CCSO Critical Care Services Ontario

IS THERE AN ASSOCIATION BETWEEN ADMISSION TIME AND MORTALITY IN INTENSIVE CARE UNITS IN ONTARIO?

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BACKGROUND

The resources needed to provide optimum care to critically ill patients admitted to intensive care units (ICUs) are a 24-hour a day responsibility. However, resources and staff availability after hours and over the weekends may vary. Previous studies have shown that patients who are admitted to ICU after hours and over the weekends are more likely to die[1,2]. However, this association is still not well established and remains controversial[4]. Some of the factors associated with mortality were identified as differences in organization of work shifts, presence of intensivist on site, ratio of caregivers to patient, closed or open ICU models.

In Ontario, all medical-surgical Level-3 ICUs are Intensivist-led closed units. In this population based study, we reassessed the association between time of admission and in-hospital mortality among adult patients (≥ 18 years) treated in ICUs in acute care hospitals of Ontario. The results from this study will help in better planning of capacity, and inform other systematic improvements that may eradicate after hours and weekend effect.

AIM

The purpose of this study was to investigate whether mortality rates of adults admitted to ICUs differed by time of admission, i.e., between weekdays, after hours and weekends.

METHODS

Data were obtained from the Critical Care Information System (CCIS), a provincial critical care near-real-time database in which 203 critical care units across 111 hospitals in Ontario enter data daily. CCIS is the most comprehensive source of province-wide information on access to critical care, quality of care, and outcomes for critically ill patients. Current study selected all 67 medical-surgical Level-3 ICUs.

Adult patients admitted between July 1st 2013 and June 30th 2018 with multiple organ dysfunction score (MODS) recorded at admission were included in this study. The in-hospital mortality risk was assessed with admissions on weekdays (Monday to Friday) and daytime compared to weekends and afterhours:

Daytime (Mon-Fri, 7:00-21:59)
After hours (Mon-Fri, 22:00-6:59)
Weekend (Sat 7:00 - Mon 6:59)

Severity of illness at admission was assessed using MODS. Age, gender, time and date of ICU admission, incidence of ventilator associated pneumonia (VAP) and central line infection (CLI) were extracted for each patient. Descriptive analysis was done for frequencies and percentages for categorical variables; and means, medians and standard deviations for continuous variables. Chi-square tests were done to compare the categorical variables. ICU mortality was calculated from the time of admission to the time of death from any cause was modeled using Poisson regression model, presented as Forest plot. The variables used as risk factors to adjust modeling death were: MODS, VAP, CLI, age, gender and hospital type. Analysis was performed using SAS version 9.4.

RESULTS

Data:

Between July 2013 and June 2018, 286,775 patients were admitted in ICUs of Ontario. Of those, 44% were female and 56% were male (Figure 1). About 55.6% of the admissions were during the daytime hours, 21.9% were during after hours, and 22.4% during the weekend.

Bivariate Analysis:

ICU Mortality

The median MODS score for patients admitted after hours and on weekends was significantly higher as compared to those admitted during regular hours (4 vs. 2). Similarly, the median MODS score was significantly higher for patients who did not survive (6 vs. 3) as compared to those who survived (Figure 2). The crude ICU mortality was significantly higher for those admitted during the weekend and after hours as compared to those admitted during regular hours (16.0% and 14.8% as compared to 13.5%, p = < .0001), [Table 1]. Age, gender, developing VAP, CLI in ICU and whether patient was admitted in teaching or community hospital were significantly associated with mortality.

Multicollinearity

Although the association test significant for ICU admission time with age, gender and hospital type, the lower correlation analysis (ρ<0.15) indicated there is no multicollinearity in the analysis [Table 1].

Figure 1. Number of admissions by age group and gender

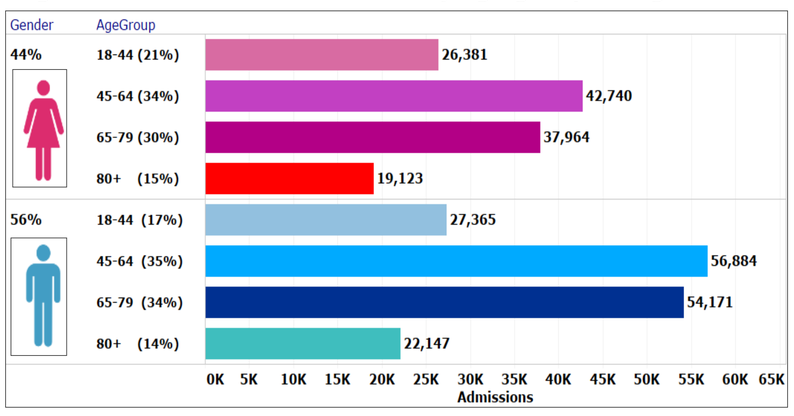
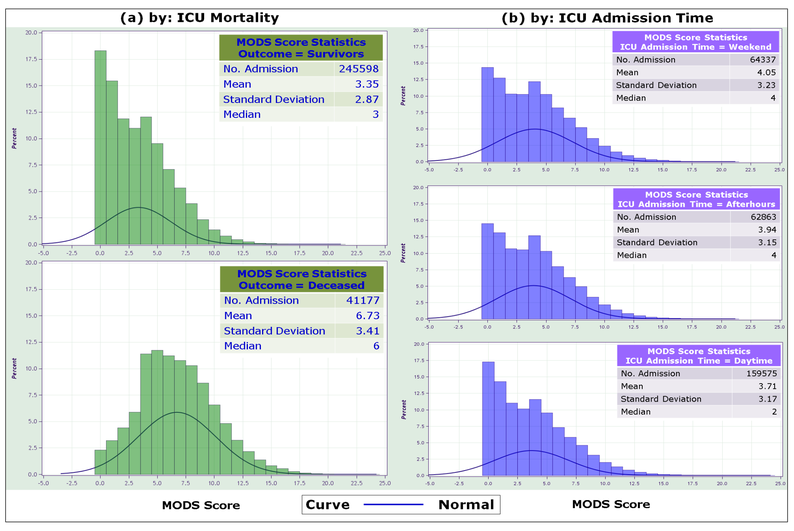


Figure 2. MODS score at admission and by patient outcome



Multivariable Analysis:

Poisson regression model of ICU mortality related to admission hours adjusted by MODS, VAP, CLI, age, gender and admission hospital type showed that patients admitted during weekends had significantly higher odds of dying (OR 1.13, 95%CI [1.10, 1.16]) followed by those admitted after hours (OR: 1.08 95%CI [1.05, 1.11]) as compared to patients who were admitted during daytime hours (Figure 3).

Adjusted MODS showed higher MODS at admission had significant mortality to lower MODS patients (OR: 1.38 [1.37, 1.39]).

The odds of dying significantly increased if the patient had developed VAP (OR:1.28 [1.06, 1.54]) or developed CLI (OR:1.31 [1.05, 1.63]) during the ICU stay.

The odds of dying also increased if the patient was admitted in teaching hospital ICU (OR: 1.13 [1.1, 1.15]) as compared to that in community hospital.

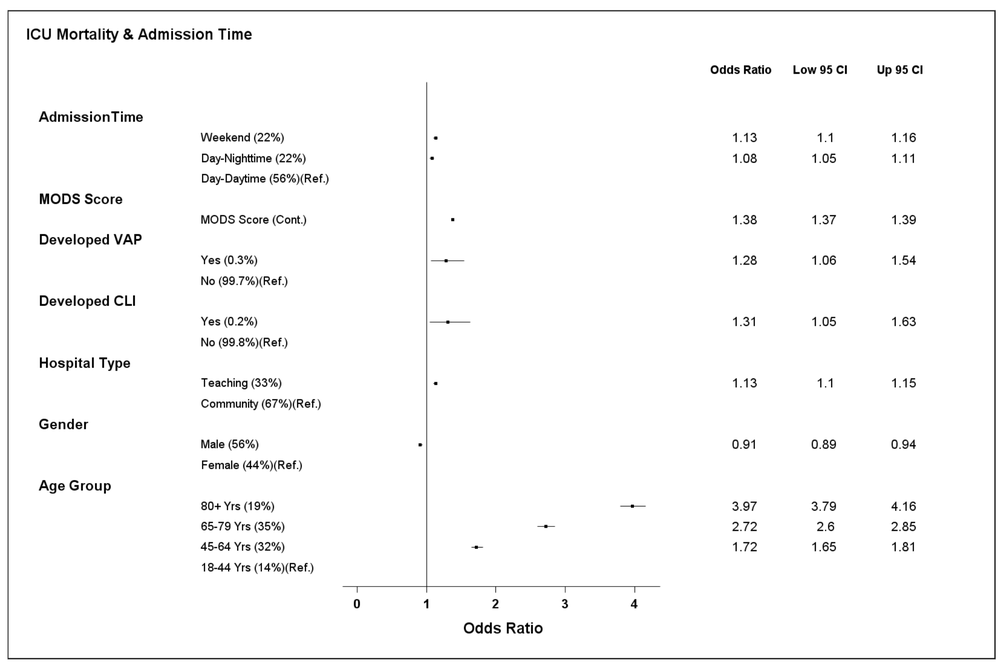
The odds dying for male patients who were admitted afterhours was lower as compared to women (OR: 0.91 [0.89, 0.94]).

Patients' age significantly increased the odds of mortality.

Table 1. Association of patient characteristics with ICU mortality and time of ICU Admission

Variable	Association with ICU Mortality N % (Deceased=41177)	Association with ICU Mortality X^2 Test (p-value)	Association with ICU Admission Time N % (Afterhours=62863)	Association with ICU Admission Time N % (Weekend=64337)	Association with ICU Admission Time X^2 Test (p-value)
Time of Admission					
- Daytime (Mon-Fri, 7:00-21:59)	21,579 (13.5%)	236			
- Afterhours (Mon-Fri, 22:00-6:59)	9,331 (14.8%)	(<.0001)*			
- Weekend (Sat 7:00 - Mon 6:59)	10,267 (16.0%)				
Age Group					
- 18-44	2,901 (7%)	4341	10,136 (24.6%)	9,834 (23.8%)	479
- 45-64	10,980 (11.9%)	(<.0001)*	20,265 (22.0%)	20,368 (22.1%)	(<.0001)*
- 65-79	16,103 (16.2%)		20,638 (20.7%)	21,606 (21.7%)	
- 80+	11,193 (20.8%)		11,824 (22.0%)	12,529 (23.3%)	
Gender					
- Female	17,859 (14.2%)	7.94	28,025 (22.2%)	28,129 (22.3%)	11.3
- Male	23,318 (14.5%)	(0.0048)*	34,838 (21.7%)	36,208 (22.6%)	0.0036*
Developed VAP During Stay					
- Yes	177 (23.9%)	55.44	162 (21.9%)	179 (24.2%)	1.48
- No	41,000 (14.3%)	(<.0001)*	62,701 (21.9%)	64,158 (22.4%)	(0.477)
Developed CLI During Stay					
- Yes	145 (28.9%)	86.8	110 (22.0%)	111 (22.2%)	0.023
- No	41,032 (14.3%)	(<.0001)*	62,753 (21.9%)	64,226 (22.4%)	(0.988)
Hospital Type					
- Teaching	15,949 (16.9%)	725	21,936 (23.2%)	20,540 (21.7%)	146
- Community	25,228 (13.1%)	(<.0001)*	40,927 (21.3%)	43,797 (22.8%)	(<.0001)*

Figure 3. Comparison of patient characteristics and ICU mortality



CONCLUSIONS

This study used data from all 67 medical-surgical level 3 ICUs in Ontario.

Admissions during after hours and weekends are common. We found a significant association between ICU mortality and ICU admission time which are aligned with some of the previous studies. Odds of ICU mortality was significantly higher for patients who were admitted during afterhours and during weekend hours. Our analysis showed that the odds of dying is highest for patients admitted during the weekend hours.

There maybe two possible reasons for the observed increased mortality during after hours and weekends. First, patients admitted during after hours and weekends had higher illness severity. Second, the lower number of staffing and resources available at most hospitals and, therefore, lower intensity of care provided during after hours and weekends may explain this finding.

RECOMMENDATIONS

Further research should focus on evaluating modifiable factors such as staffing structure, organizational model, capacity and ICU protocols to introduce improved guidelines in critical care delivery.

The individual hospital level analysis maybe performed to improve ICU mortality during afterhours and weekends.

Further research may also be performed to investigate further weekend admissions and afterhours admissions separately.

In order to better understand the underlying reasons behind variations in mortality across the week, further analysis of mortality by cause and service quality indicators would be required.

REFERENCE

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ACKNOWLEDGEMENT

To the dedicated staff at Critical Care Services Ontario and CritiCall Ontario for their contributions to this work and their constant efforts to improve access, quality and system integration across critical care services in Ontario.

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