

Pattern of in-hospital pediatric mortality over a 3-year period at University teaching hospitals in Iran

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Abstract

Introduction: Causes of death are different and very important for policy makers in different regions. This study was designed to analyze the data for our in-patient children mortality. **Materials and Methods:** In this cross-sectional study from March 2011 to March 2013, all patients from 2 months to 18 years who died in pediatric intensive care unit, emergency room or medical pediatric wards in the teaching hospitals were studied. **Results:** From a total of 18,915 admissions during a 2-year-period, 256 deaths occurred with a mean age of 4.3 ± 5 years and mortality 1.35%. An underlying disease was present in 70.7% of the patients and in 88.5% of them the leading causes of death were related to the underlying diseases. The most common underlying diseases were congenital heart disease and cardiomyopathy in 50 (27.6%). The four main causes of deaths were sepsis (14.8%), pneumonia (14.5%), congestive heart failure (9.8%), and hepatic encephalopathy (9.8%). **Conclusion:** We may conclude that after sepsis and pneumonia, congestive heart failure, and hepatic encephalopathy are the leading causes of death. Most patients who died had underlying diseases including malignancies, heart and liver diseases as the most common causes.

Keywords: Causes, children, hospital admission, mortality, underlying diseases

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Introduction

An ongoing reliable and comparative analysis of causes of death in different age groups, particularly in neonates and young children is the basis for national and international decision-making and planning process in the health system.^[1,2]

These data are very useful in health policies for disease prevention and control especially, where shortage of financial and human resources limit treatment options.^[2] Moreover, rate and pattern of child mortality is a sensitive indicator of a country's development

and a good source of evidence for its priorities and values.^[3] Global mortality in children younger than 5 years has been reduced in the past two decades from more than 12.5 million deaths in 1990 to 7.0 million in 2010 and 6.6 million in 2012; as a result of more efficient treatments, innovative ways of delivering critical interventions to the poor population, and sustained political commitment. However, these improvements have been different worldwide.^[4]

The causes of death could be much more variable in different regions and even at different times in the same center. Therefore, this study was designed to analyze data for the in-patient children mortality in all during a 2-year period.

Materials and Methods

Setting and sampling

This is a cross-sectional study designed to analyze data for the in-patient mortality among children in all Shiraz teaching hospitals from March 2011 to March 2013. There

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are three main children's teaching hospitals; include one general and two referral hospitals, all having pediatric emergency wards. However, at the time of this study, there was only one medical pediatric intensive care unit (PICU) in teaching hospitals with 10 beds.

In this study, managing physicians collected information on the admitted children to these teaching hospitals at the end of each month during the study. This information included age, sex, underlying disease, final diagnosis, duration of hospitalization, description of the hospital course and cause of death, for the patients who expired. Patients <30 days and more than 18 years old were excluded from this study.

Ethical consideration

The study has been approved by the Ethics Committee of Shiraz University of Medical Sciences.

Statistic analysis

The statistical analysis of the data was performed using Statistical Package for Social Sciences version 16 (SPSS Inc., Chicago, IL, USA). The results related to the quantitative data were shown as percentage and frequency. The results related to the survival rate of the patients analyzed by the life table method.

Results

From a total of 18,915 patients, 9584 were admitted in 2011 and 9331 in 2012. Of 18,915 PICU admissions, 256 (23.6%) patients died in the hospital of which 256 died 152 deaths (59%) occurred in the PICU with a mortality rate of 16.6%. And 104 patients (41%) died in the wards other than PICU with a mortality rate of 0.58%.

The overall mortality rate was 1.35%. Mean age of the 256 patients who died in the hospital was 4.3 ± 5.2 years with a range of 1-month to 17 years with male to female ratio of 1.37. Table 1 shows age distribution of the patients. Of the 256 deaths, 23 (9%) occurred within the first 24 h after admission and 60 (23.5%) during the first 2 days [Table 2].

An underlying disease [Table 3] was present in 70.7% of the patients, and in 88.5% of all of the expired patients, the leading causes of death were directly related to the known underlying diseases. The most common underlying diseases were congenital heart disease and cardiomyopathy in 50 (27.6%).

The four main causes of deaths [Table 4] were sepsis (14.8%), pneumonia (14.5%), congestive heart failure

Table 1: Age distribution of 256 in-patient deaths of the study group

Age	Patients number	Percentage	Cumulative percentage
2-3 months	50	19.5	19.5
4-6 months	34	13.3	32.8
7-12 months	31	12.1	44.9
13-24 months	33	12.9	57.8
3-5 years	28	10.9	68.8
6-12 years	52	20.3	89.1
12-17 years	28	10.9	100

Table 2: Duration of hospital admission of the study group

Admission day	Patients number	Percentage	Cumulative percentage
1	23	9	9
2	37	14.4	23.4
3	31	12	35.5
4	25	9.8	45.3
5	24	9.4	54.7
6	11	4.3	59
7	13	5	64.1
8-14	47	18.3	82.4
15-21	27	10.5	93
≥22	18	7	100

Table 3: Underlying diseases of the expired study patients

Underlying disease	Frequency (%)
CHD	41 (16)
Cirrhosis	19 (7.4)
Metabolic diseases	14 (5.5)
Acute myeloid leukemia	12 (4.7)
Immunodeficiency	11 (4.3)
Acute lymphocytic leukemia	9 (3.5)
Cardiomyopathy	9 (3.5)
Congenital anomalies	7 (2.7)
Cerebral palsy	5 (2)
Liver transplant	5 (2)
Aplastic anemia	5 (2)
Lymphoma	4 (1.6)
Seizure disorder	3 (1.2)
Werdnig-Hoffmann disease	3 (1.2)
Diabetes mellitus	3 (1.2)
Malnutrition	3 (1.2)
Hemolytic uremic syndrome	2 (0.8)
Neuroblastoma	1 (0.4)
Wilms tumor	1 (0.4)
Asthma	1 (0.4)
Major thalassemia	1 (0.4)
Systemic lupus erythematosus	1 (0.4)
Rickets	1 (0.4)
Other malignancies	6 (2.3)
Other gastrointestinal diseases	6 (2.3)
Other hematologic diseases	3 (1.2)
Other neurologic diseases	2 (0.8)
Other renal diseases	1 (0.4)
Other immunological diseases	1 (0.4)
Other endocrine diseases	1 (0.4)
No underlying disease	75 (29.3)
Total	256 (100)

CHD: Coronary heart disease

(9.8%) and hepatic encephalopathy (9.8%). Unusual causes of death were diabetic ketoacidosis in two and

diarrhea, asthma, and bronchiolitis in three patients. However, no case of acquired immunodeficiency syndrome (AIDS), pertussis, diphtheria, poliomyelitis, tetanus, measles or tuberculosis (except for BCGitis as a disseminated *Bacillus Calmette-Guerin* infection) was detected in the expired children.

Duration of hospitalization ranged from <24 h to 68 days (mean 8.52 ± 9.53 days).

Cumulative survival and cumulative survival rate in the hospital are shown in Table 5.

Discussion

In this study, sepsis, pneumonia, CHF and hepatic encephalopathy were the most common causes of death respectively, and majority of the patients had some type of underlying diseases. The overall rate of mortality was low and similar to some other studies.^[5,6] Sepsis was the most common cause of death probably due to significant number of immune compromised patients and those with chronic liver or heart diseases in this referral center.

This cross-sectional study of the pattern of death in children and infants in the three pediatric centers in Shiraz, is the first of its kind in Iran one of the largest similar series is from Northern Cameroon that includes deaths in all age ranges from neonatal period to adulthood.^[5] Nonetheless, our study is unique in many aspects: (1) Including large number of in-patients and their related mortality information with no missing data, (2) covering almost all the admitted nonsurgical pediatric patients, (3) including infants and children and excluding neonates, (4) differentiating the death in PICU from regular wards, (5) including data of both general and subspecialty hospitals and their emergency wards, (6) collecting the data of our study was concurrent in contrast to some other similar studies,^[5,6] (7) identifying the underlying diseases and their relations to the present illness.

The overall mortality rate in different reports on admitted children is from 6% to 17.8%,^[6-9] and in PICU from 2.8% to 32.9%,^[10-14] The difference in the mortality rate can be related to the availability of adequate PICU beds and the related facilities, the physician experience, availability of special nurses, the diseases leading to PICU admission and the underlying diseases. In addition, the low rate of mortality in the wards other than PICU may be due to the large number of patients in the general hospitals and in the emergency wards.

Table 4: Causes of deaths of the study group

Cause of death	Frequency (%)
Sepsis	38 (14.8)
Pneumonia	37 (14.5)
Congestive heart failure	25 (9.8)
Hepatic encephalopathy	25 (9.8)
Disseminated intravascular coagulation	15 (5.9)
Seizure	14 (5.5)
Arrhythmia	10 (3.9)
Respiratory failure	9 (3.5)
Gastrointestinal bleeding	8 (3.1)
Leukemia	8 (3.1)
Intracranial hemorrhage	7 (2.7)
Metabolic diseases	5 (2)
Toxin poisoning	4 (106)
Cardiomyopathy	4 (1.6)
BCGitis	4 (1.6)
Acute respiratory distress syndrome	4 (1.6)
Lymphoma	3 (1.2)
Cirrhosis	3 (1.2)
Brain tumor or abscess	3 (1.2)
Diabetic ketoacidosis	2 (0.8)
Meningitis	2 (0.8)
Drowning	2 (0.8)
Gastroenteritis	1 (0.4)
Asthma	1 (0.4)
Bronchiolitis	1 (0.4)
Acute renal failure	1 (0.4)
Chronic renal failure	1 (0.4)
Hepatitis	1 (0.4)
Drug poisoning	1 (0.4)
Neuroblastoma	1 (0.4)
Germ cell tumor	1 (0.4)
Histiocytosis	1 (0.4)
Foreign body aspiration	1 (0.4)
Electrical injury	1 (0.4)
Malignant hyperthermia	1 (0.4)
Posttransplant lymphoproliferative disease	1 (0.4)
Other tumors	3 (1.2)
Other immunologic diseases	2 (0.8)
Other infections	2 (0.8)
Other hematologic diseases	2 (0.8)
Other neurologic diseases	1 (0.4)
Total	256 (100)

BCGitis: *Bacillus Calmette-Guerin* infection

Table 5: Estimation of the cumulative survival rate of the patients using life table method

Time	Survival rate (%)	SE
1 st day	91	2
2 nd day	77	3
3 rd day	64	3
4 th day	55	3
5 th day	45	3
1 st week	36	3
2 nd week	18	2
3 rd week	7	2
4 th week	4	1

SE: Standard error

About one-third of deaths in our patients occurred in the first 6-month and about 45% during the 1st year of life. Probably because of mass immunization of children in, the related infectious diseases such as

measles, pertussis, and diphtheria, severe forms of tuberculosis or poliomyelitis were rarely observed in our patients. Surprisingly, unlike other reports, diarrhea and malnutrition were unusual causes of death, and malaria was not observed in this study. Improvement in socioeconomic and educational status of the community may be an important factor for low rate of death due to malnutrition and diarrhea. In addition, religious beliefs and restrictions may be important factors for very low rate of AIDS in our patient population.

In a report of 5909 in-patient children by Bucens *et al.*, the three most common causes of death have been lower respiratory tract infection, central nervous system (CNS) infection, and malnutrition.^[6] In another recent study, the major causes of mortality were diarrheal diseases, malaria, and malnutrition.^[7] Furthermore, in an older report of 1364 admitted children, 75% of deaths were due to acute respiratory tract infection, acute diarrhea, and severe malnutrition.^[8] Additionally, in a similar study of 8826 pediatric admissions, acute diarrhea, and severe malnutrition were the most important causes of death.^[9] Moreover, in a large series of death in children and adults, acute lower respiratory tract infection, malaria and diarrheal disease were the most common causes of mortality in children.^[5] In our study, in contrast to most of the above reports, cardiac, gastrointestinal, hepatic and CNS diseases together with malignancies were the common causes of death. This difference may be explained in part by the fact that our center is the tertiary referral center for these groups of patients from different provinces and also including different age groups of children.

In one recent report on 282 PICU admissions and 32.9% mortality, sepsis, cardiac diseases, and neurological disorders were the most common causes of death.^[14] The latter study had a higher mortality rate than our study even though some of the causes of death were similar to our patient population. CNS disorders and malignancies are reported as the second and third common causes of death respectively at the natural hospital in Dili.^[6]

In our report, an underlying disease was present in about 70% of the patients who died and in 88.5% of these patients the leading cause of death was directly related to their underlying diseases. This has created an important task for the health providers to help the patients with chronic diseases such as CHD and hepatic cirrhosis by providing access to organ transplantation or advanced surgical operations. They can also provide the means by allocating budget for preparing drugs and facilities for prevention or early detection and proper management

of malignancies. Also, they can provide specialized ICU units for these types of patients. If they achieve this goal, there will be more regular PICU beds available for other patients to be admitted. Moreover, another way to decrease mortality rate is to provide advanced PICU beds and the related facilities.

In most other reports, the percent of death during the 1st day of admission is greater than in our study.^[5,8-9] This may be related to the facilities in our health system which can manage and stabilize pediatric emergencies before they arrive to the referral hospitals. Thus, when they arrive to these centers, they are relatively stable. Limitation of this study was that all information about the patients who were discharged from hospital was not available.

Conclusion

We can conclude that after sepsis and pneumonia, CHF and hepatic encephalopathy are the two most leading causes of death. Most patients who died had underlying diseases that should lead the health care authorities to re-evaluate the health policies to address these issues.

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