Statistical significance is defined as $P < 0.05$.

Expected result(s)

Table 1: Characteristics of all deaths

Parameter	N (%)
Age - 29 days to 12 months - 12 months to 72 months - 73 months to 156 months - 157 months to 216 months	
Gender - Female - Male	
Place of death - ICU - NICU - General ward/ HDU - Other wards**	
Length of hospital stay - 0 day - 1–7 days - 8–30 days - 31–60 days - >61 days	

** Surgical, neurosurgical, plastic surgery, orthopedics

Table 2: Proportion between cancer vs non cancer illness

Parameter	N (%)
Diagnosis 1) Cancer (n =) - Leukemia/ lymphoma - Brain/ central nervous system - Sarcoma - Osteosarcoma - Others 2) Non cancer (n =) - Congenital malformation/ chromosomal abnormality - Cardiac/ respiratory disease - Metabolic disease - Neurodevelopmental disorder - Others (including sepsis, abuse, injury)	

Table 3: Factors affecting ICU or ward death

Variables/ factors	ICU death, N (%)	Ward death, N (%)
PATIENT FACTORS - Ventilator dependant - Sudden deterioration - Terminally ill - Do Not Resuscitate order		
PARENTAL FACTORS - Parent's wishes - Experienced previous loss		
HOSPITAL FACTORS - ICU bed availability		

Table 4: Multiple logistic regression assessing ward death

Variables	Adj OR	95% CI	Wald	P-value
Age				
Gender - Male - Female				
Diagnosis - Cancer - Non cancer				
Underlying life-limiting illness - Yes - No				
Length of hospital stay				
Location of death - ICU - Ward				
DNR order - Yes - No				
Ventilator dependent - Yes - No				
Sudden				

deterioration - Yes - No				
Terminally ill - Yes - No				
Parent wishes - Yes - No				
Experienced previous loss - Yes - No				

Table 5: Multiple logistic regression assessing ICU death

Variables	Adj OR	95% CI	Wald	P-value
Age				
Gender - Male - Female				
Diagnosis - Cancer - Non cancer				
Underlying life-limiting illness - Yes - No				
Length of hospital stay				
Location of death - ICU - Ward				
DNR order - Yes - No				
Ventilator dependent - Yes - No				
Sudden				

deterioration - Yes - No				
Terminally ill - Yes - No				
Parent wishes - Yes - No				
Experienced previous loss - Yes - No				

Gantt chart & milestone

Project activities		2021												2022
Months	1	2	3	4	5	6	7	8	9	10	11	12	1	
Research Activities														
Data collection														
Data Analysis/Interpretation														
Presentation/Submission														
Report Writing														
Thesis submission														

Budget proposal [If applicable]:

Not applicable

Ethical consideration(s) [if applicable]:

1. Subject vulnerability

None

2. Declaration of absence of conflict of interest

There is absence of conflict of interest between researcher and participants in this study.

3. Privacy and confidentiality

All forms are anonymous and will be entered into SPSS software. Only research team members can access the data. Data will be presented as grouped data.

4. Community sensitivities and benefits

Provide better understanding of the paediatric mortality in Hospital USM and therefore ensuring terminally ill patients and parents will be benefited from the Paediatric Palliative Care Service.

5. Honorarium and incentives

None

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