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Analysis of Factors Affecting the Bed Occupancy Rate (BOR) in Inpatient Services at Dr. J. H. Awaloei Tateli Hospital

Ade Pratiwi Tubagus*, Dwi Widya Pujiastuti, Gustian Rante Tiballa, James Klemens Phieter Phie
Universitas Pelita Harapan, Indonesia
Email: dwiwidya1991@gmail.com*

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Abstract

Inpatient services are an important component in the operational performance of hospitals that reflect the efficiency of bed utilization. Bed Occupancy Rate (BOR) as the main indicator does not stand alone, but is influenced by other indicators such as Turn Over Interval (TOI), Average Length of Stay (AVLOS), Bed Turn Over (BTO), and the number of hospitalized patients (MRS). This study aims to analyze the factors that affect BOR in inpatient services at dr. J. H. Awaloei Tateli Hospital. The study used an analytical quantitative design with a cross-sectional approach using secondary data for the period March 2025–February 2026 with 84 units of inpatient analysis units per month. The analysis was conducted univariately, bivariately using the Spearman test, and multivariate using multiple linear regression. The results showed that the average BOR was 57.16%, TOI was 3.2 days, AVLOS was 3.28 days, MRS was 240 patients, and BTO was 7.85 times. Bivariate analysis showed that TOI ($r=-0.881$; $p<0.001$), BTO ($r=0.705$; $p<0.001$), and MRS ($r=0.779$; $p<0.001$) were significantly related to BOR, while AVLOS was insignificant ($p=0.375$). Multivariate analysis showed that TOI ($B=-6.485$; $p<0.001$), AVLOS ($B=5.353$; $p=0.005$), MRS ($B=0.194$; $p<0.001$), and BTO ($B=-8.064$; $p<0.001$) had a significant effect on BOR simultaneously with an R^2 value of 0.784. BOR is significantly influenced by TOI, AVLOS, MRS, and BTO, with TOI being the most consistent factor influencing BOR.

INTRODUCTION

Inpatient services are one of the strategic units in the hospital's operational performance because it reflects the hospital's ability to manage bed capacity, patient in-flow and exit, service efficiency, and clinical service quality (Dion et al., 2023; Lifvergren & Lifvergren, 2023; Sinha et al., 2025). In hospital performance evaluation, Bed Occupancy Rate (BOR) is one of the most frequently used indicators, and in a number of studies it is also placed as an important indicator to assess the productivity, efficiency, and ability of hospital management to manage service resources. Bed Occupancy Rate itself is understood as the ratio between treatment days and bed-day capacity in a given period. The BOR indicator is important because it describes the level of utilization of hospital resources where a value that is too low indicates underutilization while a value that is too high can indicate service density and the potential for a decrease in service quality (Talebpour et al., 2025, Nisak & Cholifah, 2020)

Theoretically, BOR does not stand alone, but is influenced by the dynamics of other hospitalization indicators, especially Turn Over Interval (TOI), Average Length of Stay (AVLOS), Bed Turn Over (BTO) and the number of patients admitted to hospital (MRS). In the textbook of health facility statistics, BOR is described as the percentage of average bed use at a given time, AVLOS as the average length of time patients are treated from admission to hospital discharge, TOI as the average time a bed is not used from the time the patient leaves until it is refilled, and BTO shows how often one bed is used by patients in a period. The same book also explains that operationally, the Barber-Johnson efficiency standards that are commonly used are BOR 75–85%, AVLOS 3–12 days, TOI 1–3 days and BTO 35–45 times. Thus, the higher the number of patients admitted and the longer the beds are filled by patients, the BOR tends to increase, whereas the longer the bed is empty between two patients, the BOR tends to decrease (Nisak & Cholifah, 2020).

From the point of view of hospital management, the analysis of the factors that affect the BOR is important because the bed occupancy rate is too low indicates suboptimal resource utilization, while the BOR that is too high can be related to the deterioration of quality, increased workload, and patient safety risks. Research in the English NHS from 2010 to 2018 showed that higher levels of BOR were associated with higher total mortality and surgical mortality, the relationship even after controlling for bedside factors, volume, and other variables, although it was partially reduced after including length of treatment. Other studies show that the management of bed capacity and the distribution of bed resources need to be monitored regularly to ensure that service needs are met stably and efficiently (Kim & Oh, 2024, Laia & Luigi, 2023).

Studies in Indonesia also show that inequality in hospitalization indicators is still common (Laksono et al., 2023; Nugroho et al., 2023; Wulandari et al., 2022; Wulandari, Laksono, Nugraheni, et al., 2025; Wulandari, Laksono, Zuardin, et al., 2025). The study by Fitriani et al. reported a 78% BOR which was considered efficient, but another study at RS X Lampung in 2024 showed that a BOR of 75.91% was efficient, while AVLOS of 2.91 days and TOI of 0.92 days were still below the ideal range. Isnaini et al. even found that the average TOI was only about 0–1 days in some inpatient rooms, which indicates very fast bed rotation and potential problems with recording accuracy and interpretive efficiency. On the other hand, the evaluation at the Port Hospital of Jakarta confirmed that changes in the number of beds can affect BOR, TOI, BTO, and AvLOS, so capacity management must be in line with the number of inpatients served. These findings show that hospitalization efficiency is the result of the interaction of several indicators, not just BOR values (Fitriani, 2024, Isnaini et al., 2024).

Although there have been considerable studies on the efficiency of bed use, most recent research has focused on descriptive analysis using Barber-Johnson graphs to illustrate whether or not BOR, AVLOS, TOI, and BTO are in the efficient zone. These studies generally have not placed BOR as a dependent variable that is specifically analyzed for its determinants, especially simultaneously by including TOI, AVLOS, and the number of MRS patients in a single analytical model. In addition, some studies focus on only one indicator, such as TOI, or on evaluating trends in changes in the number of beds, so they do not provide an adequate quantitative explanation of the magnitude of the influence of each variable on the BOR in a particular hospital. The 2025 scoping review study also shows that although BOR and ALOS are often used as hospital KPIs, there is no single consensus on essential indicators that are

sufficient to explain hospital performance, so a more specific analysis in the local context is still needed (Isnaini et al., 2024, Talebpour et al., 2025).

Based on this description, the formulation of the problem in this study is how the influence of TOI, AVLOS, BTO and the number of MRS patients on the BOR of inpatient services at dr. J.H. Awaloei Tateli Hospital, both partially and simultaneously. This study aims to analyze the factors that affect BOR so that it can be known which variables are most dominant in relation to the inpatient bed occupancy rate. Theoretically, this study is expected to enrich the study of hospital management, especially regarding the relationship between inpatient efficiency indicators. Practically, the results of the research are expected to be the basis for hospital management in planning bed capacity, improving patient service flows, evaluating the length of treatment, and developing policies to improve the efficiency and quality of inpatient services in a more targeted manner (Kim & Oh, 2024, Nisak & Cholifah, 2020).

Thus, the research gap in this study lies in the lack of studies that place BOR as the main outcome and analyze it simultaneously with TOI, AVLOS, the number of MRS patients, and BTO in one research model in a specific hospital context. Previous studies have focused more on evaluating the efficiency of hospitalization indicators in general, while this study seeks to explain the factors that affect BOR in a more analytical and contextual manner at dr. J.H. Awaloei Tateli Hospital. The novelty of this research lies in the integration of the four operational factors of inpatient care in one analytical framework to support data-driven managerial decision-making.

RESEARCH METHOD

This study was a quantitative analysis research using a cross-sectional design that uses secondary data to analyze the factors that affect the Bed Occupancy Rate (BOR) in inpatient services. Cross-sectional design is used to assess relationships between variables over a specific period of time without intervening (Creswell, 2018).

This research was carried out at dr. J. H. Awaloei Tateli Hospital, Minahasa using data for the period March 2025 - February 2026, which is for 1 year. The unit of analysis in this study is the inpatient room per month so that as many as 84 units of analysis were obtained.

The population in this study was all data on hospital inpatient services during the study period. The sampling technique used is total sampling where the entire population is used as a research sample (Suliyanto, 2018).

The dependent variables in this study are Bed Occupancy Rate (BOR) and independent variables include the number of patients admitted to the hospital, Average Length of Stay (AvLOS), Turn Over Interval (TOI) and Bed Turn Over (BTO). BOR data is calculated as the percentage of bed utilization, AvLOS as the average length of time patients are discharged in days, TOI as the average time of unused beds in the day and BTO as the frequency of use of one bed by patients in a given period.

The data used are secondary data obtained from daily census reports of hospitalizations, hospital indicator reports, and hospital management information systems (SIMRS). The data collected included the number of beds, days of treatment, number of patients admitted, number of patients discharged and length of treatment days.

Data processing is carried out through the stages of editing, coding, entry and cleaning

using Microsoft Excel and IBM SPSS version 27. Data analysis was carried out in univariate, bivariate and multivariate manner. Univariate analysis is used to describe the distribution of data. The normality test was carried out using Kolmogorov-Smirnov because the number of samples was more than 50 samples (Suliyanto, 2018).

Bivariate analysis uses the Spearman correlation test because the data is not normally distributed, to determine the relationship between independent variables and BOR. Furthermore, multivariate analysis was carried out using multiple linear regression to determine the simultaneous influence of independent variables on BOR.

The regression assumption test was carried out by looking at multicollinearity through the value of Variance Inflation Factor (VIF) and tolerance with the criteria VIF<10 and tolerance >0.1. All statistical tests used a significance level of $\alpha = 0.05$. This study uses secondary data without the patient's identity so that it maintains confidentiality and research ethics (Suliyanto, 2018).

RESULTS AND DISCUSSION

Data characteristics

This study uses 84 units of analysis in the form of inpatient service data per room per month from March 2025 - February 2026. The results of the descriptive analysis showed that the average BOR was 57.16%, the average TOI was 3.2 days, the average AVLOS was 3.28 days, the average number of patients with MRS was 240 patients, and the average BTO was 7.8 times (Table 1).

Table 1. Descriptive research variables

Variable	Red	Minimum	Maximum
BOR (%)	57,16	11	99
ART (Live)	3,2	0	14,5
AVLOS (day)	3,2	2	8
MRS (patient)	240,5	31	702
BTO (times)	7,85	1,7	17,4

The normality test was then performed with Kolmogorov-Smirnov because the number of samples was more than 50. The results showed that the variables BOR ($p<0.001$), TOI ($p<0.001$), AVLOS ($p=0.022$), and the number of patients with MRS ($p<0.001$) were not normally distributed. Meanwhile, the BTO variable has a value of $p=0.074$ so that it is normally distributed according to the Kolmogorov-Smirnov test. Since most of the major variables are not normally distributed, the analysis of the relationships between variables is performed using Spearman correlation.

Bivariate Analysis

In this study, bivariate analysis was conducted with Spearman to assess the relationship between each independent variable and BOR. The results of Spearman's correlation showed that TOI had a very strong negative relationship with BOR with coefficients of $r = -0.881$ and $p<0.001$. This means that the higher the TOI, the lower the BOR. The AVLOS variable has a

correlation coefficient r = 0.098 with p=0.375, so there is no meaningful relationship between AVLOS and BOR. The BTO variable has a strong positive relationship with BOR with a coefficient of r = 0.705 and p<0.001. Meanwhile, the number of patients with MRS also had a strong positive relationship with BOR with a coefficient of r = 0.779 and p<0.001 (Table 2).

Table 2. Results of the Spearman correlation test between independent variables and BOR

Independent variables	r Spearman	p-value
YOU	-0,881	<0.001
AVLOS	0,098	0,375
BTO	0,705	<0.001
MRS	0,779	<0.001

Correlations between independent variables also show a strong pattern. TOI correlated very strongly negatively with BTO (r=-0.891; p<0.001) and strongly negative with the number of patients who were MRS (r=-0.802; p<0.001). BTO was positively correlated with the number of patients with MRS (r=0.889; p<0.001). AVLOS was negatively correlated with BTO (r=-0.380; p<0.001) and with the number of patients with MRS (r=-0.390; p<0.001), but was not significantly associated with TOI (r=0.103; p=0.352) (Table 3).

Table 3. Spearman correlation matrix between variables

Variable	BOR	YOU	AVLOS	BTO	MRS
BOR	1,000	-0,881	0,098	0,705	0,779
YOU	-0,881	1,000	0,103	-0,891	-0,802
AVLOS	0,098	0,103	1,000	-0,380	-0,390
BTO	0,705	-0,891	-0,380	1,000	0,889
MRS	0,779	-0,802	-0,390	0,889	1,000

Multivariate Analysis

Multivariate analysis was performed using multiple linear regression with BOR as the dependent variable and TOI, AVLOS, the number of patients with MRS, and BTO as independent variables. The results showed that the regression model was significant overall, with values F = 71.883 and p<0.001. The value of R = 0.886 indicates a strong relationship between all independent variables and BOR. The value of R Square = 0.784 and Adjusted R Square = 0.774 indicates that 78.4% of BOR variation can be explained by TOI, AVLOS, the number of patients who are MRS, and BTO simultaneously (Table 4).

Table 4. Summary of regression models

Components	Value
R	0,886
R Square	0,784
Adjusted R Square	0,774
Std. Error of Estimate	12,9447
F	71,883
p-value	<0.001

The results of the partial test showed that all variables in the model had a significant influence on the BOR. The TOI variable has a coefficient of B = -6.485 with p<0.001, which means that every 1 unit increase in TOI will decrease the BOR by 6.485%. The AVLOS variable has a coefficient of B = 5.353 with p=0.005, so every 1-day increase in AVLOS will increase the BOR by 5.353%. The variable number of patients with MRS has a coefficient of B = 0.194 with p<0.001, which means that an increase of 1 patient in the hospital will increase the BOR by 0.194%. The BTO variable has a coefficient of B = -8.064 with p<0.001, indicating the direction of negative influence in the regression model (Table 5).

Table 5. The result of multiple linear regression.

Variable	B	p-value
Constanta	76,978	<0.001
YOU	-6,485	<0.001
AVLOS	5,353	0,005
MRS	0,194	<0.001
BTO	-8,064	<0.001

This research was conducted to answer the research gap that is still seen in the study of inpatient efficiency. The literature shows that length of stay and bed occupancy rate are among the most frequently used indicators in hospital performance evaluation, but most studies still describe indicators descriptively, not many have modeled the simultaneous influence between indicators at the service unit level. The 2024 scoping review found that LOS was reported in 47% of studies and BOR in 23% of hospital performance evaluation studies. On the other hand, the healthcare operations management perspective also places patient flow, performance management, and resource utilization as the core of hospital management. In that context, this study adds value because it uses units of room analysis per month and examines the relationship and influence of TOI, AVLOS, the number of patients with MRS, and BTO on BOR, rather than just assessing the position of indicators in the Barber-Johnson graph as is commonly done

in national studies. (Hadian et al., 2024, McLaughlin et al., 2022)

Descriptively, this study shows that the average BOR is 57.17%, TOI is 3.21 days, AVLOS is 3.28 days, the number of patients with MRS is 240 patients, and BTO is 7.85 times. These findings illustrate that the utilization of beds at dr. J. H. Awaloei Hospital has not been evenly distributed between rooms and between months, with wide variations, especially in BOR and TOI. When compared to several recent national studies, the average BOR of this study is lower than the BOR of Hospital X Lampung in 2024 of 75.91% and much lower than the BOR of Bunda Margonda Hospital of 91.01%; however, it is still comparable to the tendency of BOR which is not optimal in the RSI of Siti Aisyah Madiun which moved from 65.24% in 2022 to 69.00% in 2024. These differences show that the problem at dr. J. H. Awaloei Hospital is not just high occupancy, but rather fluctuations in utilization between units that need to be read operationally. Because the unit of analysis of this study is room-per-month, the results are indeed more sensitive to capturing micro-variations than hospital-per-year aggregate studies that take overall BOR data for all rooms. (Marsim et al., 2025, Lestari & Ramadhan, 2025)

The results of the bivariate analysis showed that TOI had a very strong negative relationship with BOR ($r = -0.881$; $p < 0.001$), and in the multivariate model the TOI remained significant with a negative coefficient ($B = -6.485$; $p < 0.001$). This answers the formulation of the problem that the longer the bed is empty before being reused, the lower the occupancy rate. Operationally, this result is easiest to understand in terms of patient flow: delayed bed turnover will reduce the utilization of available capacity. These results are consistent with a pattern seen in national studies: hospitals with high BOR tend to have very low TOI, such as Bunda Margonda Hospital and X Lampung Hospital. More broadly, the international literature also shows that bed occupancy is related to hospital performance and needs to be read alongside patient flow indicators, rather than as stand-alone numbers. Thus, TOI in this study appears as the most stable operational indicator explaining BOR changes. (Lestari & Ramadhan, 2025, Marsim et al., 2025, Bosque-Mercader & Siciliani, 2022)

The number of patients hospitalized (MRS) variable was shown to be positively associated with BOR in bivariate analysis ($r = 0.779$; $p < 0.001$) and remained significant in the regression model ($B = 0.194$; $p < 0.001$). This result answers the formulation of the problem that the higher the number of patients admitted to hospitalization, the higher the utilization of beds. Managerially, these results confirm that BOR is not only a function of the number of beds, but the result of the interaction between service demand and patient flow speed. International studies on bed capacity optimization in South Korea also show that the main problem in bed management is not just total capacity, but inequality in utilization and in-patient flow at the operational level. Meanwhile, a national study at Royal Prima Medan and Sejiran Setason emphasized that service factors, service flow, resources, and patient access can affect the low BOR rate. In other words, the findings of a significant number of inpatients in this study show that patient demand remains the main driver of occupancy, but the impact is only optimal if the system is able to maintain bed turnover efficiently (Hartamto et al., 2025, Lestari & Ramadhan, 2025)

In contrast to TOI, AVLOS did not show a significant association in bivariate analysis ($r = 0.098$; $p = 0.375$), but became significant in multivariate models ($B = 5.353$; $p = 0.005$). This difference shows that the effect of length of treatment on BOR does not work simply, but only

appears after other variables such as TOI, the number of patients who are MRS, and BTO are controlled. Operationally, patients who are treated longer will use the bed longer, but the effect on occupancy is only apparent when demand pressures and the efficiency of bed turnover are also considered. This is in line with the international literature that places LOS as a very important indicator for resource planning, cost, and efficiency, but it is complex in nature because it is influenced by the patient's characteristics, severity, complications, and discharge process. The Bosque-Mercader and Siciliani studies also show that the relationship between occupancy and hospital quality is partly explained by LOS; in their model, control of LOS reduced some of the relationship between high BOR and poorer quality outputs. Therefore, AVLOS in this study cannot be considered insignificant, but rather its contribution becomes clear when read together with other hospitalization indicators (Stone et al., 2022, Bosque-Mercader & Siciliani, 2022)

The interpretation of BTO in this study needs to be read more carefully. In bivariate analysis, BTO was positively correlated with BOR ($r = 0.705$; $p < 0.001$), which makes operational sense because the more often one bed is used alternately, the higher the utilization rate. However, in the multivariate model the BTO coefficient turned negative ($B = -8.064$; $p < 0.001$). This change in direction cannot be read substantively without considering the problem of multicollinearity, since BTO is also very strongly correlated with MRS ($r = 0.889$) and very strongly opposite direction with TOI ($r = -0.891$). Conceptually, this shows that BTO, MRS, and TOI capture very close dimensions of utilization, so that when put together in a single model, some of the information carried by each variable overlaps (Hartamto et al., 2025, Lestari & Ramadhan, 2025).

Overall, the regression model of this study was significant ($F = 71.883$; $p < 0.001$) with $R^2 = 0.784$, meaning that approximately 78.4% of BOR variation could be explained by TOI, AVLOS, the number of patients who were MRS, and BTO. This answers the formulation of the main problem that the BOR at dr. J. H. Awaloei Hospital is indeed influenced by a combination of inpatient operational indicators, not just by one single indicator. However, judging from the consistency of bivariate and regression results, TOI appears to be the most stable explanation, followed by the number of inpatients. These findings confirm that efforts to increase BOR at Awaloei Hospital are more appropriately directed at accelerating bed turnover, strengthening the admission-discharge-transfer process, and structuring patient flows between rooms, not just pursuing an increase in the volume of hospitalizations. These results also clarify the research's contribution to the research gap: unlike many recent national studies that are still descriptive and Barber-Johnson-based at the hospital level, this study shows empirically at a room-per-month level which indicators actually move with the BOR, which only appear important after being controlled together, and which pose interpretive problems due to multicollinearity (Hadian et al., 2024).

CONCLUSION

This study shows that the Bed Occupancy Rate (BOR) in inpatient services at dr. J. H. Awaloei Tateli Hospital is significantly influenced by Turn Over Interval (TOI), Average Length of Stay (AVLOS), number of inpatient admissions (MRS), and Bed Turn Over (BTO). Bivariately, TOI, BTO, and MRS had a significant relationship with BOR, whereas AVLOS did not show a meaningful relationship. However, in multivariate analysis, all variables were

shown to have a simultaneous significant effect on BOR. Turn Over Interval is the variable that most consistently affects BOR with negative relationship directions, indicating that the longer the bed is unused, the lower the bed occupancy rate. The variable of the number of patients with MRS also plays an important role in increasing the BOR as an indicator of service demand, while AVLOS contributes after being controlled with other variables. Interpretation of BTO needs to be done carefully because there is a very strong relationship with other variables that can cause multicollinearity. Overall, this study confirms that BOR is not only influenced by one indicator, but is the result of the interaction of various inpatient operational indicators.

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