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ORIGINAL ARTICLE

Common Causes of Mortality in Pediatric Intensive Care Unit of a Tertiary Care Hospital in Karachi

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ABSTRACT

Objective: To determine the frequency of common causes of death in infants and children admitted to Pediatric ICU in a tertiary care hospital.

Study Design: Cross sectional study.

Place and Duration of Study: Study was conducted in Pediatric ICU at Civil Hospital, Karachi from 23-May 2017 to 23-Nov-2017.

Material and Methods: Patients aged between 1 month to 12 years of age, of either gender who were admitted in PICU and died during hospital stay were enrolled. Data including patient's age, weight, gender, date of admission, date of expiry and duration of hospital stay before death, diagnosis and nutritional status were recorded.

Results: Mean age was 6.54 ± 3.2 years, 196 (64.9%) were male, mean weight of the participants was 13.58 ± 16.2 kg, 143 (47.3%) mothers and 151 (50%) fathers of enrolled participants were illiterate, 153 (50.6%) participants were vaccinated, and mean duration of hospital stay was 4.32 ± 2.1 days. Most common cause of mortality was sepsis (53%) followed by gastroenteritis (12.2%) and pneumonia (11%). Least common cause was malignancy (1.3%).

Conclusions: Infectious diseases are still leading cause of childhood deaths in our target population. Low level of parental education and low income are directly related to infectious causes of child mortality.

Key Words: *Child Mortality, Pneumonia, Diarrhea, Sepsis, Preventable diseases*

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INTRODUCTION

Previously as a part of Millennium Development Goals (MDG) (1990-2015) and now as a part of Sustainable Development goals (SDG), the improvement in health and survival of children are globally recognized health system goals.¹ 5.2 million children less than 5 year died in 2019.² Child mortality is a critical measure of the children well-being and a good substitute pointer of the country's level of development.³ In 1990 the nations promised to confirm a decrease of two-thirds in child mortality by year 2015; goal is only

partially achieved as between 1990 and 2015, the global under-five mortality rate has been reduced by a little more than half, dropping from 90 to 43 deaths per 1000 live births worldwide; still, it is a remarkable achievement of MDG.¹ Globally the chances of child survival have improved; 1 in 27 children died in 2019 as compared to 1 in 11 in 1990.² As compared to global statistics Pakistan has a high under-five child mortality of 67.2 deaths per 1000 live births in 2019¹. Still, it is commendable that under-five mortality in Pakistan declined to almost half in the last 28 years; as in

1990 the under-five mortality was 140 per 1000 live births as compared 67.2 per 1000 live births in 2019.¹ As compared to Pakistan, the under-five child mortality rate is lower in other developing countries like India (40) and Bangladesh (32).³ In developed nations like United States and United Kingdom under 5 mortality is 7 and 4 per 1000 live births respectively.^{1,3} Infant and child mortality is associated negatively with the quality of life and level of living. With the end of MDG in 2015, SDGs are proposed and aims to achieve 17 different targets for the global and human betterment. Proposed SDG target for child mortality is to reduce the neonatal mortality to as low as 12 per 1000 live births and under 5 mortality to 25 deaths per 1000 live births by the end of 2030. The main aim is to halt the preventable deaths in neonates and children.⁴

The latest information regarding child mortality is cardinal to support global efforts to improve child survival. Knowledge and data on mortality trends are very important to monitor the health sector progress and to identify the weaknesses in the system for the purpose of future improvement. Information on the cause of death is important for appropriate interventions to reduce the child mortality. Although hospital data has its own limitations, still it is a useful indicator for determining the quality of child health status and services available.

Few prior studies have been carried out in the region. A study carried out in Children Hospital Lahore in 2011 concluded that significant number of childhood deaths can be prevented by implementing the strategies to lessen infection and malnutrition. The most common cause of death was gastrointestinal diseases occurring in 36% of cases followed by acute lower respiratory tract infection in 27% and central nervous system infections in 25%.⁵ Another study carried out in 2003-2006 in Civil Hospital Karachi showed that morbidity and mortality were high in children who were unvaccinated and severely malnourished. Out of 162 deaths included in the study 55% were severely malnourished and sepsis was the leading cause of death (32%).⁶ In a study conducted in Iran, sepsis (14.8%), pneumonia (14.5%), congestive heart failure (9.8%), and hepatic encephalopathy (9.8%) were leading cause, of death among admitted children.⁷

The aim of the current research is to investigate the main causes of death in children aged 1 month to 12 years who died during inpatient stay. Our target population is low-income group as patients coming to Civil Hospital Karachi are mainly from the low-income areas of Karachi. There is a big gap of information due to the lack of any research or study on this subject in our targeted population. The study provided us with information on child mortality in a major public sector hospital of the city. In addition to that, the study was helpful in identifying the factors associated with high burden of child mortality and therefore, it will help in establishing the necessary changes in our health system to improve the child survival and reduce the mortality.

MATERIAL AND METHODS

This was a cross sectional study conducted in the Pediatric intensive care unit, Civil Hospital, Karachi from 23rd May 2017 to 23rd Nov 2017. Patients aged between 1 month to 12 years of age, of either gender who were admitted in ICU and died during the hospital stay were included. Patients below 1 month of age were excluded from the study, as maternal health status and birth complications also affect the mortality pattern at this age. Also patients with surgical issues were excluded from the study. Operational definitions of different conditions are:

1. Mortality was defined as the death of the patient confirmed by absence of any spontaneous respiration, heart rate and absent pupillary and corneal reflexes (confirmed on medical records).
2. Meningitis was defined based on CSF criteria (presence of CSF WBC $>12/\text{mm}^3$ in patients up till 2 months of age and CSF WBC of $>5/\text{mm}^3$ in patients above 2 months of age or the presence of CSF absolute neutrophil count [ANC] $> 1/\text{mm}^3$ in all the ages⁸).
3. Malaria was defined as the presence of malaria parasites in the blood of a patient that has been confirmed by parasitological testing.⁹
4. Pneumonia was diagnosed if patient had chest in drawing along with respiratory rate of more than 60 breaths/min in infants up till 2 months of age, >50 breaths/min in infants aged 2-12 months, >40 breaths/min in

children aged 1-5 years, and >20 breaths/min in children more than 5 years of age.¹⁰

5. Sepsis was defined as the presence of 2 of the following with one being an abnormal temperature or leukocyte count: A temperature of >38.5°C or <36°C, TLC of >15000/mm³ or <5000/mm³, tachycardia greater than 2 standard deviations above average for their specific age group, bradycardia below the 10th percentile for their age group, average respiration rate greater than 2 standard deviations above average.¹¹
6. Severe acute malnutrition was defined by weight for height below -3z scores of the median WHO growth standards, or by the presence of bilateral pitting pedal edema.¹²
7. Measles was diagnosed when patient had fever >38°C and maculopapular rash (i.e., non-vesicular), cough, coryza (i.e., a runny nose) or conjunctivitis (i.e., red eyes).¹³
8. Severe anemia with hemoglobin level of <7g/dl.¹⁴
9. Tuberculosis was diagnosed based on the scoring criteria recommended by National TB control Program and Pakistan Pediatric Association.¹⁵
10. Gastroenteritis is presence of diarrhea with or without vomiting.
11. Enteric fever was defined as fever (38°C and above) that has lasted for at least three days, with blood culture report positive for S.Typhi.¹⁶
12. Congenital diseases were confirmed as presence of structural or functional anomalies identified on the basis of medical history and physical examination.
13. Malignancy was confirmed on the basis of the histopathological report.

A proforma was filled for each patient enrolled in the study. Demographic data including patient's age, gender, date of admission, date of expiry, duration of hospital stay before expiry, the diagnosis made during the hospital stay, weight for height, nutritional status were recorded. Nutritional status was determined by weight for height and presence or absence of edema.

Sample size was calculated using WHO sample size calculator. A total of 302 children were enrolled, taking prevalence of mortality due to

congenital disease 1.8% at the margin of error of 5% and 95% confidence interval.

Data was analyzed with the help of SPSS v.16.0. Descriptive statistics were obtained for quantitative and qualitative variables. Mean \pm SD was shown for age, duration of hospital stay, weight and hemoglobin levels (from medical record). Frequency (percentage) was mentioned for gender, residence, socio-economic status, educational status of parents, vaccination status and common causes of death including meningitis, pneumonia, malaria, sepsis, severe malnutrition, measles, malignancies, acute gastroenteritis, severe anemia, enteric fever, tuberculosis and congenital diseases. Effect modifiers like age, gender, socioeconomic status, educational status of parents, vaccination status, duration of hospital stay and residence were controlled through stratification. Post stratification chi square test was employed keeping p-value ≤ 0.05 as significant.

RESULTS

A total of 302 patients were enrolled. The mean age of enrolled participants was 6.54 ± 3.2 years and 156 (51.6%) were ≥ 5 years of age, 196 (64.9%) were male and 106 (35.1%) were female, the mean weight of the enrolled participants was 13.58 ± 16.2 kg and 147 (48.6%) has weight <10 kg, 193 (63.9%) of participants live in rural area, 151 (50%) has income between Rs. 10000 to 25000, 143 (47.3%) mothers of enrolled participants were illiterate and 11 (3.6%) have graduate level education, 151 (50%) fathers of enrolled participants were illiterate and 9 (2.9%) have graduate level education, 153 (50.6%) participants were vaccinated and 105 (34.7%) were unvaccinated, mean duration of hospital stay was 4.32 ± 2.1 days and 185 (61.2%) were admitted for < 4 days (fig 1).

The most common cause of mortality was sepsis accounting for 160 (53%) cases followed by gastroenteritis in 37 (12.2%) and pneumonia 33 (11%). Least common cause of mortality was malignancy (4 = 1.3%) followed by congenital malformation (5 = 1.7%) cases.

Stratified analysis of infection and non-infection causes of mortality by age, gender, family income, education status of mother and father, vaccination status of the child, duration of hospital stay and area of residence is summarized in table 1.

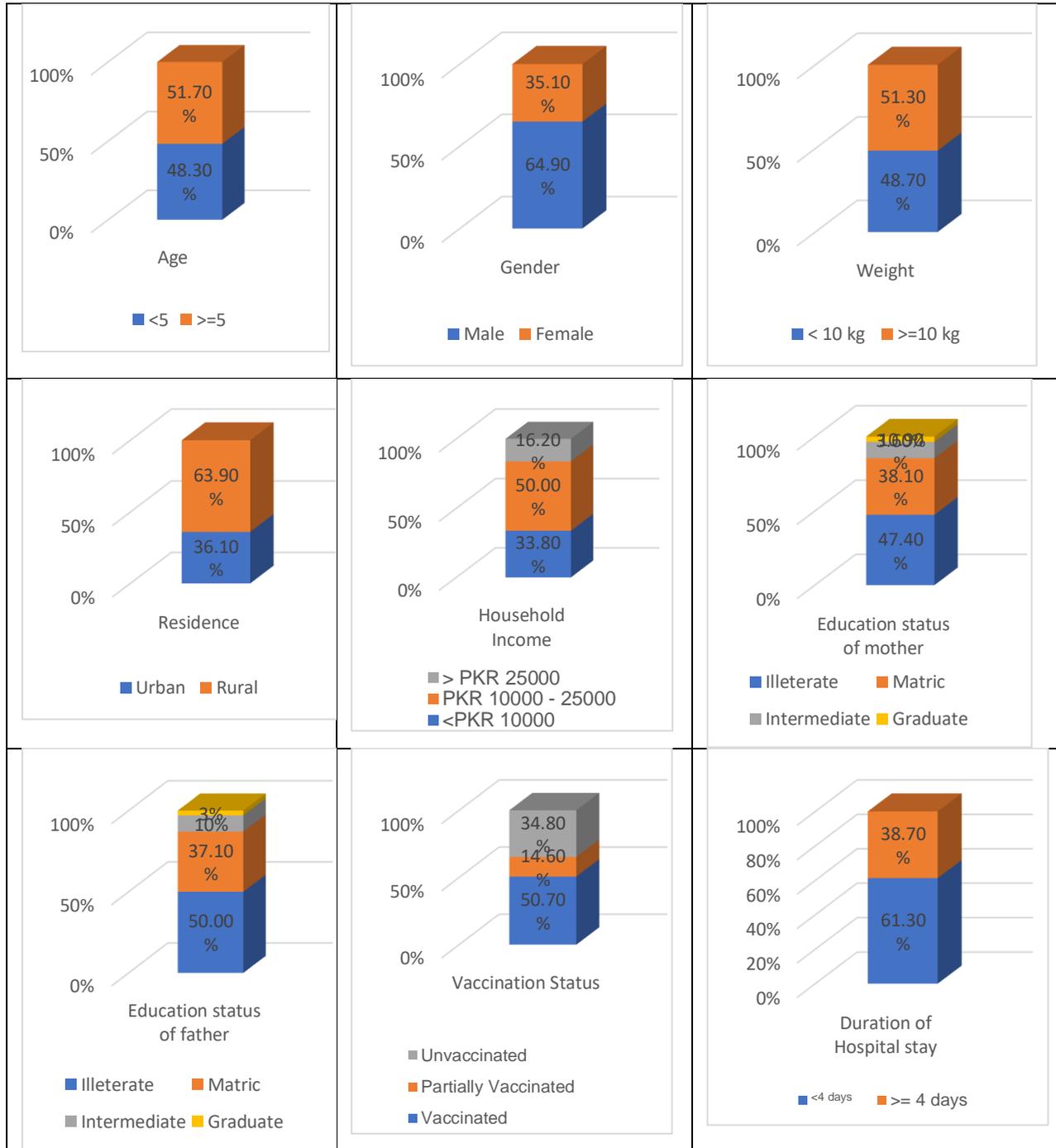


Fig 1: Characteristics of enrolled participants (n=302)

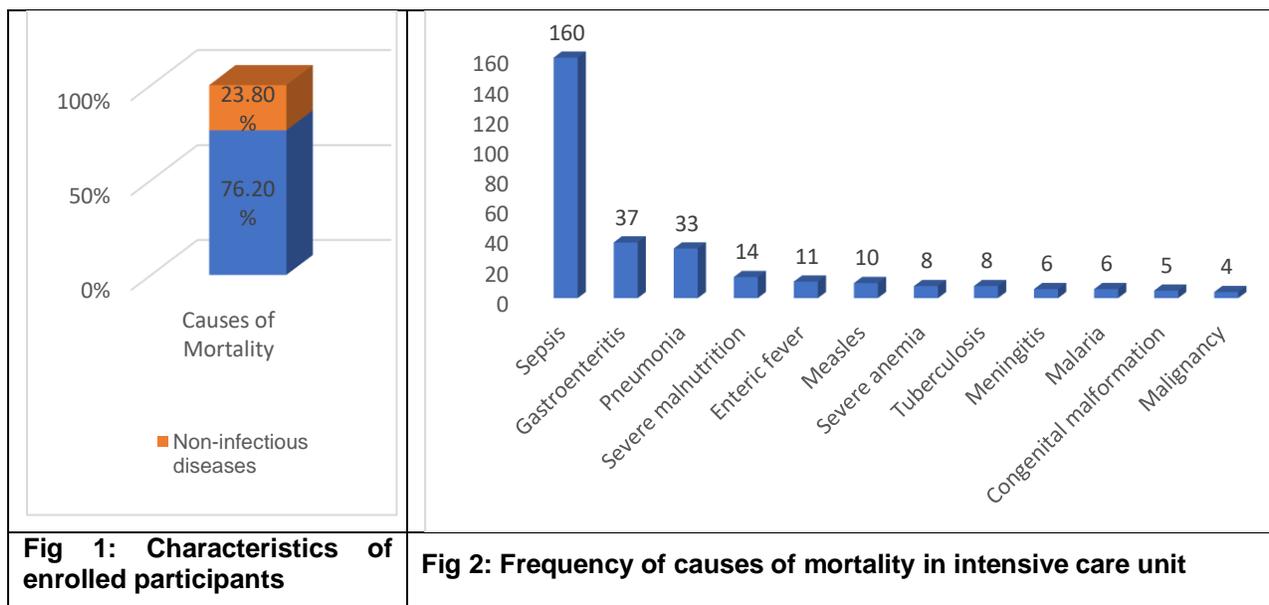


TABLE1: Stratified analysis to control effect modifier

	Infectious Causes		Non-infectious causes	
		p-value		p-value
Age				
<5 years	127 (87%)	0.001	20 (13.0%)	0.003
>=5 years	113 (72.4%)		42 (26.9%)	
Gender				
Male	160 (81.6%)	0.133	35 (17.9%)	0.08
Female	80 (75.5%)		27 (25.5%)	
Household income				
<Rs. 10000	94 (92.2%)	<0.001)	8 (7.8%)	<0.001
Rs. 10000 - 25000	115 (76.2%)		36 (23.8%)	
>Rs. 25000	31 (63.3%)		18 (36.7%)	
Education status of mother				
Illiterate	132 (92.3%)	<0.001	11 (7.7%)	<0.001
Matric	83 (72.2%)		32 (27.8%)	
Intermediate	20 (60.6%)		13 (39.4%)	
Graduate	5 (45.5%)		6 (54.5%)	
Education status of Father				
Illiterate	139 (92.1%)	<0.001	11 (7.3%)	<0.001
Secondary	80 (71.4%)		32 (28.6%)	
Intermediate	17 (56.7%)		13 (43.3%)	
Graduate	3 (33.3%)		6 (66.7%)	
Vaccination status				
Vaccinated	109 (71.2%)	<0.001	44 (28.8%)	<0.001
Partially vaccinated	31 (70.5%)		12 (27.3%)	
Unvaccinated	100 (95.2%)		6 (5.7%)	
Duration of hospital stay				
< 4 days	163 (88.1%)	<0.001	22 (11.9%)	<0.001
>=4 days	77 (65.8%)		40 (34.2%)	
Residence				
Urban	78 (71.6%)	0.009	31 (28.4%)	0.009
Rural	162 (83.9%)		31 (16.1%)	

DISCUSSION

There has been a significant reduction in child mortality over the past few decades as has been reflected by the partial achievement of MDG on child survival by 2015. Good quality of health care has a positive impact in decreasing the child mortality. Quality of critical and emergency care offered to the patients determines the outcomes. The task is linked to quick prioritization, identification and crucial treatment.¹⁵ Although epidemiological data on mortality by field survey is most reliable method of determining health status of a community, it is unavailable or incompletely available and unreliable in developing countries. Many deaths are not attended by any qualified person, so the cause of mortality is not documented properly. In such cases mortality information from hospitalized patients exhibit the causes of severe illnesses and care seeking behavior of community as well as the standard of care being given to the community.¹⁶

In 76.2% cases the underlying cause of mortality was infectious diseases. Infectious diseases are preventable cause of morbidity and mortality. In our study population, only 50.4% was completed vaccinated according to EPI schedule. In developed countries the burden of infectious diseases has decreased significantly by proper implication of vaccination but in low income countries it is still a major burden due to the incomplete vaccine coverage. Financial constraints, anti-vaccination movements and vaccine hesitancy together account for failure in comprehensive execution of vaccination programs in developing countries.¹⁷ Social science research can help define the factors leading to these challenges and the strategies to combat issues like vaccine hesitancy and anti-vaccination movements.¹⁸

In our study, we found that the most common cause of mortality in patients admitted to PICU was sepsis (53%), followed by gastroenteritis (12.2%) and pneumonia (11%). Least common causes of mortality were congenital malformation (1.7%) followed by malignancy (1.3%) cases. In another study conducted on PICU mortality patterns over 6 years period in Pakistan, sepsis (17.3%) was commonest cause of death followed by CNS diseases (14.9%), CVS (13.3), respiratory

(13.3%) and gastrointestinal diseases (9.3%).¹⁹ Another study conducted in Pakistan on causes of death in neonates and children under five year revealed that 58% deaths occurred in neonatal period and 42% in post neonatal period. The commonest cause of death in post neonatal period sepsis (19%) followed by diarrheal diseases (17%), pneumonia (17%) and meningitis (8%).²⁰

PICU mortality due to sepsis ranges from 11-40% according to a point prevalence study which included 126 PICUs in different countries across the globe. The burden of mortality was higher in Asia, Africa and South America as compared to North America, Europe and Australia.²¹ Due to improved clinical practices and enactment of standard protocols and guidelines the mortality from sepsis has decreased significantly in the developed world, but it is still a leading cause of PICU mortality in the developing world.¹⁹ Delay in seeking medical care, treatment by local quacks, improper usage of antibiotics, limited health care facilities, poor health infrastructure and malnourishment are causes leading to high mortality due to sepsis in developing areas of the world. A study from India shows the mortality due to sepsis in PICU to be 42%, which is comparable to our study and other studies conducted in the region.²² Presence of MODS is a risk factor for increased mortality due to sepsis. Duration of hospital stay was less than 4 days in 61% of cases in our study which is comparable to other studies.^{23,24}

Gastroenteritis, pneumonia and severe malnutrition were leading causes of mortality following sepsis in our study. Gastroenteritis accounted for 12.2% of the cases of mortality which is lower than in a similar study conducted in Lahore in which diarrheal diseases accounted for 36% of mortality.⁵ Use of ORS, probiotics and zinc supplements have improved the outcome in childhood diarrheal diseases. Pneumonia accounted for 11% of mortality which is lower as compared to 27% and 14.5% in two other local studies.^{5,16}

Tuberculosis (TB) accounted for 2.6% of the mortality rate in our study. This frequency is low compared to other developing countries. It is possible that higher rate of HIV/AIDS and TB co-infection in India, Bangladesh, and Africa are

attributing to high mortality in these countries due to tuberculosis.²⁵

Protein energy malnutrition comprised 4.6% of the total cases seen in this study. Malnutrition alone or in combination with other diseases contributed to 4% of the total morbidity in a study done at Enugu which is in a nearby state in South-eastern Nigeria.²⁶ The low prevalence of mortality due to PEM could be explained by the fact that most malnutrition cases were seen at the children outpatient department and later admitted directly into the main pediatric ICUs for severe complications.

As developing countries suffer from limitation of financial and medical resources, optimum utilization of these resources should be the top priority of these countries. Information regarding the mortality and distribution of diseases is the first step towards the proper utilization of available resources and ensure evidence directed resource application. This study provides us with a chance to better understand the major causes that are contributing to mortality in our targeted population. This information can be of great help in planning and implementing relevant preventive strategies to reduce mortality.

Limitations: Bacterial infection especially those causing pneumonia, diarrhea, typhoid and meningitis are preventable diseases that are associated with poor environmental sanitation. This study did not examine the environmental factors.

CONCLUSION

Pakistan still faces a large burden of child mortality. Infectious diseases are still the leading cause of childhood deaths in our country. Low level of parental education and low income are directly related to infectious causes of child mortality. There is necessity to assimilate the attitudes, beliefs and behavioral practices of people into health promotion strategies to achieve a notable reduction in infant and child morbidity and mortality.

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REFERENCES

1. UNICEF Data. Pakistan (PAK) - Demographics, Health & Infant Mortality [Internet]. 2020 [cited 2020 Feb 04]. Available from: <https://data.unicef.org/country/pak/>
2. UNICEF Data. Child Mortality [Internet]. 2020 [cited 2020 Jan 30]. Available from: <https://data.unicef.org/topic/child-survival/under-five-mortality/>
3. Haines A, Cassels A. Can the millennium development goals be attained? *Bmj*. 2004;329:394-7
4. UNICEF Data. Child survival and the SDGs [Internet]. 2020 [cited 2020 February 13]. Available from: <https://data.unicef.org/topic/child-survival/child-survival-sdgs/>
5. Bari A, Mushtaq A, Naz S, Baneen U, Khan MZ, TM A. Preventable diseases-leading cause of death in developing countries. *Pak Paed J*. 2013;37:95-100.
6. Ejaz M, Ahmed I, Inkisar A. Role of nutritional and immunization status on morbidity and mortality in hospitalized children. *Pak Paed J*. 2009;33:119-23.
7. Fallahzadeh M, Abdehou ST, Hassanzadeh J, Fallahzadeh F, Fallahzadeh MH, Malekmakan L. Pattern of in-hospital pediatric mortality over a 3-year period at University teaching hospitals in Iran. *Indian J Crit Care Med*. 2015;19(6):311-315.
8. Bonadio WA. Acute bacterial meningitis: Cerebrospinal fluid differential count. *Clinpediatr*. 1988;27:445-7.
9. Guidelines for the Treatment of Malaria. 3rd edition. Geneva: World Health Organization. Annex 3, Malaria diagnosis [Internet]. 2015 [cited 2020 Feb 17]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK294431/>
10. World Health Organization. The management of acute respiratory infections in children: practical guidelines for outpatient care [Internet]. Geneva: 1995 [cited 2020 Feb 17]. Available from: <https://apps.who.int/iris/handle/10665/41803>

11. World Health Organization. Malnutrition [Internet]. 2020 [cited 2020 February 19]. Available from: https://www.who.int/health-topics/malnutrition#tab=tab_1
12. World Health Organization. WHO-recommended surveillance standard of measles [Internet]. 2020 [cited 19 February 2020]. Available from: https://www.who.int/immunization/monitoring_surveillance/burden/vpd/surveillance_type/active/measles_standards/en/
13. Page A-L, de Rekeneire N, Sayadi S, Aberrane S, Janssens AC, Rieux C, et al. Infections in children admitted with complicated severe acute malnutrition in Niger. *PLoS One*. 2013;8(7):e68699.
14. National TB control program Pakistan. National guidelines for diagnosis and management in children [Internet]. 2006 [cited 2020 Feb 17]. Available from: <https://ntp.gov.pk/>
15. Medical microbiology and infectious diseases society of Pakistan. Typhoid Management Guidelines [Internet]. 2019 [cited 2020 February 19]. Available from: <https://www.mmisp.com/typhoid-management-guidelines-2019/>
16. Aggarwal KC, Gupta R, Sharma S, Sehgal R, Roy MP. Mortality in newborns referred to tertiary hospital: An introspection. *J Family Med Prim Care*. 2015;4(3):435–438.
17. Turner H, Thwaites GE, Clapham HE. Vaccine-preventable diseases in lower-middle-income countries. *The Lancet Infect Dis*. 2018;18(9):937-939.
18. Cobos Muñoz D, Monzón Llamas L, Bosch-Capblanch X. Exposing concerns about vaccination in low- and middle-income countries: a systematic review. *Int J Public Health*. 2015;60(7):767-780.
19. Siddiqui NU, Ashraf Z, Jurair H, Haque A. Mortality patterns among critically ill children in a Pediatric Intensive Care Unit of a developing country. *Indian J Crit Care Med*. 2015;19(3):147-150.
20. Nisar MI, Ilyas M, Naeem K, Fatima U, Jehan F. Cause of death in under 5 children in a demographic surveillance site in Pakistan. *Online J Public Health Inform*. 2017;9(1):e174.
21. Weiss S, Fitzgerald JC, Pappachan J, Wheeler D, Jaramillo-Bustamante JC, Salloo A, et al. Global epidemiology of pediatric severe sepsis: the sepsis prevalence, outcomes, and therapies study. *Am J Respir Crit Care Med*. 2015;191(10):1147-1157.
22. Kaur G, Vinayak N, Mittal K, Kaushik JS, Aamir M. Clinical outcome and predictors of mortality in children with sepsis, severe sepsis, and septic shock from Rohtak, Haryana: A prospective observational study. *Indian J Crit Care Med*. 2014;18(7):437-441.
23. Evans JM, Dayal P, Hallam DL, Natale JE, Kodali P, Sauers-Ford HS, et al. Illness severity of children admitted to the PICU from referring emergency departments. *Hosp Pediatr*. 2018;8(7):404-409.
24. Haque A, Siddiqui NR, Jafri SK, Hoda M, Bano S, Mian A, et al. Clinical profiles and outcomes of children admitted to the pediatric intensive care unit from the emergency department. *J Coll Physicians Surg Pak*. 2015;25(4):301-303.
25. Trinh QM, Nguyen HL, Nguyen VN, Nguyen TV, Sintchenko V, Marais BJ. Tuberculosis and HIV co-infection—focus on the Asia-Pacific region. *Int J Infect Dis*. 2015;32:170-178.
26. Chukwu BF, Chinawa JM, Ikekuna AN, Emodi IJ. Pattern and outcome of paediatric medical admissions at the University of Nigeria Teaching Hospital (UNTH), Ituku-Ozalla, Enugu: a five year retrospective review (2007–2011). *Niger J Paed*. 2013;40:354-9.