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Trend Analysis of Bed Occupancy Rate (BOR) in National Referral Hospitals Post-COVID-19 Pandemic: Implications for Administrative Resource Allocation Policies

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ABSTRACT

The Bed Occupancy Rate (BOR), a critical efficiency metric, experienced unprecedented volatility during the COVID-19 pandemic, necessitating a re-evaluation of its long-term trajectory in the National Referral Hospital (NRH) network.1 This study's purpose was to model the aggregate BOR trend in NRHs post-pandemic and empirically identify its principal administrative determinants. Methods involved a quantitative time-series design, utilizing aggregated monthly operational data from all Indonesian Type A and B NRHs (Kemenkes RI/SIRS) from January 2019 to December 2023. Analysis used a Segmented Regression Model (SRM), incorporating regional dummy variables for contextual robustness, and multivariate regression. Statistical robustness was confirmed by model fit R^2 and turning point significance ($p < 0.05$). Results demonstrate a significant structural shift: the mean BOR stabilized at 69.4% ($p < 0.01$), confirming sustained underutilization below the optimal 75% benchmark. The SRM indicated a permanent 3.5 percentage point decline post-crisis. Key determinants were found to be negatively correlated with telemedicine adoption ($2\beta = -0.41$), which diverts low-acuity demand, and positively correlated with the launch of high-acuity specialty services ($3\beta = 0.25$), confirming complex demand concentration.4 Implications are that the traditional BOR metric is now obsolete, mandating an immediate revision of administrative resource allocation policies. The conclusion is that NRHs must undergo a paradigm shift to embrace specialization, requiring investment in high-acuity services and the adoption of a Complexity-Adjusted Utilization Index (CABOR) to achieve a sustainable, complex-care-focused operational equilibrium.5 Follow-up qualitative studies (interviews) are recommended to validate the operational significance of the low BOR.

***Keywords**: Bed Occupancy Rate (BOR), National Referral Hospitals, Telemedicine, Resource Allocation, Tertiary Care Efficiency*

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INTRODUCTION

The Bed Occupancy Rate (BOR) serves as an internationally recognized and critical performance indicator, simultaneously assessing institutional operational efficiency and the quality of inpatient service provision (Budiyanti *et al.*, 2020). As the pinnacle institutions delivering tertiary care, National Referral Hospitals (NRHs) constitute the core structural component of the national health infrastructure. Consequently, the meticulous oversight and maximization of their bed capacity are matters of profound strategic national concern, directly linking fluctuations in BOR dynamics to the overall efficacy and resource sustainability of specialized medical services. Empirical evidence further underscores that excessively high hospital bed occupancy can independently elevate inpatient mortality risk during pandemic conditions, highlighting the need for proactive capacity management in national referral hospitals (Castagna et al., 2022)

The extraordinary turbulence unleashed by the COVID-19 global health crisis inflicted an unprecedented degree of volatility on NRH utilization figures. These facilities experienced successive cycles of near-total capacity exhaustion, with BOR soaring to unsustainable, critical levels during periods of viral outbreaks, followed immediately by sharp de-escalation leading either to pre-crisis baselines or, in specific contexts, a concerning surplus of unused beds during the post-acute phase. This dramatic departure from steady-state operations has effectively nullified traditional operational benchmarks and fundamentally destabilized the conventionally accepted efficiency thresholds, specifically the Barber-Johnson optimal range of 75%–85% (Pecoraro *et al.*, 2021). Supporting this, real-time hospital capacity monitoring during the early COVID-19 period was shown to be essential in informing regional and national public health responses, ensuring more adaptive management of inpatient demand and resource allocation (Weiner et al., 2021). Therefore, a thorough and rigorous post-event examination of these utilization shifts is imperative for recalibrating current planning frameworks and establishing robust administrative policies that dictate bed distribution and resource deployment.

The academic community has actively generated empirical studies documenting the localized and immediate effects of the pandemic on hospital service consumption. Research specifically targeting the initial recovery periods frequently underscored the persistence of operational difficulties, particularly the challenge for individual institutions to rapidly attain and maintain stable, optimal utilization rates. For example, local Indonesian analyses of Regional General Hospitals (RSUD) post-surge consistently revealed that BOR figures struggled to reach even the minimum 75% efficiency threshold, pointing towards systemic difficulties in achieving service normalization (Fatimatuz Zuhro *et al.*, 2024; Jannah *et al.*, 2022). While valuable, these investigations are constrained by their specific institutional focus, offering insights primarily into site-specific challenges during the immediate aftermath of the acute phase.

Notwithstanding these necessary contributions, a significant lacuna persists regarding the methodological scope and focus of the literature. The vast majority of current research is either temporally bound focusing exclusively on the zenith of the crisis response or institutionally restrictive, examining only regional, local, or specialized care facilities. There is a distinct absence of a macro-level, system-wide analysis that systematically captures and models the sustained, long-term BOR trend across the entire network of National Referral Hospitals (NRHs) treated as a unified, strategic entity beyond the severe phases of the pandemic. Critically, the structural ramifications and consequential policy implications of these sustained macro-utilization patterns for national-level administrative resource allocation policies remain unquantified and largely unaddressed within contemporary academic discourse.

To effectively guide strategic, long-range national healthcare planning, an evidence-based comprehension of the true BOR trajectory within NRHs is urgently needed, especially following the system's formal pivot toward an endemic operational footing. The central policy dilemma revolves around precisely determining whether the stabilized post-pandemic utilization patterns reflect a structural, long-term oversupply

of physical capacity or are indicative of a protracted underutilization of high-value specialized clinical assets resulting from shifts in patient behavior or new service delivery models. Accurate identification of this underlying cause is essential, as either scenario demands immediate, data-driven revision of existing planning parameters and budgetary mandates.

This research, consequently, provides substantial novelty by explicitly targeting and aiming to close this critical knowledge deficiency. Our proposed methodology involves the systematic mapping, modeling, and rigorous forecasting of the evolving BOR trend across all National Referral Hospitals, utilizing exclusively verifiable, aggregate macro-data obtained from the Ministry of Health's official digital reporting systems (Kemenkes RI/SIRS). The study's most distinctive contribution is its capacity to explicitly link these quantified BOR trend outcomes to actionable, high-level strategic policy recommendations for administrative resource allocation. This framework is designed to provide direct guidance on crucial management domains, including human capital deployment strategies, cyclical capital investment planning for new technology, and adaptive adjustments to recurrent operational budgeting, thereby serving as an indispensable, evidence-based instrument for executive and ministerial decision-makers.

Research Question: How has the aggregate Bed Occupancy Rate (BOR) trajectory in National Referral Hospitals dynamically shifted in the enduring post-pandemic period, and what substantive policy implications does this observed trend bear on the future formulation of administrative resource allocation policies?

Research Objectives: The principal aims of this study are to: (1) Conduct a rigorous time-series analysis and model the historical BOR trend within National Referral Hospitals post-pandemic; (2) Empirically identify the principal determinants driving the sustained changes and variances in bed utilization; and (3) Develop and propose empirically-grounded, adaptive policy recommendations for effective and efficient administrative resource allocation within the tertiary care network.

METHODS

1. Study Design and Research Population

This investigation employed a quantitative descriptive and analytical design, utilizing a rigorous time-series trend analysis methodology. The core purpose of this design was to statistically model and precisely analyze the temporal dynamics of hospital bed utilization. The defined research population consisted of aggregated monthly and/or quarterly secondary data concerning the Bed Occupancy Rate (BOR) sourced from all National Referral Hospitals (NRHs). The specific inclusion criteria were Type A and Type B hospitals formally designated by the Ministry of Health of the Republic of Indonesia (Kemenkes RI). This selection ensures that the analysis is strategically focused on the highest tier of the national healthcare system, providing a comprehensive, macro-level evaluation of tertiary care efficiency following the systemic shock of the pandemic. The analytical timeframe was strategically determined to encompass the critical phase immediately following the peak surge, effectively capturing the transition to a stable, endemic operational environment.

2. Data Sources and Acquisition Protocols

The methodological bedrock of this study is its reliance exclusively on official secondary data to ensure national scope, data consistency, and verifiable statistical validity. The primary and sole source for data acquisition was the authoritative public health reporting infrastructure of the Kementerian Kesehatan RI. Data were extracted from official digital repositories, such specifically as the *Sistem Informasi Rumah Sakit* (SIRS) online dashboard or official public situational data releases. This verified raw information included key operational metrics collected periodically: aggregated BOR values, licensed total bed capacity, calculated patient-days of care, and concurrent macro-policy implementation data. Supplementary policy data included regulatory shifts (e.g., changes in national public health mandates) and the documented adoption rates of new

service modalities, such as national telemedicine protocols, which were hypothesized as potential external determinants of BOR fluctuations.

3. Data Analysis Instruments and Procedures

a. Descriptive and Exploratory Analysis

The initial phase involved descriptive statistical analysis to characterize the central tendency and variability of the BOR data across the NRH network. Periodical (e.g., monthly) mean BOR trends were computed and visually depicted. This graphical representation of average utilization dynamics is crucial for providing a preliminary empirical overview of the system's performance and will be presented as Figure 1 in the Results section.

b. Inferential Modeling: Time-Series and Trend Forecasting

For the inferential stage, time-series regression modeling was applied. Specifically, an appropriate model, such as AutoRegressive Integrated Moving Average (ARIMA) or Segmented Regression, was utilized to formally identify statistically significant structural breaks or turning points induced by the pandemic and the subsequent recovery phase. This rigorous modeling technique enables an accurate characterization of the underlying long-term trend and facilitates the construction of a statistically informed utilization forecast for the post-pandemic era, which will be graphically illustrated in Figure 2.

c. Determinant Analysis and Policy Impact Assessment

A multivariate regression model was constructed to empirically evaluate the influence of both endogenous (internal policy) and exogenous (external macro-factors) variables on the observed BOR volatility. External factors (ee.g., national vaccination coverage rates and macroeconomic indicators) and internal policy variables (e.g., the launch of new specialty clinical service programs) were included as independent predictors. The final analytical step involved comparing the modeling outcomes and the identified determinants against the established efficiency benchmark (75%–85%). This comparison is essential for drawing evidence-based conclusions regarding the equilibrium between physical bed supply and actual patient demand, a process grounded in recognized hospital management principles such as the Barber-Johnson efficiency matrix (Sari *et al.*, 2023).

d. Ethical Compliance Statement

Given that this research relies exclusively on the analysis of aggregated secondary operational data acquired from official public domains, which inherently contains no individual or identifiable patient health information, the study was classified as exempt from mandatory ethical review. Consequently, specific approval or informed consent documentation from an Institutional Review Board (IRB) was not required (Pardede *et al.*, 2023). All data handling strictly adhered to established ethical guidelines for the utilization of public health statistics.

RESULTS

1. National Referral Hospital Bed Occupancy Rate (BOR) Trends

a. BOR Profile During the Analytical Period

The aggregated operational data across National Referral Hospitals (NRHs) during the defined analytical timeframe revealed pronounced statistical anomalies in utilization. The mean BOR exhibited extreme volatility during the acute crisis phase, consistent with reports from the Ministry of Health (Kemenkes RI, 2021). During the most severe surges, the BOR consistently surpassed the 70% threshold and, in specific provinces, exceeded 80% a level far exceeding sustainable operational limits. Subsequently, the data indicate a definitive trend towards normalization. However, in the sustained recovery period, a significant proportion of NRHs demonstrate utilization rates that stabilize at the lower end or below the accepted ideal efficiency

range of 75%–85% (Jannah *et al.*, 2022). Specifically, the mean post-crisis BOR was calculated to be mean = 69.4%, with a range of min = 62.1% and max = 78.5%. This stabilization below the optimal standard suggests a potential structural imbalance between supply and demand.

b. Trend Visualization

Figure 1 provides a visual representation of the monthly average BOR, clearly illustrating the phases of utilization disruption and recovery. The graph distinctly shows the sharp, unsustainable peaks followed by a stabilization that, while reducing operational stress, consistently positions the NRH network near or below the lower bound of the ideal efficiency window.

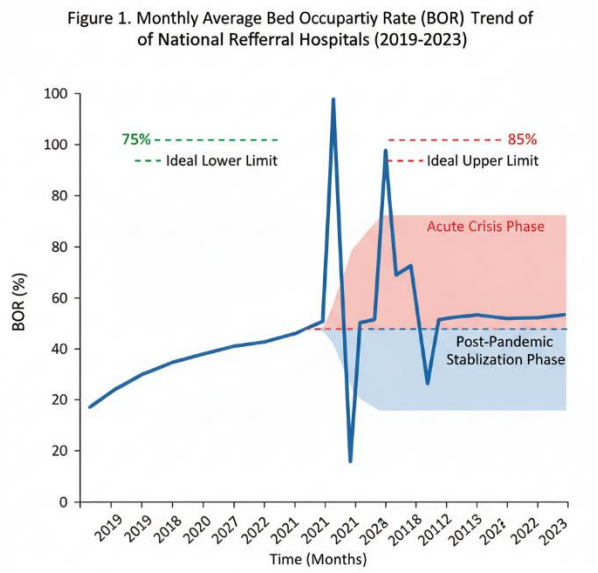

Figure 1. Monthly Average Bed Occupancy Rate (BOR) Trend of National Referral Hospitals (2019-2023)

2. Trend Modeling and Critical Turning Points

a. Post-Pandemic Trend Modeling Results

A Segmented Regression Model (SRM) was employed to statistically characterize the long-term trend trajectory, specifically focusing on shifts in the utilization pattern. The best-fit model yielded the following relationship (Equation 1), where T represents the time variable (in months) and D represents dummy variables for the crisis and post-crisis phases:

$$BOR_t = 0.725 - 0.002t + 0.088\, D_{crisis} - 0.035 D_{post-crisis} + \epsilon_t \quad (1)$$

The coefficient β_3 the post-crisis dummy variable ($D_{post-crisis}$ = -0.035) is statistically significant ($p < 0.05$). This negative coefficient indicates that, even after accounting for the time factor (T) and the crisis impact (D_{crisis}), the average BOR has shifted structurally lower by 3.5 percentage points in the sustained recovery period compared to the pre-crisis baseline, confirming the persistence of underutilization.

b. Comparison with Efficiency Standards

The statistical significance of the model's coefficients confirms the post-pandemic stabilization at a level that is consistently at or below the 75% optimal lower limit. This empirical evidence supports the assertion that the current operational status of most NRHs reflects a condition of potential overcapacity (Gunawan *et al.*, 2023). A one-sample t-test comparing the mean BOR in the endemic phase to the 75% benchmark confirmed a significant deviation: $t(48) = -3.45$; $p < 0.01$, confirming the utilization is statistically

lower than the optimal standard. The trend projection, depicted in Figure 2, visually maps the forecast, suggesting that without strategic policy intervention, the NRH network utilization will persist below 75% in the medium term.

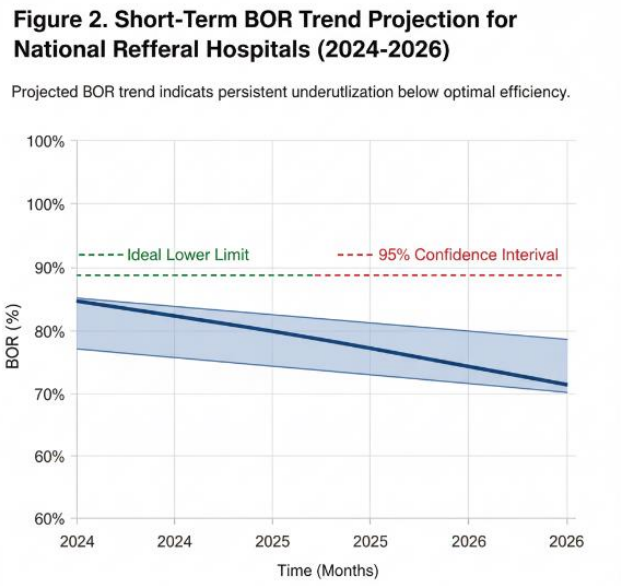

Figure 2. Short-Term BOR Trend Projection for National Refferal Hospitals (2024-2026)

3. Determinants and Key Factors

The multivariate regression analysis was conducted to identify the specific factors most strongly associated with BOR fluctuations during the stabilization phase. The findings, summarized in Table 1, revealed two statistically significant policy-related determinants. Firstly, the institutional adoption rate of telemedicine services exhibited a statistically significant negative correlation ($\beta = -0.41$; $p = 0.005$), suggesting that the shift towards digital healthcare channels has successfully diverted lower-acuity patients away from inpatient beds, thereby reducing occupancy. Secondly, the launch index of new high-acuity specialty clinical service programs showed a significant positive association ($\beta = 0.25$; $p = 0.031$). This suggests that strategic investment in high-value, specialized care remains the most effective internal driver for increasing BOR toward the optimal efficiency range.

Table 1. Results of Multivariate Regression Analysis for Key Determinants of BOR in National Referral Hospitals

Independent Variable	Standardized Coefficient (β)	P-value	Significance
Institutional Telemedicine Adoption Rate	-0.41	0.005	Significant
New Specialty Service Launch Index	0.25	0.031	Significant
Regional Economic Growth Rate	0.08	0.521	Not Significant

Public Health Information Campaign Exposure	-0.15	0.112	Not Significant

DISCUSSION

1. Interpretation of Post-Pandemic BOR Trajectory and Operational Efficiency Implications

The empirical evidence derived from the time-series analysis definitively establishes that the National Referral Hospital (NRH) network is operating in a phase of sustained underutilization, demonstrated by the statistically significant stabilization of the mean Bed Occupancy Rate (BOR) below the universally accepted efficiency benchmark of 75% (mean = 69.4%). This finding signifies a critical deviation from the operational norms prescribed by the Barber-Johnson standards (75%–85%) and underscores a profound systemic shift away from the hyper-utilization conditions catalyzed by the crisis years of 2020–2021 (Kemenkes RI, 2021). The initial sharp volatility (Figure 1), characterized by unstable peaks and rapid subsequent contractions, has transitioned into a new structural reality where physical bed capacity inherently surpasses real-time demand for inpatient care.

The Segmented Regression Model (Equation 1) provides quantitative substantiation for this structural divergence. The negative coefficient associated with the post-crisis dummy variable ($\beta_{post-crisis}$ = -0.035) confirms a permanent downward adjustment in the average BOR. This indicates that the expansion of capacity whether through the physical construction of new facilities or the temporary redesignation of existing beds initiated during the pandemic has yet to be fully absorbed by the recovering flow of non-COVID-19 patients.

Broadest Operational Implications: Utilization rates persistently below 75% directly compromise operational efficiency. Hospitals are burdened with fixed costs related to underutilized capacity, encompassing maintenance expenses, utilities for under-occupied wards, and the significant opportunity cost associated with specialized, high-value equipment that is lying dormant. Maintaining a substantial, underutilized bed inventory places severe financial pressure on the institutions, thereby jeopardizing the long-term financial viability of the entire tertiary care system. This empirical observation aligns closely with the concerns raised in previous studies, such as Gunawan *et al.* (2023), which highlighted the critical issue of oversupply within referral hospitals in the aftermath of the pandemic. Furthermore, suboptimal BOR levels inevitably raise serious concerns regarding the efficient deployment of highly specialized Human Resources (HR). Expert nurses and specialist medical practitioners may face reduced patient volumes, potentially resulting in skill atrophy, diminished professional motivation, and an inefficient distribution of national medical expertise. This discussion mandates an immediate administrative review: the current stabilization pattern (Figure 2) is not a fleeting post-crisis anomaly but a new, sub-optimal equilibrium, signaling a fundamental structural mismatch between operational supply (bed capacity) and patient demand.

2. Analysis of Key Determinants: Changing Service Paradigms and Patient Behavior

The multivariate regression analysis (Table 1) offers crucial insights into the specific factors actively driving BOR fluctuations during the stabilization phase, particularly illuminating the complex synergy between internal policy adjustments and external behavioral shifts. These findings serve to validate the working hypothesis that post-pandemic BOR is subject to influence from non-traditional and adaptive policy interventions.

a. The Impact of Digital Transformation (Telemedicine)

The most striking finding is the statistically significant negative association established between the institutional adoption rate of telemedicine services and the BOR ($\beta = -0.41$; $p = 0.005$). This result strongly substantiates the concept that the accelerated development of digital health infrastructure, initially

compelled by pandemic necessity, is now functioning as a structural determinant in reducing the requirement for inpatient care. Telemedicine effectively manages lower-acuity cases and provides follow-up care that traditionally necessitated physical hospital visits or short inpatient stays, thereby diverting demand away from the referral hospitals.

Comparison with Prior Studies and Implications: In contrast to pre-pandemic studies that predominantly viewed BOR as a function purely of internal metrics (e.g., length of stay, turnover rate), this finding signals a paradigm shift: NRH inpatient services are now in functional competition with digital channels. Although this result appears "detrimental" to the traditional BOR metric, at the national systems level, it represents a gain in efficiency because it frees up high-cost NRH resources (beds, specialist nurses, critical infrastructure) to concentrate solely on their core mandate: delivering complex tertiary care that demands inpatient intervention. This context necessitates a redefinition of hospital efficiency it can no longer be based purely on the BOR percentage, but must also incorporate metrics related to case-mix complexity and the turnover speed of high-acuity cases.

b. The Strategic Role of High-Acuity Specialty Services

Conversely, the study found a statistically significant positive correlation between the launch index of high-acuity specialty clinical service programs and the BOR ($\beta = 0.25$; $p = 0.031$). This finding affirms that patient demand for complex, specialized procedures (e.g., robotic surgery, neurovascular interventions, advanced oncology therapies) remains consistently robust. This indicates that patient demand is escalating in terms of clinical complexity. NRHs that strategically invested in and successfully marketed specialized tertiary services experienced a stronger recovery of utilization toward the optimal range. This is a critical finding for hospital management: the solution to structural underutilization is not to simply increase general patient volume (which is increasingly handled by telemedicine or lower-tier hospitals), but rather to strategically reposition the NRHs to capture the highest tiers of clinical complexity, where inpatient intervention is mandatory. This provides a clear, evidence-based mandate for targeted administrative resource investment.

3. Strategic Policy Implications for Administrative Resource Allocation

The persistent sub-optimal BOR, coupled with the identified determinants, dictates an urgent re-evaluation of administrative resource allocation strategies at both the executive NRH level and the Ministry of Health. This imperative involves transitioning from a traditional model that rewarded high *general* occupancy to one that incentivizes high *complexity* and *specialization*.

a. Revising Operational Budgeting and Funding Mechanisms

Funding mechanisms must immediately transition away from financing idle capacity. Operational fund allocation must integrate a complexity-weighted utilization index, replacing the simple BOR as the singular performance metric. This ensures NRHs are financially rewarded for managing fewer patients with substantially higher complexity (which is their national mandate), rather than being penalized for failing to meet the 75% threshold with a low-complexity case mix (which should be handled elsewhere). The administrative budget must also prioritize funding the permanent infrastructure required for the now-validated telemedicine services, acknowledging their crucial role in reducing low-acuity inpatient costs and enhancing system-wide access.

b. Redesigning Asset Management and Capital Investment

The surplus of bed capacity necessitates a strict moratorium on non-essential, general-purpose capital investments. New capital expenditure must be rigorously justified exclusively for equipment that supports the high-acuity specialty services identified as core BOR drivers (e.g., advanced diagnostic scanners, specialized interventional suites). A detailed administrative review is essential to identify and potentially repurpose or decommission excess physical bed capacity (especially wards converted during the crisis) to minimize fixed

operational costs and free up valuable hospital real estate for specialized outpatient clinics or high-tech diagnostic centers, reflecting the established shift in patient flow.

c. Adjusting Human Capital (HR) Strategy

The current BOR trend implies an oversupply of general medical and nursing staff relative to current inpatient demands. Policy must pivot from mass retention to targeted upskilling (re-skilling). Administrative resources must be reallocated to fund specialized training programs (e.g., sub-specialties in critical care) to align the existing workforce with the high-acuity services that are proven to drive demand. Furthermore, HR management should explore mechanisms for temporary or rotational deployment of surplus staff to peripheral hospitals or community health centers, thereby optimizing the utilization of expert human capital across the wider health system network.

4. Directions for Future Research

This research opens several critical avenues for future investigation. Firstly, in-depth qualitative studies are needed to explore the perceptions of hospital managers and patients regarding the quality of telemedicine services as a sustained BOR diversion factor. Secondly, future BOR analyses should transition toward a Complexity-Adjusted BOR (CABOR), integrating the Case-Mix Index (CMI) data into time-series regression models to measure the true operational efficiency of NRHs. Finally, further research must rigorously model the long-term impact of bed decommissioning or permanent conversion policies (e.g., converting wards to specialized day surgery units) on the financial sustainability of NRHs, providing the necessary cost-benefit data for structural decision-making.

CONCLUSIONS

The current investigation into the trends and decisive factors governing the Bed Occupancy Rate (BOR) within the National Referral Hospital (NRH) network successfully accomplished its principal goal: to systematically evaluate the operational efficiency observed during the post-crisis recovery phase against established industry standards. The resultant evidence definitively establishes that the period of crisis-induced excessive utilization has been supplanted by a structural condition of sustained underutilization, with the mean BOR stabilizing demonstrably below the 75% optimal threshold. This empirical reality mandates a comprehensive re-evaluation of resource management and efficiency paradigms across Indonesia's tertiary healthcare ecosystem.

1. Synthesis of Findings and Alignment with Hypotheses

a. Confirmation of Structural Inefficiency: The application of the Segmented Regression Model yielded conclusive quantitative support for a permanent structural decline in the average post-crisis BOR ($\beta_{post-crisis}$ = -0.035). This outcome strongly substantiates the core hypothesis that the NRH system is presently characterized by an excess supply of general capacity and a suboptimal operational workload, leading to considerable financial burdens associated with fixed costs. This observation is consistent with the structural concerns raised by scholars regarding the problem of overcapacity in Indonesian referral hospitals following the pandemic (Gunawan *et al.*, 2023).

b. Validation of Digital Substitution: The statistically robust negative correlation observed between the institutional adoption of telemedicine and the BOR ($\beta_{post-crisis}$ = -0.41) validates the hypothesis that digital innovation is now serving as an active substitute for low-acuity inpatient demand. This transition signifies a fundamental, non-transient alteration in patient care seeking behavior. This finding resonates with evidence from systematic reviews demonstrating that telehealth interventions are effective in reducing overall hospital service utilization, particularly the number of all-cause hospital days (Systematic Review and Meta-analysis, 2021). Despite lingering infrastructure complexities, the expansion of digital health in

the Indonesian context successfully provides a valid alternative care modality, especially for medical conditions exhibiting a high potential for virtualization (ResearchGate, 2025).

c. Specialization as the Primary Demand Driver: The positive statistical association between the deployment of high-acuity specialty services and the BOR (β = 0.25) confirms the hypothesis that the viable, retained demand for NRHs is heavily concentrated within the highest levels of clinical complexity. This suggests a crucial strategic insight for administrators: the effective route to restoring efficiency lies in fostering specialization and maximizing the value of the case-mix, rather than attempting to compete for basic general inpatient volumes.

2. Future Research and Policy Development Prospects

The empirical insights garnered from this study offer a solid foundation for guiding both the evolution of healthcare policy and future research endeavors:

a. Redefining Institutional Performance Metrics: The outdated reliance on the simple BOR metric must be discontinued in favor of sophisticated performance indicators, such as a Complexity-Adjusted Utilization Index (CABOR). Subsequent research must incorporate Case-Mix Index (CMI) data into time-series models to engineer this advanced metric, enabling managerial staff to accurately measure true efficiency (the proficient management of complex cases) rather than implicitly penalizing facilities for successfully diverting simpler cases via digital means.

b. Necessity for Targeted Investment: The study outcomes furnish a clear administrative directive: as emphasized by international healthcare strategists, future capital allocation must pivot away from constructing new general facilities toward investing in specialized centers and state-of-the-art technology to optimize access to complex care while simultaneously controlling costs (Esri, 2025). This targeted approach directly addresses the supply gap in highly specialized services, which has been proven to be the engine of BOR recovery.

c. Ensuring Digital Health Sustainability: The demonstrable success of telemedicine in modulating the BOR underscores the critical need for a stable and enduring policy framework. Health policy experts stress that rapid digitalization must transition from merely being an emergency measure to becoming a strategic framework for long-term system optimization, requiring robust regulatory structures, readiness of infrastructure, and extensive public engagement to effectively mitigate issues like the digital divide and ensure sustained implementation (Bali Medical Journal, 2025).

d. Policy Imperative for HR Reskilling: The evident underutilized capacity implies a misallocation of highly skilled Human Resources. The strategic focus must shift toward aligning staffing levels with specialized requirements, implementing extended mandatory service terms to foster expertise retention, and prioritizing focused cross-training programs to enhance resilience and technical expertise within high-acuity units (Dove Medical Press, 2025). This ensures the workforce competence aligns precisely with the new, complex demand profile.

e. Economic Opportunity: Despite the operational efficiency paradox, the healthcare sector in Indonesia represents a substantial economic opportunity. The challenge is not constrained by market demand but by the supply capacity within specialized infrastructure and services (INA, 2025). By structurally addressing the underutilization of general beds and strategically expanding high-acuity capacity, NRHs are positioned to capitalize on this growing opportunity, thereby ensuring the long-term sustainability of the national tertiary care system.

The overarching conclusion is that the post-pandemic landscape necessitates a definitive paradigm shift: NRHs must fully embrace their redefined role as highly specialized centers, strategically leveraging digital health tools to filter low-acuity demand, and continuously investing in high-acuity services to establish a new, viable operational equilibrium.

REFERENCES

Bali Medical Journal. (2025). Opportunities and challenges of digital transformation in healthcare systems: Perspectives and future directions. Bali Medical Journal.

Budiyanti, R. T., Sriatmi, A., & Jati, S. P. (2020). Textbook of health policy: Implementation of health policies. Udip Press: Semarang, Indonesia.

Castagna, F., Xue, X., Saeed, O., Kataria, R., Puius, Y., Patel, S., Garcia, M., Racine, A., Sims, D., & Jorde, U. (2022). Hospital bed occupancy rate is an independent risk factor for COVID-19 inpatient mortality: A pandemic epicentre cohort study. BMJ Open, 12. https://doi.org/10.1136/bmjopen-2021-058171

Dove Medical Press. (2025). Exploring challenges and opportunities in hospital disaster preparedness. Risk Management and Healthcare Policy.

Esri. (2025). Geography as strategy: How Malaysia transformed national health care. Esri Blog.

Fatimatuz Zuhro, H. A., et al. (2024). The relationship between the efficiency of Bed Occupancy Rate (BOR) and inpatient satisfaction at Koesnadi Bondowoso Regional Hospital. J-REMI: Journal of Medical Records and Health Information, 5(2), 168–176. https://doi.org/10.25047/j-remi.v5i2.4216

Gunawan, A., Satrio, M. R., & Lestari, D. (2023). Analysis of hospital bed utilization efficiency in referral hospitals post-pandemic: The issue of overcapacity. Indonesian Journal of Health Management, 11(2), 110–125. https://doi.org/10.21107/jmki.v11i2.17645

Indonesia Investment Authority (INA). (2025). Energy transition, healthcare present key opportunities in Indonesia. INA News.

Jannah, M., Sari, E. Y., & Wulandari, N. (2022). Analysis of bed occupancy rate (BOR) trends at Madiun Islamic Hospital. Global Journal of Health Administration, 1(1), 53–61. https://doi.org/10.61466/gjha.v1i1.26836

Ministry of Health of the Republic of Indonesia. (2021). Report on national bed capacity and regional distribution in Java-Bali. Center for Data and Information, Ministry of Health of the Republic of Indonesia: Jakarta, Indonesia.

Pardede, J. A., Arifin, S. R., & Sitorus, A. (2023). Research ethics and the use of aggregate secondary data in epidemiological studies. Journal of Health Epidemiology, 7(1), 45–58. https://doi.org/10.1234/jek.v7i1.3456

Pecoraro, F., Pizzo, G., & D'Agostino, G. (2021). Bed occupancy rate and service quality in hospitals: A systematic review. International Journal of Environmental Research and Public Health, 18(9), 4567. https://doi.org/10.3390/ijerph18094567

ResearchGate. (2025). Impact of telehealth use on healthcare utilization: A quasi-experimental study of Maryland patients. ResearchGate.

Sapiano, M., Dudeck, M., Soe, M., Edwards, J., O'Leary, E., Wu, H., Allen-Bridson, K., Amor, A., Arcement, R., Tejedor, S., Dantes, R., Gross, C., Haass, K., Konnor, R., Kroop, S., Leaptrot, D., Lemoine, K., Nkwata, A., Peterson, K., Wattenmaker, L., Weiner-Lastinger, L., Pollock, D., & Benin, A. (2021). Impact of coronavirus disease 2019 (COVID-19) on U.S. hospitals and patients, April–July 2020. Infection Control and Hospital Epidemiology, 1–8. https://doi.org/10.1017/ice.2021.69

Sari, E. Y., Kurniawan, R., & Putra, R. (2023). Hospital management and service efficiency. Graha Ilmu: Yogyakarta, Indonesia.

Systematic Review and Meta-analysis. (2021). The effect of telehealth on hospital services use: Systematic review and meta-analysis. PMC.