**Intensive Care Unit Bed Utilization of a Tertiary Care Hospital: A Five-Year Trend Analysis**

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**ABSTRACT**

**INTRODUCTION:** There is acute shortage of intensive care unit beds in Nepal. At the same time, the demand for intensive care unit beds is increasing. So, we have to optimally utilize our limited and expensive intensive care unit beds. The aim of this study was to evaluate performance indicators of ICU bed utilization of a tertiary care hospital in Kathmandu.

**METHOD:** This is a retrospective study done over a period of five years from 2009 to 2013 BS. The admission and discharge records of patients admitted in five-bed mixed medical surgical intensive care unit was retrieved. The variables that we used to evaluate the ICU bed utilization over a period of five years were average length of stay (ALOS), bed occupancy rate (BOR), bed turn over rate (BTOR) and turnover interval (TI).

**RESULT:** A total of 1111 patients were admitted in the ICU over a period of five years. The trends in ICU bed utilization showed that the average length of stay was minimum of 5.45 days in 2068 with the maximum of 7.28 days in 2069. In 2066, the bed occupancy rate was 69.75%, the bed turnover rate was 38.60 times per year and the turnover interval was 2.86 days. In 2070, these indices were 98.85%, 50.40 times per year and 0.08 days respectively.

**CONCLUSION:** This study shows that there is increasing trend in the utilization of ICU beds. So we should increase the number of ICU beds to cater the large number of potentially treatable critically ill patients in upcoming days.

**KEY WORDS:** Average length of stay, bed occupancy rate, bed turnover rate, ICU (Intensive Care Unit) bed utilization, turnover interval.

**INTRODUCTION**

Most critically ill patients who require intensive care cannot be care for in other parts of the hospital. So, it is important for intensive care units to have adequate capacity. Clinicians and media have reported problems with bed shortages in ICUs especially in government hospitals because the government hospitals play key role in delivering medical services to the community at affordable price. A low-income country like Nepal has acute shortage of ICU beds. An average of 7.2 ICU beds with ventilator is available per 100,000 populations in Kathmandu valley. Due to aging population and increase in the severity of hospital cases the demand for intensive care unit beds is increasing. Having few ICU beds may result in either refusal of intensive care or delayed admission of critically ill patients with recoverable conditions. A systematic review by Sinuff and colleagues confirmed that hospital mortality is increased three-fold for patients refused ICU admission.

ICUresourcesarethoseressourcesthatprovideintensive care to critically ill, injured or physiologically unstable. Although referred to as ICU beds, they include not only the beds but also the full complement of professional staff and capacities for physiological monitoring and invasive diagnostic and therapeutic interventions. Health care professionals need to act more efficiently in allocating scarce resources.

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occupancy is regarded as a measure of resource use, unit activity, workload, and increasingly as a quality indicator. Accurate and consistent measurement of occupancy is required for the purposes of unit, hospital and health system planning, comparisons within and between health systems and providing realistic benchmarks for quality monitoring. This study was done to evaluate trends in the performance of “New Intensive Care Unit” of Bir hospital in terms of average length of stay, bed occupancy rate, bed turnover over and turnover interval over a period of five years.

METHOD

This is a retrospective study done over a period of five years from 2066 to 2070 B.S. (2009/10 to 2013/14 AD). All admission and discharge records were retrieved from the ICU register book of New ICU of Bir hospital – a tertiary level government hospital under National Academy of Medical Sciences. The new ICU is 5-bed mixed medical and surgical unit functioning under the department of anaesthesiology and intensive care. The variables retrieved from the register included chart numbers, date of admission and discharge. All data were stored in Microsoft Excel 2010. The ICU performance indicators were average length of stay, bed turnover, bed occupancy rate, and turnover interval, which were calculated with the following definitions and formulas.

Average length of stay (ALOS) in ICU: This measure refers to the average number of days that a patient is admitted in an ICU. It is calculated as:

\[ \text{ALOS} = \frac{\text{cumulative inpatient days}}{\text{number of admissions}} \]

Bed occupancy rate (BOR): This indicates the percentage of beds occupied by patients in a specified period, usually one year. It reflects the ratio between beds used and beds provided. It is calculated as:

\[ \text{BOR} (%) = \frac{\text{cumulative inpatient days}}{\text{number of ICU beds} \times 365} \times 100 \]

Bed turnover (BTOR): Bed turnover is a measure of the productivity of ICU beds and represents the number of patients treated per bed in a specified period of time, usually one year. It is calculated as:

\[ \text{BTOR} = \frac{\text{number of admissions}}{\text{number of ICU beds}} \]

Turnover interval (TI): This measure is related to BTOR. It measures the average time that beds are unoccupied between successive patients admission. It is calculated as:

\[ \text{TI} = \frac{365}{\text{BTOR}} - \text{ALOS} \]

RESULT

A total of 1111 patients were admitted in the ICU over a period of five years. Table 1 shows the data for the number of active beds, active bed days, number of admissions and occupied bed days during the study period.

<table>
<thead>
<tr>
<th>Year (B.S.)</th>
<th>Active beds</th>
<th>Active bed days</th>
<th>No of admissions</th>
<th>Occupied bed days</th>
</tr>
</thead>
<tbody>
<tr>
<td>2066</td>
<td>5</td>
<td>1825</td>
<td>193</td>
<td>1273</td>
</tr>
<tr>
<td>2067</td>
<td>5</td>
<td>1825</td>
<td>199</td>
<td>1229</td>
</tr>
<tr>
<td>2068</td>
<td>5</td>
<td>1825</td>
<td>231</td>
<td>1258</td>
</tr>
<tr>
<td>2069</td>
<td>5</td>
<td>1825</td>
<td>236</td>
<td>1717</td>
</tr>
<tr>
<td>2070</td>
<td>5</td>
<td>1825</td>
<td>252</td>
<td>1804</td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>9125</td>
<td>1111</td>
<td>7281</td>
</tr>
</tbody>
</table>

There was steady increase in the number of admissions over the study period. The highest occupied bed days was observed in 2070. Table 2 shows the 5-year trends in ICU performance indices. The average length of stay in ICU increased from 6.60 days in 2066 to 7.16 days in 2070. In 2066, the bed occupancy rate was 69.75%, bed turnover was 38.60 times/year and turnover interval was 0.51 day, whereas in 2070 these indices were 98.85%, 50.40 times/year and 0.08 day, respectively.

<table>
<thead>
<tr>
<th>Year (B.S.)</th>
<th>ALOS (days)</th>
<th>BOR (%)</th>
<th>BTOR (times/year)</th>
<th>TI (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2066</td>
<td>6.60</td>
<td>69.75</td>
<td>38.60</td>
<td>2.86</td>
</tr>
<tr>
<td>2067</td>
<td>6.18</td>
<td>67.34</td>
<td>39.80</td>
<td>2.99</td>
</tr>
<tr>
<td>2068</td>
<td>5.45</td>
<td>68.93</td>
<td>46.20</td>
<td>2.45</td>
</tr>
<tr>
<td>2069</td>
<td>7.28</td>
<td>94.08</td>
<td>47.20</td>
<td>0.46</td>
</tr>
<tr>
<td>2070</td>
<td>7.16</td>
<td>98.85</td>
<td>50.40</td>
<td>0.08</td>
</tr>
<tr>
<td>Total</td>
<td>6.55</td>
<td>79.79</td>
<td>44.44</td>
<td>1.66</td>
</tr>
</tbody>
</table>
DISCUSSION

There is a need for optimizing an efficient distribution and use of expensive ICU resources. Statistical indicators can suggest issues for performance management, quality improvement and further scrutiny. One of the performance indicators is Average Length of Stay (ALOS) in ICU. Prolonged ICU stay can adversely affect the health status by increasing the risk of infection, complications, and possibly, mortality. Operationally, it impacts upon ICU bed availability and results in cancellation of elective surgeries, leading to long waiting times. Patients with prolonged ICU stay consume a significant share of the ICU resources. The ALOS in our ICU increased slightly from 6.60 days in 2066 to 7.15 days in 2070. The ALOS be kept as short as possible but it is quite different from ICU to ICU depending upon the type of cases, nature of emergency and severity of illness. ALOS is being recommended to keep around 5-6 days for efficient utilization of ICU.

Another performance indicator is ICU bed occupancy rate (BOR). There currently does not appear to be definitive evidence on what the optimal target for ICU occupancy should be, however, it could be around 70–75%. This is based on the premise that 100% occupancy is unobtainable as the discharge of existing patients and subsequent admission of new patients is not instantaneous and time is required for servicing and resetting the beds. The BOR in our ICU was optimal around 70% in 2066, but after five years increased to higher rate of almost 99% in 2070. High occupancy rates have a negative effect on patient outcomes and restrict access to ICU services. High occupancy rates, particularly those above 80%, were seen to have a direct relationship with ICU and hospital mortality and ICU readmission within seven days of discharge. As occupancy increases there may also be escalating challenges such as refused or delayed admissions to ICU; cancellation of elective surgery; increased severity of illness on later admission to the ICU; nursing critically ill patients elsewhere in the hospital; transfer of emergency patients; hospital diversions; and premature discharge. Thus our 5-bed ICU has to be considered too small and require an increase in the number of beds. There was no high dependency unit or intermediate ICU in our hospital. So, our ICU had to admit less severe patients wherein patients were admitted for monitoring purpose only without requiring active organ support. Lack of strict admission and discharge policy also might have lead to high occupancy rate.

The bed turn over rate (BTOR) indicates the speed with which patients on any ICU bed are rotated. The BTOR in our ICU increased from 38.60 in 2066 to 50.40 times/year in 2070. Small BTOR would indicate fewer people utilizing the hospital. Whereas, increase in BTOR appears to be the outcome of increasing admission rates but also indicates that the hospital is operating at a high level of efficiency regarding bed utilization. Similarly, the Turn Over Interval decreased from 2.86 days in 2066 to 0.08 days in 2070. Rapidly declining turnover intervals reflected shortage of ICU beds.

LIMITATION

This is retrospective study of a single ICU so this may not hold true for other ICUs. We consider only the number of admissions instead of average of number of admissions, discharge and deaths over a period of time, which may have affected the value of difference indicators. Length of stay was counted in days not in hours.

CONCLUSION

This study shows that the trend in the utilization of ICU beds is increasing over a period of five years. The availability of present ICU beds is grossly inadequate. So considering the current ICU performance indicators we should increase the number of ICU beds to cater the increasing number of critically ill patients in upcoming days.

REFERENCES

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