RESEARCH ARTICLE

Feasibility of Routine Data Collection on Intensive Care Unit Performance and Activity in Resource Limited Settings

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Background: Routine collection and analysis of data allows a critical care department to highlight the outcomes of the interventions done and to identify the grounds for improvement. Data on characteristic and outcomes of patients admitted in intensive care units (ICUs) are lacking.

Methods: A software (ICU e-monitoring®) was designed to enter for each patient demographic data, SAPS3 on admission, Nine Equivalent Manpower Use Score, presence of medical devices and episodes of hospital acquired infections. We report data collected during 2014 with comparison to data collected with the same methodology in 2008 [1].

Objective: To determine the standardized mortality ratio, the mean length of ICU stay, mean length of mechanical ventilation and ICU acquired infection incidence rate.

Study design: Descriptive

Place of study: Medical ICU, Pakistan Institute of Medical Sciences Islamabad

Results: A total of 196 admissions were recorded during the year 2014 vs 354 in 2008. 47.2% were males and 52.8% were females. Mean age was 32.1 years ± 15.3 SD (37.7 ± 18.9 SD in 2008). A total of 65 (33%) deaths were recorded during the year and standardized mortality ratio was found to be 0.71 vs 1.09 in 2008. Mean Length of stay was 15.9 Days ± 12.9 SD (9.3 days ± 8.9 in 2008) and mean duration of mechanical ventilation was found to be 12.04 Days (8.7 in 2008). Overall ventilator associated pneumonia (VAP) rate was 42.3 cases per 1000 ventilator days. Rate of Catheter Related Blood Stream Infections (CRBSI) was found to be 17.2 cases per 1000 CVC days.

Conclusion: Major changes in our patient population characteristics were seen between 2008 and 2013: number of patients and standardized mortality was decreased while incidence of VAP and CRBSI was increased. It is possible to collect meaningful data on ICU performance and activity in resource limited settings.

Keywords: Intensive Care Unit; Mortality; Feasibility

There is an enormous amount of technical data continuously generated within the intensive care environment that necessitates its presentation in an informative manner [1]. Manual recording and charting often prove inefficient both in terms of nursing time and the quality of patient record produced. It is now becoming a common belief that creating a less paper environment by replacing manual charting with digital documentation system allocates more time for patient centered care which is becoming a key focus to in delivering healthcare services in an ICU [2-3]. Contrary to that, it was also detected that after the implementation of a digital clinical information system (CIS), an increase in the time nurses spent on documentation of care [4]. Due to such discrepant observations there is a need for a meticulous experiential research in this area to improve these systematic data collection programs with more focus to sparing time for patients' care. Nonetheless, the capability to scientifically and logically link physiological monitors and other selected data sets into an organized and analyzable database holds remarkable promise for improving patient safety, care and clinical outcomes in the intensive care unit [5]. Rapid advances in computer development have brought powerful computers within the financial reach of individuals and small intensive care units and the number of operating rooms and intensive care departments equipped with a CIS is increasingly growing [6-7]. However, adequate planning of the microcomputer system along with its chalked-out quality assurance program must precede its implementation in order to minimize the computer related errors [8-9]. Although

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critical care medicine is a rapidly growing specialty around the globe, yet is poorly recognized as a medical specialty in resource limited health systems. "Intensive care medicine between 2000 and 2010", a French-Pakistani cooperation program in intensive care medicine was launched between the Pakistan Institute of Medical Sciences (PIMS), a tertiary care teaching hospital in Islamabad, Pakistan and the medical intensive care unit (MICU) of Saint Antoine hospital in Paris, France. It certainly enables patients needing intensive care to understand the various difficulties posed in Pakistan, the weaknesses of the health scheme and the slow development of this medical specialty [10]. Sustainability of the results achieved by this cooperation program is still questionable, yet it achieved the recognition of intensive care medicine as a medical specialty and young doctors are now joining specific training programs. Routine information collection and analysis is thought to enable critical care department to highlight the results of previous interventions and identify the basis for future enhancement. Pakistan lacks data on the characteristics and results of ICU patients It is believed that routine collection and analysis of data allows critical care department to highlight the outcomes of past interventions and to identify the grounds for future improvement. Data on characteristic and outcomes of ICU patients are lacking in Pakistan. Data collected in 2014 in a 9-bedded medical ICU is reported here. Our main objectives were to determine the mortality rate, mean duration of ICU stay and mechanical ventilation and ICU acquired infection incidence rate during the year 2014 and to compare it with 2008 data.

Methods

The study was conducted in 2015 at medical ICU of Pakistan Institute of Medical Sciences, Islamabad, Pakistan. It was a cross-sectional study and was approved by the hospital ethical committee. Medical ICU performance and activity information have been entered daily since 2008. A software (ICU e-monitoring®, Centre for Research and Management, Islamabad, Pakistan, 2007) was designed to enter patient demographic data, SAPS3 on admission and episodes of hospital acquired infections (ventilator associated pneumonia (VAP), catheter related blood stream infection (CRBSI)). Data of 2014 was collected with the same methodology as in 2008, previously published7 and served for comparison. Data was entered and analyzed using 'Statistical Package for Social Sciences' (SPSS) version 22. Chi-square test was employed to assess the significance of observed difference between percentages of categorical variables like gender and mortality rates. P-value of <0.05 was considered significant. t-test for independent variables was employed to assess the significance of difference between means of continuous variables like age, duration of ICU stays and duration of mechanical ventilation. P-value of <0.05 was considered significant. Rate of Ventilator associated pneumonia (VAP) and rate of catheter related blood stream infections (CRBSI) was also measured for both the years 2008 and 2014 along with the rate ratios.

Results

A total of 196 admissions recorded during the year 2014 as compared to 354 in 2008. Comparison between gender and mortality distribution is represented in (Table 1).

Table 1- Comparison between gender and mortality data for year 2008 and 2014.

Variable		Year 2008	Year 2014	P-Value (Chi-Square)
Gender	MALES	167 (42.7%)	81 (41.3%)	0.187
	FEMALES	187 (52.8%)	115 (58.7%)	
	TOTAL	354 (100%)	196 (100%)	
Mortality	PRESENT	166 (47%)	65 (33.2%)	0.002
	ABSENT	188 (53%)	131 (66.8%)	
	TOTAL	354 (100%)	196 (100%)	

There was no significant difference between gender distribution for year 2008 and 2014 (P=0.187). Mortality was found to be reduced in year 2014 (33% vs 47% in 2008). The difference was found to be statistically significant (P=0.002). Comparison between mean age, mean duration of ICU stays and mean duration of mechanical ventilation is represented in (Table 2).

Table 2- Comparison between Age, mean ICU Stay and mean duration of mechanical ventilation for year 2008 and 2014

Variable		Year 2008	Year 2014	P-Value (t-TEST)
Age (Years)	Mean	37.7	32.1	0.001
	SD	18.9	15.3	
Icu Stay (Days)	Mean	9.3	15.9	0.001
	SD	8.9	12.9	
Mechanical Ventilation (Days)	Mean	8.7	12.04	0.001
	SD	6.9	6.7	

Mean age of admitted patients in year 2014 was lesser as compared to year 2008 (32.1 vs 37.7 years in 2008). The difference was statistically significant (P=0-001). Mean duration of ICU stays in year 2014 was more as compared to year 2008 (15.9 vs 9.3 days in 2008). The difference was statistically significant (P=0-001). Mean duration of mechanical ventilation in year 2014 was also more as compared to year 2008 (12.04 vs 8.7 days in 2008). The difference was also statistically significant (P=0-001). Overall VAP rate was 42.3 cases/1000 ventilator days as compared to 16.7 in 2008 (2.5-fold increase). Rate of CRBSI was 17.2 cases/1000 CVC days as compared to 12.1 in 2008 (1.4-fold increase). VAP and CRBSI results are tabulated in (Table 3).

Table 3- Comparison between rate of VAP and CRBSI for the year 2008 and 2014

Variable	Year 2008	Year 2014	Rate Ratio (2014/2008)
VAP (Cases/ 1000 Ventilator Days)	16.7	42.3	2.5
CRBSI (Cases/ 1000 CVC Days)	12.1	17.2	1.4

Discussion

It is possible to collect meaningful data on ICU

performance and activity in resource limited settings, which are useful as internal and external comparator. Our results are not much different from already published ones on feasibility of ICU data collection. Lee et al realized the need for a collaborative critical care ECG data sharing mechanism and performed a feasibility study in which 21 centers entered data from 12 consecutive ICU monitoring patients from each center. They had been able to successfully develop and implement Critical Care EEG Monitoring Research Consortium (CCEMRC) database which is now available for public download [11]. Brunsveld-Reinders et al successfully developed and implemented a checklist as an instrument to gather and incorporate in-hospital transport data of critically ill patients in a systematic framework of ICU data management. Their aim was to increase safety of intra-hospital transport of critically ill patients and they used eleven existing guidelines and five published checklists to develop their own customized checklist [12]. Serpa Neto et al. evaluated the feasibility of transitioning from APACHE II to SAPS III as prognostic model in a Brazilian general intensive care unit by analyzing the existing database and statistically proved SAPS III as a better predictive model [13]. Smischney et al aimed to validate an automated search algorithm for electronic medical record regarding initiation of mechanical ventilation in a medical ICU. They developed an automated electronic search strategy which was found to be highly efficient and reliable [14]. Several other authors conclude the feasibility of automated data collection in an intensive care environment and commend its superiority over manual systems [15-17]. We found major changes found in our patient population characteristics between 2008 and 2014: number of patients decreased by 44%, (354 in 2008 to 196 in 2014) which may be attributed to presence of few more intensive care setups established during this period in private sector. Gender distribution in admitted cases was not statistically significant for both the year (P=0.187), however, mean age of admitted patients in year 2014 was significantly lesser (P=0.001) as compared to year 2008 (32.1 vs 37.7 years), which may also be due to the filtration of these patients in the private sector ICUs.

In this study, mortality rate was found to be reduced in year 2014 (33% vs 47% in 2008). The difference was found to be statistically significant (P=0.002). Mean duration of ICU stays and mechanical ventilation in year 2014 was longer as compared to year 2008 (15.9 vs 9.3 days) and (12.04 vs 8.7 days), respectively. The difference was also statistically significant (P=0-001). Overall VAP and CRBSI rate showed 2.5-fold and 1.4-fold rise in 2014, respectively. Since 2008, our institution has begun an intensive care medicine post-graduate training program and established and enforced requirements for admission to ICU. It also acquired more time-based machinery and resources. The observed changes may be explained by longer remain in ICU and mechanical ventilation, as well as by differences in the case-mix of our patient population and enhanced clinical management. Our results are similar to the study reported by Moran et al, who tested the feasibility of an electronic format to model hospital mortality and the length-of-stay ICU of patients recorded in the adult patient database of the Australian and New Zealand Intensive Care Society. They found mortality rate in patients admitted to Australian and New Zealand ICUs decreased 4% (14 percent in our study over six years) over 11 years. A similar trend occurred for mechanically ventilated patients. However, they did not find any change in length of ICU stay over this period [18]. Bird et al found ICU mortality as 33.7%, in patients with hematological malignancy admitted to a specialist cancer intensive care unit in 2011. They found that mortality was lower than in previous studies [19]. Rosenthal et al determined incidence of device-associated infections in the 55 ICUs of 46 hospitals of developing countries during 2002-2005. They found an overall rate of device-associated infections as 14.7% [20]. Our study indicated higher rates of device associated infections and requires urgent targeted interventions.

In summary, electronic formats for data collection in ICU have been continuously appraised and found much feasible. We reached to the same conclusion with our experience. ICU outcomes have been the subject of controversy and depend on vide variety of factors including clinical presentations, heterogeneity of the population with respect to age, gender, underlying comorbidities, trajectory and severity of illness, time to presentation and infecting organisms. The type and number of affected organs adds further complexity and outcomes depend upon patient centered care. Stringent implementation and continuous evaluation of patient-centered care using automated data management system is crucial to the improvement in ICU outcomes. We recommend further studies in this area.

Conclusion

We found it quite feasible to collect meaningful data on ICU performance and activity in resource limited settings, which are useful as an internal and external comparator. We found significant changes in our patient population characteristics and ICU outcomes between 2008 and 2014.

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