



Assessment of Bed Utilization Indicators of Medicine Ward of a Tertiary Level Hospital: A Cross-sectional Study in Eastern India

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Abstract

Background: Efficient hospital bed utilization is an important function of hospital administrators. Scarcity of beds, overcrowding, and flooring are often the picture of tertiary hospitals.

Objectives: This study aims to find out hospital bed utilization indicators such as average daily census, bed occupancy rate (BOR), average length of stay (ALS), bed turnover rate (BTR), and bed turnover interval (BTI) in Medicine ward of a tertiary hospital in West Bengal, India.

Methods: A descriptive cross-sectional study was conducted in acute male and female as well as chronic male and female wards under medicine department of a tertiary hospital in West Bengal from June to August 2018. The record of active beds, patient days, daily admissions and discharge were reviewed for May 2018 by complete enumeration method from admission, discharge and death registers and recorded in a pre-designed pretested checklist. Average daily census, BOR, ALS, BTR, and BTI were computed using standard formula. Pabon Lasso model was used to analyse the performance of the medicine ward.

Results: Average daily census, ALS, BOR, BTR, BTI in medicine ward were 261.81 patients, 8 days, 108.55%, 4.22 patients/ bed and -0.63 days respectively. Pabon Lasso graph reflected high BOR and high discharges per bed (productivity) in acute medicine wards reflecting good quantitative performance in contrast to chronic medicine wards with low discharges per bed (productivity or BTR) and higher ALS.

Conclusion: Medicine ward reflected higher BOR and ALS but lower BTR (productivity) as per the Pabon Lasso graph. Efforts must be made to reduce ALS in chronic medicine wards.

Keywords: Bed Occupancy, Facilities and Services Utilization, Hospital Administration, Hospital Bed, Utilization

1. Background

A hospital bed is a scarce service that should be utilized rationally. The term hospital bed utilization denotes how a certain community makes use of its hospital resources.¹ Utilization rates also give some indication of the care required by a population, and therefore the health status of the population. Over-utilization and under-utilization are two primary facets of inappropriate utilization.² Over-utilization refers to the use of hospital resources (beds and manpower) that is of no benefit to the patient (such as staying more days after he/she has recovered enough to go home) or care, which can be provided at a lower level, and less costly healthcare setting.^{3,4} Conversely, under-utilization refers to the use of hospital resources below the expectations. Overcrowding, bed crisis, bed sharing, and flooring in the wards of tertiary care center is a quite common scenario in developing countries. Often people who need to be admitted have to run from one tertiary

level hospital to another due to the unavailability of vacant beds.

Davies and Macaulay have described various bed utilization indicators such as average length of stay (ALS), bed occupancy rate (BOR), bed turnover rate (BTR), and bed turnover interval (BTI).⁵ ALS indicates the average period (days) of stay in the hospital per admitted patient, BOR expresses the percentage of occupancy of hospital beds, BTI expresses the average period of days during which a hospital bed remains vacant till it is occupied by a new patient. The BTR indicates the number of turnover of patients in one year for the given bed complement.⁶

Pabon Lasso in the year 1986, described a chart in which there was a simultaneous application of the three commonly used bed utilization indicators to evaluate the performance of a hospital.⁷ In this chart BOR is measured along X axis, productivity (the number of discharges per bed) is measured along the Y axis, and ALS is indicated by

a series of straight lines radiating outward from the origin. This chart is divided into four sectors. Sector 1 (lower left) indicates relatively low levels of bed occupancy and productivity- the least desirable situation; sector 2 (upper left) indicates relatively low levels of bed occupancy, high productivity, and short hospital stays; sector 3 (upper right) indicates relatively high levels of bed occupancy and productivity- the most desirable situation; and sector 4 (lower right) indicates relatively high levels of bed occupancy, low productivity, and long hospital stays (typical for hospitals specializing in chronic diseases).⁷

Bed utilization indicators depend on various factors⁸⁻¹² such as hospital bed availability, payment for hospital services whether free or paid, population age, service coverage and bed distribution, medical customs and social patterns, availability of physicians, research, and training. etc. There are therefore great variations in the bed utilization indicators across India even in similar types of hospitals. What should be an ideal level of BOR, ALS, BTR, and BTI is unknown. In order to have international, national, or local hospital performance assessment, the country needs to have data compilation similar to National Family Health Survey (NFHS), India, or real time updates on hospital's performance statistics. Currently there is no such mechanism existing to compare the hospital performance indicators. These data may help improve hospital performance.

In 2015, the bed utilization indicators such as BOR, BTR, and ALS in the Medical College Hospitals of West Bengal were reported to be 95.9%, 69.2, 5.1 days, respectively.¹³

The determination of bed utilization indicators of a ward of a tertiary care hospital during a particular month is not usually reported in literature rather the compiled annual indicators of the entire hospital are available, which too not updated. To improve the performance of the entire hospital, individual ward with suboptimal performance needs a focus. To achieve optimum utilization of hospital beds and improve the entire hospital's performance, review and monitoring of different bed utilization indicators in individual wards are required. Much study has not been conducted in the literature regarding individual hospital wards performance on bed utilization in West Bengal, particularly the medicine ward. This study will help in finding the bottlenecks in any hospital's performance with regard to bed utilization indicators in individual wards.

2. Objectives

This study was conducted with the objective of finding out the indicators of the utilization of hospital beds which are, average daily census, BOR, ALS, BTR, and BTI in Medicine ward of a tertiary level hospital in West Bengal.

3. Methods

An Institution-based observational descriptive study with a cross-sectional design was conducted in the Medicine, the ward of a tertiary care teaching hospital in West Bengal for a period of three months from June 2018 to August

2018. Medicine Department was the only ward of this institution that had four wards namely; an acute male, an acute female, a chronic male, and a chronic female, which can help in better interpretation of bed utilization indicators. The study population were the beds in the medicine ward of the institution during the last month i.e., May 2018. Record review was performed in May 2018 based on Judgement Sampling. As the study began in June 2018, therefore the most recent available data were for the last month i.e., May 2018. Time frame for record review was from 1st May 2018 to 31st May 2018. All the patients admitted to the beds/floor in the Medicine ward during May 2018 were included in the study. The 'other beds' present in Medicine wards were earmarked for super-specialty departments, who were utilizing the bed services of the medicine ward. These 'other beds' were also included in this study for estimation of different indicators. Those beds whose information was incomplete in the register were excluded. Indicators of hospital utilization services were assessed for these four wards individually and overall in Medicine ward by complete enumeration method. The study was conducted by record review technique using pre-designed, pre-tested observation check list, admission register, discharge register, death register, and other record registers, etc. Check list was prepared by 1st and 2nd author and corrected by the Head of the Department of General Medicine, Community Medicine, and Principal of Nursing College. Pre-testing was performed in Observation ward under General Emergency of the institution and accordingly modified. Checklist comprised of four sections for each sub-wards under Medicine Ward. Under each section, information was collected regarding 14 items such as the number of days in the month, the daily census for each day of the month for the beds, other beds or floors as applicable, the length of stay for all discharges (discharged home, dead, discharge on risk basis) on all days of the month, number of discharges on all days of the month, number of beds in the ward, maximum patient days and secondary calculations using formulae for the average daily census, ALS, BOR, bed turn over rate and bed turn over interval. The 14-item checklist was validated by six experts (three experts from the Department and three experts from outside Department (Head of Medicine, Senior Faculty Nursing and Principal of Nursing College). The item-level content validity index, scale level content validity index based on the average method and the scale-level content validity index based on the universal agreement method were 0.98, 0.97 and 0.92, respectively.

Data regarding the number of active beds, bed-days, patient days, daily inpatient admission, discharge, death, etc. for each of the studied 31 days of May 2018 was collected from the registers of all the four Medicine wards and entered in the pre-designed checklist. The checklist was further analysed to derive the hospital utilization indicators such as average daily census, BOR, the ALS, bed turn over rate, bed turn over interval, or T interval. The Data collection was restricted to the inpatient wards under

the Medicine Department of the teaching institute.

Collected data from the checklist was compiled and analysed using Microsoft excel 2007 version. Data were expressed using frequency, mean, standard deviation, and percentages. The result was represented using tables and figures. The indicators of the utilization of bed indicators such as average daily census, BOR, ALS and BTR as well as BTI were computed using the above-discussed formulae over a time frame of 31 days. The BOR, BTR and ALS of different medicine wards were utilized to plot the four medicine wards in the corresponding sectors as per Pabon Lasso⁷ graph in order to evaluate the individual medicine wards performance. In Pabon Lasso chart BOR is measured along X axis, productivity (the number of discharges per bed) is measured along the Y axis, and ALS is indicated by a series of straight lines radiating outward from the origin. This chart is divided into four sectors. Sector 1 (lower left) indicates relatively low levels of bed occupancy and productivity- the least desirable situation; sector 2 (upper left) indicates relatively low levels of bed occupancy, high productivity, and short hospital stays; sector 3 (upper right) indicates relatively high levels of bed occupancy and productivity- the most desirable situation; and sector 4 (lower right) indicates relatively high levels of bed occupancy, low productivity, and long hospital stays.⁷ The average bed occupancy (93.86 %) and BTRs (5.74 monthly) found for the Medical College Hospitals under the Department of Health and Family Welfare, West Bengal from 2011 to 2015 were employed to define the borders of sectors 1, 2, 3, and 4.¹³

4. Results

It was observed that the mean daily inpatient census of the different wards of Medicine were 47.42 ± 0.81 in beds of acute male, 29.45 ± 5.9 on floor of acute male, 21.84 ± 0.37 in the bed of acute female, 15.9 ± 1.83 on the floor of acute female, 66.58 ± 2.53 in the bed of chronic male, 5.55 ± 2.68 in other beds of a chronic male under supervision of superspecialist consultation, 68.45 ± 3.79 in beds of chronic female and 6.61 ± 2.25 in other beds of the chronic female ward under the supervision of superspecialist consultation, respectively. Figure 1 shows the daily census of different wards of the Medicine Department of a tertiary care teaching hospital in West Bengal in May 2018. It can be seen that there is a steady number of daily inpatient admissions in most of the wards especially the acute male bed and acute female bed followed by chronic male and chronic female bed, etc. However, the floor of the acute male ward reflected a slightly greater variation (range 17-39) in the daily census during May 2018. Figure 2 shows the average daily census in the four wards of the Medicine Department i.e., acute male and female and chronic male and female in May 2018. It can be seen that the average daily census was nearly similar (range 72.13-76.87) in all wards of medicine (i.e., chronic male, chronic female, and acute male) except acute female ward where it was comparatively half of the other wards (37.74) in May 2018.

The average number of days of service rendered to each discharged patient, whether discharged home, discharged on a risk basis, or dead during the given period of time was considered for computation of ALS. As it was a tertiary care centre therefore there was no transfer to other hospitals. Figure 3 shows the ALS in four wards of medicine. It can be seen from Figure 3 that ALS for chronic wards was more than acute wards. Amongst the chronic wards, females (11.7) had higher ALS than males (9.38), however, in acute wards, males (6.58) had higher ALS than females (5.49).

BOR was the highest (180.50%) in acute female ward followed by acute male (138.44%), chronic male (97.53%) and chronic female ward (81.08%). It was also more than cent percentage (108.55%) in overall Medicine ward during May 2018. As there was no doubling of patients per bed in this ward; therefore, this reflected flooring in the wards. BTR was higher in the acute wards compared to chronic

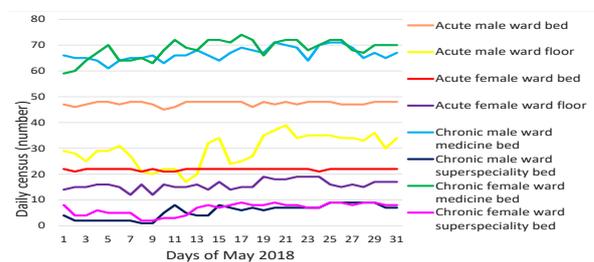


Figure 1. Daily Census of Different Wards of Medicine Department in the Teachi Hospital of West Bengal in May 2018 .

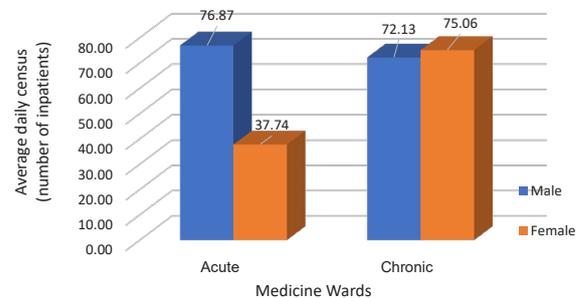


Figure 2. Multiple bar chart showing the average daily census in the four wards of medicine in the tertiary care center of West Bengal in May 2018 .

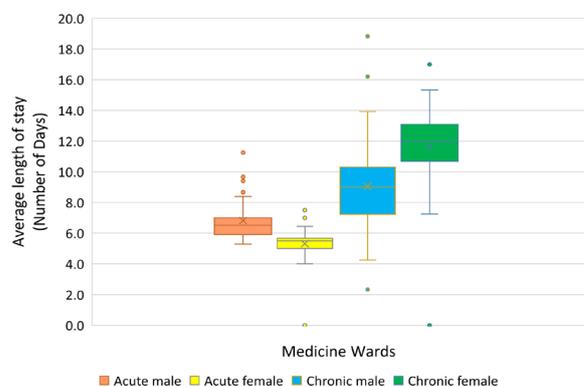


Figure 3. Box and Whisker Plot Showing Average Length of Stay in Different Ward of Medicine in the Teaching Hospital of West Bengal During May 2018 .

wards. In other words, the floor and beds of acute wards served a greater number of patients compared to the beds of chronic wards during May 2018. In the Medicine ward, the overall BTR (productivity) was 4.22 patients per bed (or floor) in May 2018. The gap between a discharge and an admission per bed in May 2018 in acute wards and the Medicine ward overall was negative reflecting scarcity of beds and overutilization, in contrast to the chronic wards which reflected short positive T or optimum utilization. The BOR, BTR, BTI or T interval of the different wards have been depicted in Table 1. All the bed utilization indicators for the different wards and Medicine Department of a teaching hospital in West Bengal have been summarized in Table 2. The average daily census in the medicine ward was 261.81, the ALS was 8 days, BOR was 108.6%, bed turn over rate was 4.22 while bed turn over interval was slightly negative which is -0.63.

Figure 4 shows the Pabon Lasso⁷ graphical representation of the efficiency of different wards of Medicine during May 2018 in a teaching tertiary hospital in West Bengal. It could be seen that plotting for both acute male and acute female wards came under sector 3 which is the most desirable situation out of the four situations possible in Pabon Lasso graph.⁷ The acute male and acute female wards with high BOR and high BTR (productivity) displayed a better hospital performance compared to chronic male and chronic female wards. Chronic female wards represented excess bed availability, higher ALS and less BTR (productivity) i.e., the least desirable situation. At the same

time, chronic male ward and medicine ward overall (BOR 108.55%, BTR 4.22, ALS 8; sector 4) reflected a higher BOR with higher ALS of stay but with less BTR (productivity) probably typical for wards mostly specializing in chronic diseases (true to its name of ward).

5. Discussion

An observational descriptive and cross-sectional study was conducted in the Medicine ward of a tertiary hospital in West Bengal for a period of three months June to August 2018, with an aim of determining the bed utilization indicators for the medicine ward of the teaching hospital in May 2018 (last month).

In the current study, we found that the average daily census in the medicine ward was 261.81 during May 2018. During May 2017, there were a total of 5834 admissions in the entire teaching hospital, while there were 70262 annual admissions in 2017.¹⁴ In the current study, 943 patients were discharged from the medicine ward in May 2018. In the annual report it was revealed that a total of 69346 patients were discharged from the entire hospital during 2017 and 5,913 patients were discharged during May 2017.¹⁴ In this study, during May 2018 the total patient days in the medicine ward was 7504. During May 2017, the total number of patient days in the entire hospital was 42987 and during the complete year 2017, the total patient days in the entire hospital was 524561.¹⁴ Though the 2017- and 2018 data are not directly comparable, due to the paucity of literature, it could be said that medicine ward contributed

Table 1. Bed Occupancy Rate, Bed Turnover Rate and Turn Over Interval in Different Wards of Medicine Department in a Teaching Hospital of West Bengal During May 2018

Hospital Bed Utilization Indicators	Sub-variables	Medicine Wards				Medicine Ward
		Acute Male	Acute Female	Chronic Male	Chronic Female	
BOR	No. of patient days (a)	2060	1231	2177	2036	7504
	No. of beds (b)	48	22	72	81	223
	Total no. of days (c)	31	31	31	31	31
	BOR (%)=(aX100)/ (bXc)	138.44	180.50	97.53	81.08	108.55
BTR	No. of discharges (d)	313	224	232	174	943
	Available beds (b)	48	22	72	81	223
	BTR= d/b	6.52	10.18	3.22	2.14	4.22
Turn over interval	Available beds (b)	48	22	72	81	223
	Total no. of days (c)	31	31	31	31	31
	Actual Patient days (a)	2060	1231	2177	2036	7504
	No. of discharges (d)	313	224	232	174	943
	Turnover interval= [(bXc)- a]/ d	-1.83	-2.45	0.24	2.73	-0.63

BOR, bed occupancy rate; BTR, Bed turn over rate.

Table 2. Summary of Bed Utilization Indicators in Medicine Ward of a Tertiary Care Centre of West Bengal in May 2018

Name of Medicine Wards	Average Daily Census	Average Length of Stay	Bed Occupancy Rate (%)	Bed Turnover Rate	Turnover Interval
Acute male	76.87	6.6	138.44	6.52	-1.83
Acute female	37.74	5.5	180.50	10.18	-2.45
Chronic male	72.13	9.4	97.53	3.22	0.24
Chronic female	75.06	11.7	81.08	2.14	2.73
Medicine	261.81	8.0	108.55	4.22	-0.63

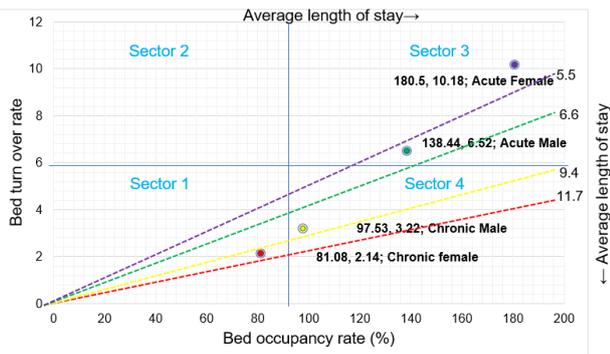


Figure 4. Pabon Lasso graph showing the efficiency of different wards of Medicine in a teaching hospital of West Bengal in May 2018

Note-The average bed occupancy (%93.86) and bed turnover rates (5.74 monthly) found for the Medical College Hospitals under the Department of Health and Family Welfare, West Bengal from 2011 to 2015 were used to define the borders of sectors 3, 2, 1, and 4.

to around 15%-20% of the entire hospital in terms of the number of discharges and number of patient days.

The study revealed that the BOR of the medicine ward was 108.55% in May 2018. This was consistent with the same institution's annual report which reflected 103.40% BOR in the entire teaching hospital during 2017 and 100.63% during May 2017.¹⁴ Similar BOR (95.9%) were reflected in all Medical College and Hospitals (thirteen) with 15,071 beds under Department of Health and Family Welfare, West Bengal during 2015.¹³ In another study, BOR in 2013 in medicine ward of a tribal-based government tertiary care centre in Central India was 85%.¹⁵ However, the findings were quite different in May 2002 in the Medicine ward of a tertiary care centre in other states with BOR of 47.1%.⁸ This could be due to the difference between a government institution and a private institution, where patients have to pay for their health care.

The current study revealed that the ALS in medicine ward during May 2018 in the teaching hospital was eight days. This was consistent with the latest available report of the same hospital's ALS (8.3 days) during 2015¹⁴ and with ALS of 9.3 days and seven days in Medicine ward in May 2002 and 2013, respectively in other state's tertiary care centre.^{8,15} Sindhu et al. also found the ALS of 10 days in 2018.¹⁶ In 2007, Qureshi et al. found ALS as 6.9 days in a tertiary care centre in Kashmir.¹⁷

Even the BTR in this institution during May 2018 was 4.22. Similar results (BTR- 69.2, i.e., 5.8 per month) were obtained from the thirteen Medical College and Hospitals of West Bengal during 2015.¹³ In the same teaching institution, BTR was 29.3 (2.4 per month) during 2015.¹³ This difference could be because of variations in the time frame, as with increasing time, the referral and workload in this teaching institute might be increased. Therefore, it is catering to more patients per bed in a given time period.

Overall, the findings from this study in the Medicine ward for a month corroborated well with the entire hospital's bed utilization indicators, being monthly or annually, and also matched with all the Medical College and Hospitals in the state of West Bengal.

However, Ravi Kiran and Vijaya et al⁸ found a very low BTR of 1.6 and a very high TOI of 10.5 for the Medicine ward in the tertiary care centre in May 2002 reflecting underutilization and low productivity. The negative T interval in the current study reflected the scarcity of beds and overutilization in the medicine ward during May 2018.

5.1. Limitations

The BTR in acute male and female wards might reflect an inflated value as the actual calculations considered the number of patients discharged per bed or floor per month. Floors were included to calculate parameters. Separate calculations for floor days could not be performed.

6. Conclusion

BOR higher than 100% in acute Medicine wards in the tertiary level hospital led to flooring. There was high BOR and high discharges per bed (productivity) in acute medicine wards reflecting good quantitative performance in contrast to chronic medicine wards (as the name suggests) with low discharges per bed (productivity/BTR) and higher ALS during May 2018. Overall, during May 2018, the Medicine ward reflected higher BOR, lower BTR (productivity) and higher ALS typical of chronic diseases. All efforts should be made towards efficient utilization of hospital beds in the chronic female ward followed by chronic male ward and steps should be taken to address the flooring or scarcity of beds in acute ward. With the existing universal limitations in resources, administrators can, at least, think of reducing the ALS in chronic wards by making standard discharge criteria, and this can lead to an increase in BTR (productivity), at the same time, optimize BOR or bring back BOR below 100%. Every hospital administrator must routinely monitor the trends and report the month and ward-wise break up of bed utilization indicators, apart from annual reporting of the performance of the entire hospital.

Authors' Contributions

All authors equally contributed to this study.

Conflict of Interest Disclosures

The authors declare no competing interests.

Research Highlights

What Is Already Known?

The hospital bed is a costly commodity in health care. Efficient bed utilization is a constant challenge for Hospital administrators. Despite being a known problem for many decades, the problem is not easy to address in most the hospitals.

What Does This Study Add?

With universal limitations in resources and difficulty in increasing hospital beds, the study addressed how reducing the ALS using standard discharge criteria may increase the productivity of a hospital.

Ethical Approval

The approval for conduction of the study was obtained from Institutional Ethics Committee (Approval code: MC/Ko/IEC/173/06-2018), the Medical Superintendent cum Vice Principal and the Nursing Superintendent.

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