Audit of in-hospital mortality by age and time-of-day among patients presenting to a low-resource Ugandan hospital

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ABSTRACT

Introduction: Admission to hospital outside of normal working hours is consistently associated with poorer patient outcomes. Our aim was to determine the association of patients' age and time of presentation to a low-resource Ugandan hospital with admission rate and in-hospital mortality.

Method: Prospective observational non-interventional audit in the emergency and outpatient departments of Kitovu Hospital in Uganda, a low-resource sub-Saharan hospital. Data on age, sex, time of admission was collected from all non-pregnant patients during 2020 and 2021, and outcomes analysed.

Results: Out of 17,133 patients who presented to the hospital 189 died in hospital (1.1% of all presentations and 7.9% of all admissions); 46 (24.3%) patients died within 24 hours of arrival (0.3% of all presentations and 1.9% of all admissions). Deaths within 24 hours of arrival in hospital were more likely in the very young and the old, and in those who presented at night and on the weekend.

Conclusion: As many in-hospital deaths occur shortly after arrival, resuscitation skills are needed even in low-resource settings for as much of the 24-hour day as possible.

Key words: Out-of-hours presentation, hospital mortality, hospitalization

INTRODUCTION

Providing 24-hour care seven days a week is especially challenging for low-resource hospitals in sub-Saharan Africa. Admission to hospital on weekends and/or outside of normal working hours is consistently associated with poorer patient outcomes.[1-4] This audit compared the patients admitted to a low-resource Ugandan hospital and their mortality according to their age, sex, and time of presentation

The objective of the study is to determine the association of patients' age and time of presentation to a low-resource Ugandan hospital with admission rate and patient mortality

METHOD

Study design and Setting

This prospective observational study, which is part of an ongoing audit process, was performed in the emergency and outpatient department of Kitovu Hospital, which has 248 beds (50 medical and 35 surgical) and is located near Masaka, Uganda, 140km from the capital city of Kampala. It is a private not-for-profit (PNFP) hospital, accredited by the Uganda Catholic Medical Bureau.

Most emergency medical care is provided by recently qualified doctors (i.e.,

within 3 years of graduation) assisted by clinical officers (i.e., non-physician clinicians). The emergency (ED) and outpatient departments (OPD), which care for all patients attending the hospital except those attending the obstetric department, are located beside each other, sharing a common entrance. Clinical staff move between them as needed. The ED is open 24 hours a day, and the OPD from 9 am to 5 pm. During the day the combined departments are staffed by at least two clinical officers and a doctor, and at night one doctor is first on-call and supported by two others who are second and third on-call.

Participants and study process

Participants were all non-pregnant patients who presented between 23rd November 2020 and 31st October 2021. During the day, a dedicated researcher entered patients' age, sex, date, and time of arrival into an Excel database (Version 2102, Microsoft Corp., Redmond, WA). At night, this information was recorded by the nurse on duty and entered in the database the following morning. The subsequent immediate disposition of each patient was also recorded (i.e., admitted, discharged, or died while in the emergency department), and hospital records were then reviewed to identify patients who died while in hospital.

Statistical methods and data analysis

The admission and mortality rates according to patient age, time of day, day of week, and month of presentation were graphed, and the ages and times with the lowest admission rates were identified by visual inspection. Two different denominators were used to assess mortality: for death occurring on the day of presentation (i.e., within 24-hours) all patient presentations to the hospital were used as the denominator, whereas for deaths after 24-hours the denominator was the number of patients admitted. Numeric variables were compared using Student's t-test and the unadjusted odds ratios of categorical variables with admission rate and mortality were compared using chi squared analysis with Yates' continuity correction; calculations were performed using Epi-Info version 6.0 (Centre for Disease Control and Prevention, USA). The p-value for statistical significance was 0.05. Adjustment of odds ratios was performed using Logistic software.[5]

Ethics

Ethics Ethical approval of the study was obtained from the Scientific Committee Kitovu Hospital. The study conforms to the principles outlined in the Declaration of Helsinki.

Limitations

This study was performed in a single centre and there was no follow-up of patients after hospital discharge. We did not record the number of patients who attended repeatedly or who had chronic conditions.

RESULTS

During the study period of 341 days 17,133 patients (50.2 per day) presented to the hospital's OPD or ED; their mean age was 38.0 (SD 23.4) years, 14% were younger than 10 years, 8% 10 to 19 years old, 35% 20 to 39 years, and 43% over 40 years of age). About 7,010 (40.9%) were male, and 2,400 patients (14%) were admitted to hospital.

One hundred and eighty-nine patients died (1.1% of all presentations and 7.9% of all admissions); 46 patients died within 24 hours of arrival (0.3% of all presentations and 1.9% of all admissions) and 143 patients died more than 24 hours after admission to hospital (0.8% of all presentations and 6.0% of all admissions).

Patients who were admitted were only slightly older than those not admitted [39.0 (SD 28.4) versus 37.8 (SD 22.4) years, p-value 0.02). Men were more likely to be admitted than women (odds ratio 1.75, 95% CI 1.60 – 1.91 p-value <0.0001), even though men who were admitted were significantly younger than women admitted [36.7 (SD 27.9) versus 41.7 (SD 28.8) years, p-value <0.0001). Of the 2,338 children below 10 years of age who presented to the hospital 563 (24.1%) were admitted, after 40 years of age the chance of admission increased from 10% to >30% for patients ≥ 90-year-olds (Figure 1).

Most patients (82.6%) presented between 9 am and 5 pm. The lowest chances of admission were observed in patients between 20 and 40 years of age (7.9%) (Figure 1), those presenting between 8 am and 12 noon (6.3%) (Figure 2), and those presenting from Monday to Thursday (11.3%). As there was a surge in admissions attributable to COVID-19 before February 2021 and between May and July, 2021 the lowest admission rates were observed from February to April 2021 and from August to October 2021. Patients admitted between these age groups and

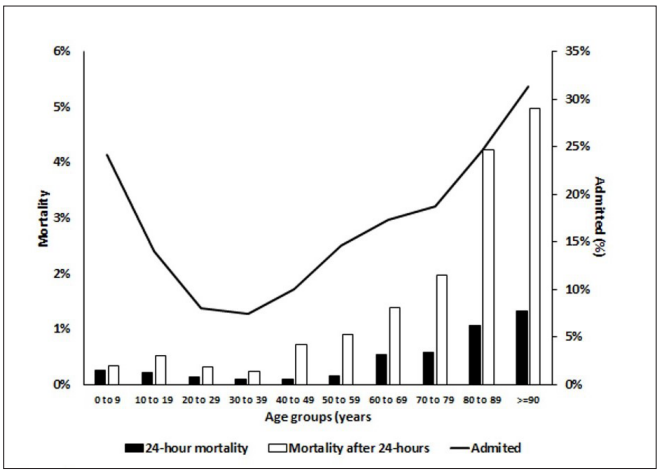

Figure 1. Mortality and admission rates by age at presentation

Table 1. Patients admitted, died within 24 hours of presentation, and died more than 24 hours after hospital admission

		Of 17,133 patients presenting n (%)	Admitted to hospital n (%)	Died in hospital within 24 hours n (%)
Sex	Female	10123 (59.1)	1133 (11.2)	20 (0.2)
	Male	7010 (40.9)	1267 (18.1)	26 (0.4)
Age	20-40 years	6287 (36.7)	495 (7.9)	8 (0.1)
	<20 or >40 years	10846 (63.3)	1905 (17.6)	38 (0.4)
Time	8:00 am to 12:00 noon	11331 (66.1)	718 (6.3)	11 (0.1)
	12:01 pm to 7:59 am	5802 (33.9)	1682 (29.0)	35 (0.6)
Day	Monday to Thursday	12763 (74.5)	1448 (11.3)	25 (0.2)
	Friday to Sunday	4370 (25.5)	952 (21.8)	21 (0.5)
Month	February to April or August to October	9414 (55.0)	1094 (11.6)	13 (0.1)
	November to February or May to July	7719 (45.0)	1306 (16.9)	33 (0.4)
		Of 2,400 patients admitted n (%)	**Died in hospital after 24 hours n (%)**	
Sex	Female	1133 (47.2)	90 (7.9)	
	Male	1267 (52.8)	53 (4.2)	
Age	20-40 years	495 (20.6)	19 (3.8)	
	<20 or >40 years	1905 (79.4)	124 (6.5)	
Time	8:00 am to 12:00 noon	718 (29.9)	37 (5.2)	
	12:01 pm to 7:59 am	1682 (70.1)	106 (6.3)	
Day	Monday to Thursday	1448 (60.3)	84 (5.8)	
	Friday to Sunday	952 (39.7)	59 (6.2)	
Month	February to April or August to October	1094 (45.6)	44 (4.0)	
	November to February or May to July	1306 (54.4)	99 (7.6)	

time periods also had a lower risk of death within 24 hours of presentation and, for those admitted, a lower chance of death more than 24 hours after hospital admission (Table 1).

After adjustment for age, time of presentation and sex, the chance of death within 24 hours increased six-fold for presentation between 8 am and 12 noon and nearly two-fold for presentation between Friday and Sunday. However, after adjustment, neither time of day nor day of the week were associated with mortality 24 hours after hospital admission. After adjustment men were not more likely to die within 24 hours, but women were after 24 hours (Table 2).

The deaths within 24 hours accounted for 24% of all in-hospital deaths, the rate of which subsequently fell exponentially with the last death recorded 31 days after admission. Although only 412 patients (2.4%) presented between midnight and 7am, 280 (68%) were admitted and these patients had the highest chance of dying (4.1%) within 24 hours of arrival; indeed, 17 of their 29 deaths (58.6%) occurred within 24 hours and accounted for 34.8% of all deaths within 24 hours (Figure 2).

Patients who died were older [56.6 (SD 26.5) versus 37.8 (SD 23.3) years, p-value (<0.0001)], regardless of whether they died within 24 hours of presentation [52.1 (SD 29.1) versus 38.0 (SD 23.3) years, p-value <0.0001], or more than 24 hours after admission [58.0 (SD 25.6) versus 37.8 (SD 28.2) years, p-value <0.0001]. There was no significant difference between the ages of men and women who died [52.7 (SD 26.7) versus 59.4 (SD 26.1), p-value 0.0900].

DISCUSSION

Main findings

Nearly a quarter of the patients who died in hospital did so within 24-hours of arrival to the hospital. These deaths were more likely in the very young and old, and in

Table 2. Crude (cOR) and adjusted odds ratio (aOR) of admission, death within 24 hours of presentation and death more than 24 hours after admission to hospital.

Hospital admission after presentation (N=17,133)					
		cOR	**(95% CI)**	**aOR**	**(95% CI)**
Sex	Female	(reference)			
	Male	1.75	(1.60 - 1.91)	1.61	(1.46 - 1.76)
Age	20-40 years	(reference)			
	<20 or >40 years	2.49	(2.24 - 2.77)	2.80	(2.51 - 3.13)
Time	8:00 am to 12:00 noon	(reference)			
	12:01 pm to 7:59 am	6.03	(5.48 - 6.65)	5.96	(5.41 - 6.57)
Day	Monday to Thursday	(reference)			
	Friday to Sunday	2.18	(1.98 - 2.39)	1.79	(1.62 - 1.98)
Month	February to April or August to October	(reference)			
	November to February or May to July	1.55	(1.42 - 1.69)	1.41	(1.28 - 1.55)
Death within 24 hours of presentation (N=17,133)					
		cOR	**(95% CI)**	**aOR**	**(95% CI)**
Sex	Female	(reference)			
	Male	1.88	(1.01 - 3.52)	1.63*	(0.91 - 2.93)
Age	20-40 years	(reference)			
	<20 or >40 years	2.76	(1.23 - 6.45)	2.73	(1.27 - 5.88)
Time	8:00 am to 12:00 noon	(reference)			
	12:01 pm to 7:59 am	6.25	(3.03 - 13.14)	5.39	(2.71 - 10.71)
Day	Monday to Thursday	(reference)			
	Friday to Sunday	2.46	(1.32 - 4.58)	1.85	(1.03 - 3.33)
Month	February to April or August to October	(reference)			
	November to February or May to July	3.10	(1.57 - 6.25)	2.70	(1.42 - 5.14)
Death after 24 hours in 2,400 patients admitted to hospital					
		cOR	**(95% CI)**	**aOR**	**(95% CI)**
Sex	Female	(reference)			
	Male	0.51	(0.35 - 0.73)	0.52	(0.37 - 0.74)
Age	20-40 years	(reference)			
	<20 or >40 years	1.74	(1.04 - 2.97)	1.69	(1.03 - 2.78)
Time	8:00 am to 12:00 noon	(reference)			
	12:01 pm to 7:59 am	1.24	(0.83 - 1.86)	1.22*	(0.82 - 1.79)
Day	Monday to Thursday	(reference)			
	Friday to Sunday	1.07	(0.75 - 1.54)	1.09*	(0.77 - 1.53)
Month	February to April or August to October	(reference)			
	November to February or May to July	1.96	(1.33 -2.88)	1.92	(1.33 - 2.77)

** = not statistically significant*

95% CI = 95% confidence interval

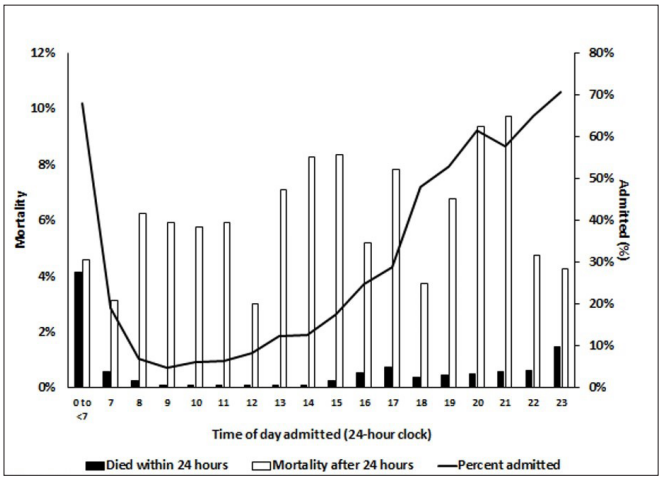

Figure 2. Mortality and admission rates by time of day of presentation.

those who presented to the hospital at night and on the weekend. However, after adjustment for age, sex and all times of presentation, in-hospital mortality 24 hours after admission to hospital was not associated with the time of day or day of the week of presentation but was associated with months of presentation, age, and female sex.

Interpretation

Unsurprisingly, very young and older patients were more likely to die, and patients arriving to the hospital were probably sicker during the two peaks of the COVID-19 pandemic before February and between May and July 2021. The precise number of patients who had COVID-19 during these periods can only be estimated, because the number of antigen tests available was limited. Others have reported that men are more likely to present to hospital out-of-hours than women [3] and that, after adjustment for age and sex, weekend admissions were associated with early but not late in-hospital deaths.[6] However, these increases in mortality for out-of-hours and weekend admissions are small and not the two to six-fold increases we observed.

Clinical significance

It is debateable if out-of-hours mortality we observed was higher because the patients were sicker or the quality of care provided at these times was lower.[1,4] Anyone can become acutely ill at any time, and the efficacy of most treatments for acute life-threatening illnesses are time dependent and must be delivered within minutes. Many deaths can be prevented if the causes of poor perfusion and oxygenation are identified and promptly corrected. Our results highlight the need for these resuscitation skills [7] to be available, even in a low resource setting, for as much of the 24-hour day as possible.

CONCLUSION

As many in-hospital deaths occur shortly after arrival, resuscitation skills are needed even in low-resource settings for as much of the 24-hour day as possible.

Funding and Conflict of interest statement

All costs were borne by the authors. John Kellett is a major shareholder of Tapa Healthcare DAC. The other authors have no potential conflicts of interest.

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