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Role of surveillance and prevention in hospital acquired infection and mortality

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Abstract
Background: *Mortality analysis is important for health planning and resource allocation. These data are essential for low and middle-income countries like India. Globally, the adult mortality rate was 175.45 deaths per 1000 males and 121.19 deaths per 1000 females in 2018 whereas in India it was 204 death per 1000 for males and 147 deaths per 1000 for females. Tuberculosis, respiratory infections and diarrhoea form a large proportion of in-hospital deaths. Causes of death analysed through hospital mortality data can provide an idea about the epidemiological trends as they are complete and accurate.*
Methods: *We retrospectively analysed the records of all admitted patients who died in the Department of Medicine at All India Institute of Medical Sciences, New Delhi, between the periods of December 2017 to November 2018. Patients with age less than 14 years of age and those with incomplete records were excluded. Cause of death was classified into infectious, cardiovascular system, respiratory system, gastrointestinal system, neurological system and others.*
Results: *Out of 205 deaths, 132 (64.4%) were males with a mean age of 49.3 ± 16.2 years, and 73(35.6%) were females with a mean age of 48.2 ± 16.9 years. The interval between admission and deaths ranged from 2 hours to 74 days, with a median duration of 4 days. The leading causes of death were infectious and parasitic diseases (57.6%), cardiovascular (17.6%), gastrointestinal diseases (10.7%) and neurological diseases (4.9%).*
Conclusion: *In our study, infections were the most common cause of death (57.6%), followed by cardiovascular causes (17.6%). In-hospital complications like hospital/ventilator-associated pneumonia, catheter-associated urinary tract infections and acute coronary syndromes together cause 29.26% of deaths in the medical ward. Hospital derived mortality data are an important component of health statistics and regular auditing helps in policy making.*
Keywords: *Infectious disease, epidemiology, public health.*

Introduction

Data on causes of mortality is extremely valuable in obtaining the health statistics of a population as well as in planning further intervention strategies for public health. Population-based mortality data tells about the burden of disease. Death related

data also helps in assessing quality of care being provided. Accurate, complete and timely hospital mortality reporting is a key attribute of a functioning health system. It can support countries' efforts in transition to higher quality health systems in LMIC (low and middle income countries) enabling national and local advocacy, accountability and action[1]. Information on death events from India is recorded in the sample registration system (SRS), which is used to estimate mortality indicators. However, there is a need for a uniform system for publishing the death-related data by the hospitals. The gold standard for cause-of-death reporting is to have the cause certified by a medical practitioner using the rules and procedures of the International classification of diseases and related health problems (ICD), which is currently available in its tenth revision (ICD-10)[2,3].

According to data released by World Bank in 2018, the global mortality rate of males was 175.45 deaths per 1000 males, and for females, it was 121.19 deaths per 1000 females. In India, the adult mortality rate is 204 death per 1000 for males and 147 deaths per 1000 for females[4]. Although wide disparities exist in the levels of mortality across countries and regions, non-communicable diseases like ischaemic heart disease, cerebrovascular disease and stroke remain the most common cause of death in all WHO regions except Africa[5]. Hospital based mortality data show an increasing proportion of in-hospital mortality due to chronic diseases as compared to infections[6].

Hospital-based mortality data can provide us with common causes of death and their clinical and biochemical characteristics at presentation. These hospital-based data can be used to develop the hospital mortality model that will be used as a tool for measuring the burden of disease and healthcare quality. There is a lack of hospital-based data in literature from India. With this study, we aim to identify the causes of death in a medical ward of tertiary care hospital.

Materials and Methods

We retrospectively analysed the records of all the patients who died in the Department of Medicine at All India Institute of Medical Sciences, New Delhi, between the periods of December 2017 to November 2018. Causes of death were classified into different categories like infectious, cardiovascular, respiratory, gastrointestinal, neurological, genitourinary system, injuries, poisoning, and others. The infectious category included lower respiratory tract infections, urinary tract infections, and central nervous system infections. Patients with no localized source of infection associated with sepsis and multi-organ dysfunction were also classified under the infectious category. Others included diagnoses that could not be classified in the rest of the above-mentioned categories. Patients with age less than 14 years or those with incomplete data were excluded from the study. Out of 311 total deaths during the period, we excluded 106 subjects with incomplete records, and thus 205 subjects were included in this study. Our objective was to identify the primary cause of death amongst patients admitted to the medical wards. The outcome variables measured included demographic data, pre-existing illness, in-hospital course, laboratory values after admission and cause of death.

All the data collected were recorded in an Excel sheet. This data was analysed using Statistical Package for the Social Sciences (SPSS version 21.0). Continuous variables were presented as means ± standard deviation. Qualitative variables were expressed as proportions and percentages. Comparisons of categorical variables were performed using Chi-square test. A p-value of <0.05 was considered statistically significant.

Results

Out of 1330 admission, 311 deaths occurred from December 2017 to November 2018, with a gross death rate of 23.4% in a department of medicine ward. Out of 311 deaths, 205 deaths were included in the study. There were 132(64.4%) male deaths

with a mean age of 49.3 ± 16.2 years, and female deaths were 73 (35.6%) with a mean age of 48.2 ± 16.9 years. Out of 205 deaths, maximum deaths occurred in the age group of 46-60 years which was 64 (31.2%) followed by 60 (29.3%) deaths in the age group of more than 60 years (Table 1). At the time of admission, 60.5% of patients were on mechanical ventilation, 37.5% were on inotropic support, and 6.8% had post cardiopulmonary resuscitation. Sixty-three (30.7%) patients who died had diabetes, 48 (23.4%) had chronic kidney disease, and 42 (20.5%) were hypertensive at the time of admission. Some form of comorbidity was present in 74.6 % (153) of the patients. The interval between admission and deaths ranged from 2 hours to 74 days, with a median duration of 4 days. Out of 205 deaths, 67 (32.7%) deaths occurred within 48 hours of admission, and 29 patients (14.1%) died within 24 hours of admission (Table 2).

Most frequent complications or events that occurred during hospital stay before death were ventilator acquired pneumonia (VAP) or hospital-acquired pneumonia (HAP) (17.6%) followed by catheter-associated urinary tract infections (CAUTI) (6.3%). Eleven patients developed acute coronary syndrome (ACS), and six patients developed deep venous thrombosis (DVT) during hospitalization (Figure).

The causes of death were classified into different categories depending on the aetiology and system involved. Overall, leading causes of death were infectious and parasitic diseases (57.6%), cardiovascular (17.6%), gastrointestinal diseases (10.7%), neurological disorders (4.9%), and genitourinary diseases (3.4%). Lower respiratory tract infections (LRTI) (20.5%), sepsis (12.7%), urinary tract infections(UTI) (7.3%), tuberculosis (4.9%) and vector-borne diseases (2.4%), including malaria and dengue, were the most common infectious causes. Among cardiovascular causes, acute coronary syndrome (5.3%) was the leading cause. Chronic liver disease (3.4%) and intraventricular haemorrhage (1.4%) were the leading causes of death under gastrointestinal and neurological causes, respectively (Table 3).

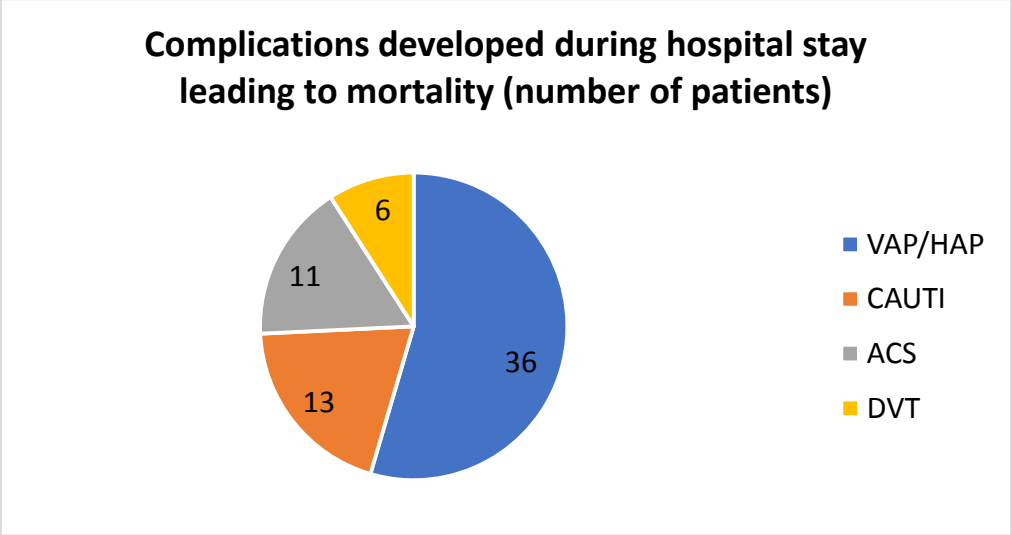

Figure: Frequent complications/events among patients during the hospital stay.

VAP, ventilator associated pneumonia;
HAP, hospital-acquired pneumonia;
CAUTI, catheter associated urinary tract infection;
ACS, acute coronary syndrome;
DVT, deep vein thrombosis.

Table 1: Demographic profile of patients

Profile	**No. of patients (%) n = 205**
Gender	
Males	132 (64.4%)
Females	73 (35.6%)
Age group (years)	
14-30	38 (18.5%)
31-45	43 (20.9%)
46-60	64 (31.2%)
>60	60 (29.3%)
Mean age (years)	Mean ± SD
Males	49.3 ± 16.2 years
Females	48.2 ± 16.9 years

Table 2: Patient profile at the time of admission

	No. of patients (%) n = 205
On mechanical ventilation	124 (60.5%)
On vasopressors	77 (37.5%)
Post Cardiopulmonary resuscitation	14 (6.8%)
Diabetes mellitus	63 (30.7%)
Chronic kidney disease	48 (23.4%)
Hypertension	42 (20.5%)
Death within 24 hours	29 (14.1%)
Death within 48 hours	67 (32.7%)

Table 3: The causes of death among patients

Causes of death	**No. of patients (%) n = 205**
Infectious causes	118 (57.6%)
Lower respiratory tract infection	42 (20.5%)
Sepsis	26 (12.7%)
Urinary tract infections	15 (7.3%)
Tuberculosis	10 (4.9%)
Vector-borne diseases	5 (2.4%)
Others	20 (9.8%)
Cardiovascular causes	36 (17.6%)
Acute coronary syndrome	11 (5.3%)
Cardiomyopathy	11 (5.3%)
Rheumatic heart disease	4 (1.9%)
Pulmonary embolism	3 (1.4%)
Others	7 (3.4%)
Gastrointestinal causes	22 (10.7%)
Chronic liver disease	7 (3.4%)
Acute liver failure	6 (2.9%)
Upper GI bleed	6 (2.9%)
Others	3 (1.4%)
Neurological causes	10 (4.9%)
Intraventricular haemorrhage	3 (1.4%)
Status epilepticus	3 (1.4%)
Ischemic stroke	2 (0.98%)
Others	2 (0.98%)
Genitourinary causes	7 (3.4%)
Chronic kidney disease	5 (2.4%)
Glomerulonephritis	2 (0.98%)
Other causes	12 (5.8%)

Discussion

In our study, mortality among males (64.4%) was higher than in females (35.6%). Many previous studies have also shown that males have higher in-hospital mortality than females[7,8]. This is not surprising considering that males have a lower life expectancy[9].

Our study shows that maximum deaths occurred in the age group of 46-60 years among both males and females with a similar mean age at time of death. In a study in medical wards of a hospital of Nigeria, 34.3% of patients were in the age group of 40-60 years[10]. Another study by Khare et al from Madhya Pradesh, India also reported the maximum number of in-hospital deaths among 45 years and above aged patients[11].

In our study, infectious causes were found to be the leading primary cause of death(57.6% of cases), followed by cardiovascular causes (17.6%). Among infections, lower respiratory tract infections (LRTI) were the most common cause of death. Infections and sepsis syndrome arethe most common primary cause of death worldwide as well as in India. An audit of mortality among armed forces hospital also found infectious causes (33%) followed by respiratory diseases (17%) to be the leading cause of death[12]. A study analysing patterns of mortality among cancer patients also found infections as the most common cause of immediate death[13]. Lower respiratory tract infections (LRTI) and sepsis were the common infections among our patients. An analysis of the global burden of disease study, 2015 (GBD) also shows that the burden of LRTI among adults aged more than 70 years is gradually increasing[14]. Treatment of LRTI has also become complicated due to new agents and increasing antibiotic resistance. The worrying rise in incidence of sepsis has prompted WHO to call for global action against this problem[15].

Cardiovascular causes were the most common non-infectious cause of primary death in our study (17.6%) with 5.3% of total patients having an in-hospital myocardial infarction. This is in accordance with the Medical Certification of Cause of Death (MCCD) report (which publishes the national mortality data in India)in which diseases of the circulatory system were the most common cause of death (33.1% in males and 32.6% in females) in 2018[16]. Godale L found that an increasing proportion of deaths were attributable to cardiovascular causes over her study in Solapur over 5 years[7]. This change is due to changing behaviour and lifestyle patterns. Gastrointestinal and neurological causes were other causes of death in this category.

Nosocomial infections are important risk factors for mortality. VAP/HAP is a preventable complication. In our study, 36 (17.6%) patients who died had hospital or ventilator acquired pneumonia. Various literature reports the presence of VAP/HAP as a risk factor for increased mortality. Sopena et al. in their study reported a mean incidence of HAP of 3 +/- 1.4 cases per 1,000 hospital admissions[17]. A study by Werarak et al concluded that 24.7% of admitted patients developed HAP and 75.3% developed VAP, with most patients having late-onset HAP/VAP[18]. CAUTI was the next common nosocomial infection which has been shown to increase morbidity and mortality[19,20].

Diabetes (30.7 %) followed by chronic kidney disease (in 23.4% patients) was the most common comorbidity at the time of admission. A comorbidity was present in 74.6 % of patients. Ayaz T in his study found that the presence of a comorbidity i.e. diabetes, hypertension, kidney disease etc. is significantly associated with an increased risk of mortality among a geriatric population[21]. The altered physiology as well as a relatively immunosuppressed state explains the increased mortality and morbidity in such patients.

Hospital mortality statistics and its trend are a rich source of information and can help to recognize the inadequacies in processes involved in patient care which can be used for reducing in-hospital mortality. There is a need for a uniform system for publishing the death-related data by the hospitals which, when compiled at the state and national level can help to sculpt a mortality model.

The limitation of this study was its small sample size. Being a super speciality hospital, admitted patients are segregated to different departments; hence data from the Department of Medicine might not be representative of the entire hospital.

Conclusion

Regular surveillance of hospital mortality data helps in determining the quality of health care provided as well as in predicting disease trends over a long term. Accurate hospital-based mortality data is a valuable source of information in health planning and policy making.

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