Introduction

The emergency department (ED) is the first line of contact to health care for the critically ill and is often considered the face of the hospital. A well-trained and well-equipped ED directly correlates with survival of the patients. However, emergency medicine (EM) is a nascent specialty in India, and its development has been protracted and inadequate.\(^1\)\(^2\)

Early and aggressive intervention is reported to increase the odds of survival and decrease mortality in critically ill patients. Since emergency medicine is a nascent specialty in India, a review and assessment of the mortality profile in the Emergency Department (ED) would help improve the quality of care. \textbf{Aims:} The aim of the study is to determine the mortality profile and causes of preventable deaths at large ED in South India. \textbf{Methods:} This retrospective chart review was conducted between January and December 2017. Patients admitted with Triage priority 1 and priority 2 of our ED, who died, despite treatment, were recruited in the study. Two ED consultants blinded from each other, independently audited all the charts to determine preventable and nonpreventable causes of death. \textbf{Results:} There were a total of 69,369 patients during the study period who presented to the ED. Despite resuscitation 189 (0.7%) died, the mortality rate was 2.43%. Cardiac-related (32%) and sepsis-related (31%) causes were the most common cause of death, 23.8% were due to preventable causes and 16.9% of which were due to inappropriate management. In patients with sepsis, the odds of death due to preventable causes were significantly high (odds ratio 4.31, 95% confidence intervals: 1.96–9.47; \(P < 0.001\)). \textbf{Conclusions:} Cardiac- and sepsis-related causes of death, together accounted for most of the mortality. In patients with sepsis, the odds of death due to preventable causes were more than four times higher than those without preventable causes.

\textbf{Keywords:} Emergency department, mortality profile, sepsis

Abstract

\textbf{Background:} Early and aggressive time to intervention has been shown to increase the odds of survival and decrease mortality in critically ill patients. Since emergency medicine is a nascent specialty in India, a review and assessment of the mortality profile in the Emergency Department (ED) would help improve the quality of care. \textbf{Aims:} The aim of the study is to determine the mortality profile and causes of preventable deaths at large ED in South India. \textbf{Methods:} This retrospective chart review was conducted between January and December 2017. Patients admitted with Triage priority 1 and priority 2 of our ED, who died, despite treatment, were recruited in the study. Two ED consultants blinded from each other, independently audited all the charts to determine preventable and nonpreventable causes of death. \textbf{Results:} There were a total of 69,369 patients during the study period who presented to the ED. Despite resuscitation 189 (0.7%) died, the mortality rate was 2.43%. Cardiac-related (32%) and sepsis-related (31%) causes were the most common cause of death, 23.8% were due to preventable causes and 16.9% of which were due to inappropriate management. In patients with sepsis, the odds of death due to preventable causes were significantly high (odds ratio 4.31, 95% confidence intervals: 1.96–9.47; \(P < 0.001\)). \textbf{Conclusions:} Cardiac- and sepsis-related causes of death, together accounted for most of the mortality. In patients with sepsis, the odds of death due to preventable causes were more than four times higher than those without preventable causes.

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A number of such studies have been done in the West, but there is a paucity of data from tropical countries like India. The spectrum of diseases, associated comorbidities, and endemic pathogens in developing tropical countries differ from that in the West, infectious diseases being more common in the developing countries like India. Hence, the main causes of death and their preventability in the ED will also differ. The noncompliance of patients from developing countries is also an added factor affecting their morbidity and mortality. Hence, there is a need to obtain and study more data from the Indian subcontinent.

We, therefore, conducted this study to determine the cause and pattern of mortality and assess the preventability of deaths in our ED.
Methods

Study design and setting

This retrospective chart review was done in the adult ED of Christian Medical College, Vellore, which is a large tertiary care hospital in South India with 2700 inpatient beds. The adult ED has 49 beds with 75,000 admissions yearly. One hundred and eighty-nine patients, admitted to the priority 1 and 2 bays of our ED, who died despite treatment, during the study period of 1 year, (January 1, 2017–December 31, 2017) were recruited into the study. Patients who expired outside the ED (before arrival or after admission to the ward) were excluded. Investigators followed hospital policy of patient confidentiality, and data were collected from the hospital online medical records and the mortality register. Details of demographics, comorbidities, clinical presentation, examination findings, and the ED treatment given were noted. A datasheet was made using Microsoft Excel version 16, after which Statistical Package for the Social Sciences (SPSS Inc. Released 2015, version 23.0, Chicago, IL, USA.) was used to analyze the data collected. Two ED consultants blinded from each other, independently audited all the charts to determine preventable and nonpreventable causes of death. The preventability of deaths was determined on the basis of multiple factors including initial resuscitation, time of empiric antibiotics/antidotes/other life-saving drug administration, life-saving interventions (intubation, central line insertion, etc.), and handing over to appropriate specialty and their intervention.

The primary outcome of this study was to describe the mortality profile in the ED. The secondary outcomes were to determine the mortality rate, causes of death, seasonal patterns, preventable deaths, and the predictors of mortality in the ED. Categorical variables were described using frequencies and percentages, and continuous variables were divided into categories based on preventability. These variables were further considered as dependent and independent variables, and univariate analysis was performed to look for associations. Cross-tabs were made and evaluated using the Chi-square test or Fisher’s exact test for categorical variables and t-test or Mann–Whitney test for continuous variable as appropriate. Characteristics of preventable deaths were analyzed via univariate analysis, with calculation of 95% confidence intervals (CIs), and taking $P < 0.05$ as being statistically significant.

Patient confidentiality was maintained using identifiers and a password-protected access to the data for a limited number of individuals was maintained to ensure the protection of privacy. This study was approved by the Institutional Review Board.

Results

Patient demographics

During the year 2017, there were a total of 69,369 patients who presented to the ED. A total of 26,939 (38.8%) were admitted to either the priority 1 or 2 bays, among whom 189 (0.70%) died, despite resuscitation. The mortality rate was 2.43%, as illustrated in Figure 1. The mean age was 56.5 ± 7.01 years with a male predominance of 62.96%. Majority of the deaths were in priority 1 (80.95%). There was a higher frequency of deaths between 8 am and 8 pm as described in Table 1. A third (36.51%) of patients had no recordable pulse and blood pressure, a quarter (26.9%) were gasping and 35.98% who had a glasgow coma scale (GCS) <8 on presentation to the ED. The bulk of the causes for death were due to cardiac complications (32%) followed by sepsis (31%) as shown in Table 2. Alarmingly, 8.46% of patients did not have any comorbidity. Among patients with no known comorbidities, sepsis was the leading cause of death (50%).

![Strobe diagram](image-url)
The medical records of all the patients who died were independently audited by two ED consultants and preventability of the deaths was assessed on the basis of four criteria. These consisted of missed diagnosis, delayed diagnosis, inappropriate management, and lack of intensive care unit (ICU) beds. First three criteria were defined from the study by Lu et al., [9] whereas lack of ICU beds was found to be an added cause for preventability of deaths among patients in our cohort. The interrater reliability between the two observers was found to be good with an interobserver variability Cohen’s k coefficient of 0.86. There were 30 (15.8%) patients who had advanced directive for do not resuscitate order and were not included in this analysis. Among patients with preventable causes of death, 16.9% of them were estimated to be due to inappropriate management as described in Table 3. Characteristics of patients with preventable deaths were compared to the others, and the odds of preventable deaths due to sepsis were found to be significantly high (odds ratio [OR] 4.31, 95% CI: 1.96–9.47; P < 0.001) as compared to the odds of preventable deaths due to cardiac causes which were significantly low (OR 0.24, 95% CI: 0.08–0.65; P = 0.001) as illustrated in Table 3.

**Table 1: Baseline characteristics**

| Characteristic                | n (%)     |
|------------------------------|-----------|
| Mean age (years)±SD          | 56.5±17.01|
| Males                        | 119 (62.96) |
| Time of ED arrival           |           |
| 8 am-8 pm                    | 112 (59.26) |
| 8 pm-8 am                    | 77 (40.74)  |
| Mean time spent in ED (h)±SD | 4.34±4.16  |
| **Triage priority**          |           |
| Priority 1                   | 153 (80.95) |
| Priority 2                   | 31 (16.40)  |
| Priority 3                   | 5 (2.64)    |
| **Vital signs at presentation** |         |
| Pulse not recordable         | 69 (36.51)  |
| Pulse and BP not recordable  | 69 (36.51)  |
| Only BP not recordable       | 8 (4.23)    |
| Tachypnea (>20/min)          | 119 (62.96) |
| Gasping                      | 51 (26.98)  |
| Intubated                    | 8 (4.23)    |
| GCS <8                       | 68 (35.9)   |
| GRBS <60 mg%                 | 24 (12.67)  |
| GRBS ≥200 mg%                | 58 (30.69)  |
| SpO₂ ≤90%                    | 119 (62.96) |

ED: Emergency department, SD: Standard deviation, BP: Blood pressure, GCS: Glasgow coma scale, GRBS: General random blood sugar

**Table 2: Causes of death, preventable deaths, nonpreventable, and reasons for preventable causes**

| Characteristic                  | n (%)     |
|---------------------------------|-----------|
| Advance directive of DNR        | 30/189 (15.8) |
| Preventable causes              | 38/159 (23.8) |
| Not preventable causes          | 121/159 (76.1) |
| Reasons for preventable causes  |           |
| Missed diagnosis                | 0.38 (0) |
| Delayed diagnosis               | 7.38 (18.4) |
| Inappropriate management        | 27.38 (71.1) |
| Lack of ICU beds                | 4.38 (10.5) |
| **Causes of death**             |           |
| Cardiac causes                  | 61 (32)   |
| Sepsis                          | 58 (31)   |
| Aspiration                      | 4 (2)     |
| CVA                             | 12 (6)    |
| Trauma                          | 2 (1)     |
| Malignancy                      | 12 (7)    |
| DCLD/UGI bleed                  | 15 (8)    |
| COPD exacerbation               | 6 (3)     |
| Others                          | 19 (10)   |

DNR: Do not resuscitate, ICU: Intensive care unit, CVA: Cerebrovascular accident, DCLD: Decompensated chronic liver disease, UGI: Upper gastrointestinal, COPD: Chronic obstructive pulmonary disease

**Figure 2: Comorbidities of patients**

The study was conducted in a tertiary care hospital, with one of the largest EDs in India and attends to patients from all over the country. During the study period of 1 year, the mortality rate was 2.43%. This is much higher than those reported in Nepal (0.25%) and Pakistan (0.7%) which belong to the same region.[10,11] This might be due the large number of patients that are referred in critical conditions after being treated at other primary care centers.

Almost three-fourth of preventable causes of death in our study were attributed to improper management, which included a spectrum of, delay in initiation of treatment to noncompliance to evidence-based protocols. Lu et al. in a similar study in Taiwan reported that improper medical management accounted for 53% of preventable deaths.[9] Sepsis was the second most common cause of death in our study. In patients with sepsis, the odds of death due to preventable causes were more than four times higher than those without preventable causes. These findings highlight the need to improve the quality of care to the critically ill and the importance of evidence based medicine as shown by the International Multicentre Prevalence Study on Sepsis study which reported that the odds of inpatient death are significantly reduced by 40% among patients who received evidence-based care.
death was reduced by 40% in patients whose care included compliance to the 3-h sepsis guidelines.[4]

The finding of improper management can be explained by inadequate training and poor health care infrastructure causing overcrowding in the ED, which has shown to be associated with increased mortality.[12] India has a population of more than a billion people, yet a very poor distribution of qualified health workforce.[3] Furthermore, the recognition and training for a new specialty like EM in India has been grossly inadequate.[8]

Cardiac-related causes and sepsis were the leading cause of death, which is consistent with findings reported by other studies.[8,10,11] and also begs the need to treat these conditions aggressively and in a time-bound manner. More than a third of the patients who died had an unrecordable pulse, blood pressure, came gasping or intubated outside, and had a GCS <8. Hence, it might be beneficial to use scoring systems such as quick sequential organ failure assessment for sepsis[14] and Global Registry of Acute Coronary Events for acute coronary syndrome[15] which are based on vital signs at presentation and have shown to predict mortality. Almost half of all patients who died had diabetes and hypertension which represents the impact comorbidities have on mortality.

The limitation of our study was that it was conducted in a single tertiary care referral hospital, with many patients who are referred from smaller centers in critical conditions, so it may not be a fair representation of the population of an ED. Pediatric patients and those who died after discharge from the ED or after admission to the wards were not enrolled. There were several patients with incomplete documentation and autopsy data were not available to confirm preventable causes in patients without a diagnosis.

Conclusions

Our study showed that a vast majority of critically ill patients did not reach the ED and were brought dead; hence, there is a dire need to improve the currently substandard prehospital care in India. We recommend more aggressive ED management of the alarmingly high number of patients with no known comorbidities mostly dying of sepsis. We also recommend the EDs from the Indian subcontinent, with its varied spectrum of diseases, associated comorbidities and endemic pathogens and facing sepsis as a major cause of preventable deaths, be vigilant in identifying and appropriately managing these critically ill patients. This may prevent many from taking their last breath in the ED.

Research quality and ethics statement

The authors of this manuscript declare that this scientific work complies with reporting quality, formatting, and reproducibility guidelines set forth by the EQUATOR Network. The authors also attest that this clinical investigation was determined to require the Institutional Review Board/Ethics Committee review, and the corresponding protocol/approval number is IRB Min. No. 1028 dated December 4, 2017. We also certify that we have not plagiarized the contents in this submission and have done a plagiarism check.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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