

Variation in Inpatient Bed Utilization Across Clinical Specialties: Identifying Opportunities for Capacity Optimization in District General Hospital Matale

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Abstract:

➤ Introduction

Efficient utilization and in-ward bed management in a hospital is important for resource management and service delivery. Hospital-wide Bed Occupancy Rate (BOR) measures may conceal substantial differences in utilization between individual wards. Analysis of routinely collected ward-level statistics can therefore provide useful evidence for inpatient capacity planning.

➤ Objective

To assess variation and temporal trends in inpatient bed utilization across clinical units in District General Hospital Matale.

➤ Methodology

A retrospective study was conducted using routinely collected hospital statistics from 1st of July 2024 to 30th June 2026. Twelve inpatient wards in different specialties with complete and comparable data through the study period were included. Monthly BOR was calculated using inpatient days and available bed-days. Mean, standard deviation, range and coefficient variation were used to describe the level and variability of occupancy.

➤ Results

A total of 288 ward-month observations were assessed. Significant variation in bed utilization was observed across wards in different specialties. Mean monthly BOR ranged from 31.34% in Paediatric ward to 117.97% in ENT. ENT demonstrated persistently high utilization, exceeding 85% occupancy throughout the study period. Comparatively high BOR was observed in Dermatology (73.41%) and female Medical ward (79.88%). Lower occupancy rates were observed in Paediatric wards (31.34%,36.97%) and Respiratory Medicine ward (33.59%). Month-to-month variability was highest in Paediatric wards.

➤ Conclusion

Inpatient bed utilization varied across clinical specialties within the same hospital, with patterns ranging from sustained occupancy above nominal capacity to relatively low and variable utilization. Hospital-wide average occupancy may therefore obscure important ward-level and specialty-level differences. More detailed assessment and outline analysis of monthly, ward-level BOR can be done routinely to support evidence-informed inpatient capacity planning. Decisions regarding bed allocation should consider the clinical demand, temporal variability, patient flow and operational requirements in addition to average occupancy.

Keywords: *Bed Occupancy Rate; Hospital Beds; Hospital Bed Management; Routine Health Information.*

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I. INTRODUCTION

Hospital beds represent a major resource that requires careful planning and efficient utilization, ensuring the right bed, right time, to the right patient(1). Resource constraints, inappropriate distribution, and utilization of inpatient beds result in congestion in some units while capacity remains relatively less utilized in others(2). Therefore, systematic bed utilization with strict monitoring is utmost important rather than relying on historically allocated bed numbers.

Bed Occupancy Rate (BOR), which is widely used as an indicator of bed utilization, is defined as “the percentage of available bed-days that are occupied during a specified time period”(3). The Bed turnover rate (BTR) measures the productivity of hospital beds. It represents the number of patients treated per bed in a defined period, usually 1 year(4). These indicators are used to describe the availability, distribution, and efficiency of health service resources. BOR is influenced by multiple interacting factors, including hospital size, type of services provided, demand for inpatient care, admission patterns, and length of stay(5). A systematic review of hospital bed capacity planning methods revealed that occupancy, admission rates, average length of stay, demographic factors, and factors that determine service demand are the main variables that influence hospital bed requirements (6). Therefore, the frequently cited reference point of an occupancy rate 85% could be variable(7).

According to the Annual Health Bulletin 2024, Sri Lanka reported 91,159 total hospital beds, including 83,949 inpatient beds, with an overall state-sector BOR of 57.5%, and bed turnover rate of 92.1 in 2024. However, BOR and bed turnover rate substantially different in each institution, each subspecialty and each unit(8)(3).

In District General Hospital (DGH) Matale, the criteria on which the number of beds allocated to each subspecialty was not described, and may not reflect the pattern of service demand. The adequacy of bed number for the specialty would not be provided only by the occupancy, as it is influenced by admission demand, length of stay, or deviations in the care pathway. Therefore, the importance of specialty level longitudinal examination in the hospital was highlighted. Inpatient capacity planning, specialty specific bed allocation, identification of specialties with sustained capacity pressure, recognition of seasonal variations, and consideration of shared bed capacity would be supported by the evidence.

This study therefore, aims to assess the variation in inpatient bed utilization across clinical specialties in DGH Matale using routinely collected monthly hospital data from 1st July 2024 to 30th June 2026, with the objective of identifying utilization patterns relevant to future inpatient capacity planning.

II. METHODOLOGY

➤ Study Design and Setting

A retrospective study was conducted using routinely collected hospital data in DGH Matale, which is a leading

hospital in Central Province, Sri Lanka. Inpatient services through multiple clinical specialties are provided in DGH Matale, and statistics of those services are compiled by the Medical Statistics Unit for administrative monitoring and reporting purposes. The study assessed the variation in inpatient bed utilization across clinical specialties over a 24-month period from 1st July 2024 to 30th June 2026.

➤ Study population

Inpatient wards in clinical specialties with complete and comparable bed-utilization data during the study period were included in the study. These wards were General Medicine male and female, General Surgery male and female, two Paediatric wards, male and female Orthopedic wards, Ear Nose Throat(ENT) ward, Dermatology ward, Respiratory Medicine ward and, Psychiatry wards. Cardiology ward was excluded as it was established during the study period. Clinical areas not comparable with conventional inpatient wards, including Intensive care units, Premature baby Unit, Obstetrics and Gynaecology wards were excluded from the study.

Specialty-month was considered the primary unit of analysis, and each ward contributed up to 24 monthly observations. Ward-level data were initially extracted separately. They were aggregated to derive specialty-level measures in specialties where more than one ward provided inpatient care under the same specialty. Aggregation was performed using the underlying numbers of available beds and inpatient days rather than by averaging ward-specific BOR.

➤ Data collection and analysis

Data were obtained from the hospital statistics record. The number of available beds, number of admissions, and inpatient days were extracted for each month and ward. Microsoft Excel data sheet was used to compile data with year, month, clinical specialty, ward, number of available beds, number of inpatient days, and calculated monthly BOR. No individual patient record or personally identifiable information was gathered. Completeness and consistency of data were ensured before analysis. Changes in bed capacity during the study period were reviewed to prevent calculation errors.

The primary measure of bed utilization was BOR. According to the WHO guidance, BOR was calculated as the proportion of available bed days that were occupied during a month. For each ward and month,

Available bed days = Number of available beds/Number of days in the month

Monthly BOR = $\frac{\text{Number of inpatient days during the month}}{\text{Number of available bed days during the month}} \times 100$

The available bed days were calculated according to the actual number of beds available during the respective period. For specialties comprising multiple wards, the monthly BOR was calculated using the combined inpatient days and combined available bed days.

Monthly BOR was calculated for each clinical specialty over a 24-month study period. The distribution and variability of bed utilization were described with descriptive statistics. The mean, standard deviation (SD), minimum, and maximum monthly BOR were calculated for each specialty. Within-specialty variability over time was assessed with SD and the Coefficient of variation (CV). Occupancy levels were interpreted in the context of the characteristics of each clinical service rather than applying a single occupancy threshold to classify specialties as appropriately or inappropriately utilized.

➤ *Ethical and Administrative Consideration*

The study involved secondary analysis of routinely collected hospital statistics; no patient information or intervention was involved. Administrative permission was granted from the relevant authority to access and analyze hospital statistics. All extracted data were stored securely and were utilized only for the study.

III. RESULTS

A total of 288 ward-month statistical observations were analyzed over a 24-months period from July 2024 to June 2026 in twelve wards.

➤ *Bed utilization across clinical units*

Marked differences in BOR were observed, with the mean ranging from 31.34% in Paediatric ward 3 to 117.97% in ENT ward. The highest BOR of 117.97% (SD 16.01) was reported in the ENT ward, and it exceeded 85% during all months of the study period. Monthly BOR ranged from 87.31% to 156.19% (Table 1).

The second-highest mean monthly BOR of 79.88% (SD 6.24) was in female Medical wards, ranging from 71.31% to 94.11%.

Relatively high utilization was demonstrated in the Dermatology ward with a mean monthly BOR of 73.41% (SD 8.11) and a range of 58.92% to 89.78% (Table 1).

The lowest BOR were observed in Paediatric wards 3 and 4 with a mean monthly BOR of 36.97% (SD 11.15), and 31.34% (SD 13.56) respectively (Table 1).

Table 1 Distribution of Monthly BOR by ward, July 2024-June 2026

Ward	Mean BOR* (%)	SD*	Minimum (%)	Maximum (%)
Medical male	54.45	8.81	40.48	69.69
Medical female	79.88	6.24	71.31	94.11
Surgical male	66.25	5.38	58.64	79.87
Surgical female	53.30	6.94	43.01	65.82
Paediatric ward 3	36.97	11.15	22.28	61.29
Paediatric ward 4	31.34	13.56	17.83	73.70
Orthopedic male	65.38	10.68	44.73	83.44
Orthopedic female	64.03	10.06	44.73	83.44
ENT*	117.97	16.01	87.31	156.19
Dermatology	73.41	8.11	58.92	89.78
Respiratory	33.59	6.79	21.10	46.85
Psychiatry	59.5	5.6	47.47	69.79

*BOR- Bed Occupancy Rate SD- Standard Deviation ENT-Ear Nose Throat

➤ *Variability in Bed Occupancy*

The degree of month-to-month variability also differed considerably among ward. The greatest relative variability was observed in Paediatric Ward 4 (CV 43.28%), followed by Paediatric Ward 3 (CV 7.81%) and the Respiratory ward (CV 20.21%). In contrast, Medical female ward (CV 7.81%) and Surgical male ward (CV 8.13%) demonstrated relatively stable monthly BOR. Although ENT ward maintained consistently high occupancy throughout the study period, its CV was 13.57%, indicating that the magnitude of occupancy above nominal bed capacity varied between months.

➤ *Admission Volume*

Considerable differences of ward admissions were observed among clinical specialties during the study period. Surgical male ward (23 433), followed by Medical female ward (22 674) recorded the highest cumulative admissions. Comparatively lower admission volumes were observed in

Orthopedic female ward (1 017) and male ward (1 125), Respiratory ward (1 220). Despite having 10 883 admissions, ENT ward consistently demonstrated the highest BOR throughout the period.

➤ *Overall Pattern of Bed Utilization*

The 24-month analysis of BOR of wards demonstrated substantial heterogeneity in bed utilization across clinical specialties. Sustained BOR above nominal bed capacity was demonstrated in ENT ward, while the medical female ward and the Dermatology ward demonstrated comparatively high occupancy. An intermediate level of bed utilization was demonstrated among the Medical male ward, Surgical male and female wards, Orthopedic male and female wards, and Psychiatry wards. In contrast, both Paediatric wards and the Respiratory medicine ward had low average BOR, with significant month-to-month variability.

IV. DISCUSSION

This study was carried out to study the variation in inpatient bed utilization among 12 wards in various clinical specialties. It demonstrated substantial variation in bed utilization among wards during the 24-month period from July 2024 to June 2026. Persistently high BOR was the most notifiable finding, with a mean monthly BOR of 117.97%, and exceeded 100% during 20 of the 24 months studied. Comparatively high BOR was observed in the female Medical ward (79.88%) and Dermatology ward (73.41%). In contrast, a considerably lower occupancy rate was observed in the two Paediatric wards and the Respiratory Medicine ward. Study findings revealed that hospital-wide measures of bed occupancy may conceal substantial differences in utilization between individual clinical specialties.

From the hospital administration perspective, this observed difference is important (9). BOR depends on interaction between available bed capacity, patient demand, admission patterns, and length of stay, and the appropriate level of BOR may differ according to ward size and specialty (10). A systematic scoping review revealed that the required number of beds is not a norm at hospital and regional levels, but models and methods may be identified and used to estimate bed numbers in hospitals and each ward (6). Further, it highlighted the importance of considering demand, admission rates, length of stay, service characteristics, and variable capacity when determining hospital bed requirements. Various theories were introduced in studies to calculate and determine optimal bed capacities depending on specialty, admission rate (11,12). Accordingly, the identified differences in BOR in the present study should be interpreted as indicators of areas requiring further managerial assessment rather than categorizing as direct evidence of over- or under-utilized beds.

The sustained demand of beds relative to officially evident beds in ENT warrants particular attention. Monthly BOR above 85% in all months and more than 100% in 20 months out of 24 months study period indicates that recorded inpatient days exceeded the theoretical number of bed-days generated by the reported bed complement.

A mean monthly BOR of 79.88% with comparatively low month-to-month variability in female Medical ward demonstrates relatively high and consistent utilization. In contrast, the male Medical ward recorded a mean BOR of 54.45%. It illustrates the limitations of accessing medical bed utilization only at the broad specialty level. With consideration of operational and clinical feasibility, such differences may justify further assessment of whether bed allocation between related wards corresponds to current demand. However, patient sex, ward configuration, staffing, infection control requirements, and further operational constraints need to be considered before discuss on flexible bed use.

Less marked differences were observed between male and female Surgical wards, with mean BOR of 66.25% and 53.30%, respectively. In addition, a reduction in BOR in the

female Surgical ward over the second half of the study period suggests that utilization within a single broad specialty may change over time and may differ between component wards. Therefore, operational planning needs to be more focused with regular review of ward-level utilization than rely on fixed historical bed allocations (12).

Orhtopaedic male and female wards showed similar overall utilization, with mean monthly BORs of approximately 64-65%, although they had greater month-to-month variability. For wards with and moderate utilization but fluctuation on demand, decision on bed capacity should consider temporal variability and periods of peak demand rather than relying solely on average bed occupancy (6,7).

Comparatively low BOR (33.59%) in the Respiratory Medicine ward should not be interpreted in isolation as specialized services may require dedicated beds because of infection prevention requirements and isolation needs. But, planning of bed capacity and service expansion may need be considered to utilize resources maximally.

Interpretation of Psychiatric BOR which was 59.5% requires specific consideration, because length of stay, discharge arrangements, and availability of community and social support services may differ substantially from those of acute medical and surgical wards (13). This further supports the principle that comparisons of BOR across specialties should be interpreted within their respective clinical and operational contexts rather than against a universal target.

Comparatively, both Paediatric wards demonstrated relatively low BOR, with means of 36.97% and 31.34%. Capacity planning in these units needs to be done with combined consideration of BOR and the high month-to-month variability. Modifications need be considered for optimal resource utilization, but peak occupancy with seasonal admission patterns should be incorporated for analysis.

The findings of the present study have relevance to broader Sri Lankan Health system. BOR is an indicator of health service performance, and the Annual Health Bulletin provides national and institutional measures of bed occupancy (8). However, hospital-level or national-level averages can conceal differences between individual clinical services. This study demonstrates the additional managerial value of examining routinely collected statistics at unit level and at shorter time intervals.

Findings suggest the establishment of regular ward-level monitoring of bed utilization rather than relying solely on annual hospital-wide occupancy figures. More detailed assessment need to be done in wards with relatively high BORs and with low BORs. Clinical, functional, and seasonal demand together with staff requirements and reserve capacity need to be considered where clinically appropriate. However, the decision of changing the bed number or redistribute beds should not be based on BOR alone.

Hospital administration has a vital role to assess appropriate use of existing beds and consider admission patterns, length of stay, patient flows and service requirements before increasing bed numbers(14,15).

Assessment of variation in BOR between wards over a 24-month period based on routinely collected data had strengthen the study. Calculation of BOR from monthly inpatient days and available bed-days, rather than relying solely on annual or quarterly occupancy figures, permitted more detailed assessment of temporal patterns. The study also demonstrated the feasibility of transforming available hospital statistics into information relevant to local managerial decision-making without additional primary data collection.

Findings were interpreted with several limitations. The study relied on routinely collected hospital statistics, and was therefore dependent on the accuracy and completeness of these records. Inability to identify daily or within-day periods when demand exceeds available capacity was considered a limitation. Other factors which might limit the number of admissions, such as human and other resource limitation was not considered. A single hospital study was considered a limitation for generalization.

Despite these limitations, this study would be a guide to future studies. Future analysis incorporated with average length of stay, discharge patterns, diagnosis, daily peak occupancy, and staffing level would provide a more comprehensive basis for determining optimal inpatient capacity.

V. CONCLUSION

The bed utilization varied substantially across wards in clinical specialties within the hospital during the two-year study period. Persistently high utilization in the ENT ward and low utilization in the Paediatric and Respiratory Medicine ward, while other clinical services demonstrated intermediate or variable patterns. These findings highlighted the limitations of relying solely on hospital-wide average occupancy and demonstrated the value of routine ward-level and monthly monitoring. Bed occupancy data should be used as a screening and management tool to identify services requiring further assessment, rather than a stand-alone basis for changing bed numbers. Integrating utilization data with clinical demand, patient flow, length of stay, and operational capacity may support more evidence-informed allocation of inpatient resources.

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