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Risk Analysis of Outpatient Waiting Times: The Impact of Technology-Based vs. Manual Queuing Systems in East Java Hospitals

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ABSTRACT

In Indonesian hospitals, prolonged waiting times for outpatient services remain a critical challenge, particularly in facilities lacking integrated queue management technology. This study evaluates the variation in waiting time risks between hospitals utilizing traditional manual systems and those employing partially connected digital systems. Using a purposive sampling method, we assessed ten hospitals, comprising both public and private institutions. Crucially, we implemented the Risk Grading Matrix as a novel analytical framework to evaluate risk levels by quantifying the likelihood and clinical impact of service delays in every hospital. Our analysis revealed that all participating hospitals exceeded the national waiting time standard of 60 minutes. However, the risk assessment demonstrated distinct differences based on system integration. Hospitals with less advanced, partially connected digital systems exhibited significantly higher risk profiles compared to those relying on manual systems (total risk score: p=.008). Furthermore, both the likelihood of delays (p=.031) and the severity of impact on patient safety (p=.017) were statistically higher in facilities with inefficient digital integration. These findings indicate that the architecture of a queue management system is a primary determinant of waiting time risks, which directly undermines patient satisfaction and timely care delivery. Consequently, we advocate for the adoption of optimized digital queue management systems, as they provide a more robust approach to enhancing service quality, patient safety, and institutional risk governance.

Keywords
Hospital Risk Level
Queuing System
Technology-Based
Waiting Time

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Introduction

The optimization of outpatient waiting times remains a critical priority for Indonesian hospitals, as it directly dictates service quality under the Ministry of Health's Minimum Service Standards. While excessive waiting times are a well-documented challenge, current literature in Indonesia predominantly focuses on descriptive measurements of average waiting times. However, focusing solely on average time metrics fails to capture the latent clinical and operational hazards inherent in inefficient queue management. There is a pressing need to transition from simple temporal observation to a proactive risk-based assessment to identify how queuing failures jeopardize patient safety.

Measuring average waiting time is useful for identifying bottlenecks, improving staffing, and tracking service trends. Yet, treating waiting time exclusively as a "time-based" metric is insufficient because it treats all delays as uniform, ignoring the clinical consequences. Poor queue management often results in wasted resources and increased work pressure, significantly elevating the risk of staff burnout. Even when medical care is high-quality, excessive wait times diminish perceived service standards and patient satisfaction [1]. Evidence from outpatient pharmacy settings further highlights these systemic flaws, where patients frequently endure delays exceeding standard thresholds, indicating deep-seated inefficiencies in the care delivery process [2].

To bridge this gap, this study employs the Risk Grading Matrix, a methodological shift that evaluates waiting times through the dual lenses of clinical likelihood and severity of impact. By mapping queuing inefficiencies against the STARKES (Standar Akreditasi Rumah Sakit) requirements for hospital risk governance, this study moves beyond reporting "how long" patients wait to analyzing "how risky" the current systems are for patient outcomes. This shift provides clinical managers with a concrete mechanism to prioritize safety interventions, ensuring that risk mitigation is aligned with national accreditation mandates.

The urgency of this transition is further underscored by the transformative potential of digital health. Digitalization and information management interventions—such as online registration and automated queuing—have been shown to significantly reduce waiting times and improve patient experiences more evenly than traditional manual systems [3]. International evidence confirms the efficacy of these technologies; for instance, the implementation of AI-based assistants at the Shanghai Children's Medical Center reduced

average wait times from 21.8 to 8.8 minutes, yielding a statistically significant improvement in patient satisfaction. Furthermore, transitioning to web-based systems organizes patient flow, reduces crowding, and supports long-term operational sustainability [4].

Traditional manual systems frequently suffer from process bottlenecks, contributing to resource maldistribution and operational instability maldistribution [5], [6], [7]. Despite the necessity of meeting STARKES standards, there remains a significant research gap regarding the comparative risk profiles of varying queuing systems—ranging from fully manual to partially connected digital infrastructures. Most previous studies are limited to single-site observations and fail to provide a broader regional perspective on risk variance. Therefore, this study aims to fill this gap by utilizing the Risk Grading Matrix to quantify the risks associated with non-integrated queuing systems. By doing so, it provides hospital administrators and policymakers with a data-driven foundation to align technological innovation with national accreditation requirements, ultimately moving the hospital sector toward a safer, more reliable model of outpatient care.

Material and Methods

This study is a quantitative cross-sectional study. The population comprised all public and private hospitals in East Java that have not implemented an integrated queuing system. The sample consisted of 10 hospitals that agreed to respond. Data were collected through purposive sampling via email over a period of one month. The study population comprised 10 hospitals across East Java, selected to represent the diverse landscape of healthcare service delivery in East Java. The sample distribution reflects variations in operational capacity and institutional governance as detailed in Table 1 below.

Table 1. Distribution of Sample

Hospital Classification	Ownership Status	Frequency (n)
Type B	Government	2
Type B	Private	4
Type C	Government	1
Type C	Private	1
Type D	Private	2
Total		**10**

To ensure the validity and reliability of the Risk Grading Matrix, the instrument was completed by a designated committee in each hospital, consisting of the Head of the Quality Assurance Unit, the Head of Nursing, and senior operational managers. These personnel were chosen due to their direct involvement in clinical risk management and their comprehensive understanding of daily outpatient service workflows. This approach is consistent with international best practices in healthcare management, which emphasize that risk assessments must be derived from the expertise of front-line clinical leaders who possess the most accurate

insights into operational failures. Researchers provided supervision and facilitated the data collection process through structured workshops to ensure consistent interpretation of the probability and impact scales, thereby minimizing subjective bias during the grading process. This study uses the Risk Grading Matrix method, which is carried out by following these steps: Determining the criteria for the Likelihood and Consequence Risk Matrix. The criteria for the Likelihood (Table 2) and Consequence Risk Matrix (Table 3) used are the frequency of occurrence of an event and the effect that will be received.

Table 2. Likelihood Criteria

Level	Criteria	Description
1	Rare	Events will only occur around 0-10%
2	Unlikely	Events occur around > 10-30%
3	Possible	Events sometimes occur around > 30-50%
4	Likely	Very likely event to occur around >50-90% in 1 time period of 1 month
5	Very likely	Events always occur > 90% in 1 time period during 1 month

Table 3. Impact Criteria

Level	Criteria	Description
1	Very low	1. Does not impact the achievement of the agency's/activity's objectives in general
		2. Somewhat disruptive to services
		3. The impact can be handled during routine activities
		4. The loss is less material and does not affect stakeholders
2	Low	1. Disrupts the achievement of agency/activity objectives, although not significantly
		2. Severely disrupts service delivery
		3. Threatens the efficiency and effectiveness of several program aspects
		4. Material losses are minor and have little impact on stakeholders
3	Moderate	1. Significantly disrupts the achievement of agency/activity objectives
		2. Significantly disrupts service activities
		3. Significantly disrupts program administration
		4. Significant financial losses
4	High	1. Some agency/activity objectives failed to be achieved
		2. Service disruptions lasted more than 2 days but less than 1 week
		3. Threatening the effective functioning of the program and the organization
		4. Major financial and non-financial losses to the organization
5	Very High	1. Most agency/activity objectives failed to be achieved
		2. Service disruptions lasted more than a week
		3. Threatening programs, organizations, and stakeholders
		4. Significant losses for the organization, both financially and non-financially

Table 4. Risk Category

Score	Risk Category
1-4	Low
5-8	Moderate
9-14	High
15-19	Very High
20-25	Extreme

Descriptive analysis was used to describe the total score of risk. Data were analyzed descriptively and subjected to a Mann-Whitney U test. This difference test was conducted to analyze the difference in risk between hospitals that implement a manual queuing system and those that have not integrated one.

Results

Table 5 compares the risk of excessive waiting times across hospitals in East Java by queuing-system source, likelihood, impact, total score, and category, enabling systematic identification of service improvement priorities.

Table 5. Difference In Risk of High Waiting Time at Hospital in East Java

Hospital	Queuing System Source	Risk Impact	Likelihood	Impact	Total Score	Category
A	Manual	Patient Satisfaction	1	2	2	Low
B	Manual	Patient Satisfaction	1	4	4	Low
C	Non-integrated	Diagnosis/Treatment Delay	2	5	10	High
D	Manual	Diagnosis/Treatment Delay	2	2	4	Low
E	Manual	Diagnosis/Treatment Delay	1	3	3	Low
F	Non-integrated	Diagnosis/Treatment Delay	3	4	12	High
G	Manual	Patient Satisfaction	2	3	6	Moderate
H	Non-integrated	Patient Satisfaction	3	4	12	High
I	Non-integrated	Patient Satisfaction	2	5	10	High
J	Non-integrated	Diagnosis/Treatment Delay	2	4	8	Moderate

The empirical data reveal a clear correlation between queuing infrastructure and clinical risk profiles; hospitals utilizing manual systems consistently maintain a "Low" risk category, where inefficiencies are primarily confined to patient dissatisfaction. In contrast, facilities relying on non-integrated queuing systems exhibit significantly higher risk scores (ranging from 8 to 12), shifting the impact from mere operational inconvenience to critical "Diagnosis/Treatment Delays." This transition underscores that fragmented digital infrastructures—where queue data fails to synchronize with clinical workflows—create latent operational hazards that directly jeopardize patient safety by impeding timely medical interventions.

The novelty of this study lies in its shift from traditional temporal efficiency measurements to a proactive, risk-based diagnostic framework aligned with STARKES clinical governance mandates. By employing the Risk Grading Matrix, this research transforms the outpatient queuing paradigm from a descriptive operational metric into a quantifiable safety indicator. This approach provides a robust, data-driven mechanism for clinical managers to

prioritize digital transformation, not merely as a strategy for service optimization, but as a fundamental intervention to mitigate systemic clinical risks and ensure institutional accreditation compliance.

Table 6. Test Statistics[a]

	Total	Likelihood	Impact
Mann-Whitney U	0.000	3.000	1.500
Wilcoxon W	15.000	18.000	16.500
Z	-2.660	-2.154	-2.394
Asymp. Sig. (2-tailed)	0.008	0.031	0.017

a. Grouping Variable: group

The Mann–Whitney U test results show a significant difference between the two hospital groups in total risk scores (p = 0.008), likelihood (p = 0.031), and impact (p = 0.017). These findings suggest that the queuing systems used by hospitals have a real effect on the level of waiting time risk in outpatient services, both in terms of the chance of an event happening and the extent of its impact. Therefore, it can be concluded that differences in queuing systems significantly contribute to differences in the level of outpatient waiting time risk.

Table 7. Risk Estimate

		95% CI	
Value		Lower	Upper
For cohort level_risk = 2.00	0.200	.035	1.154
N of Valid Cases	10		

The analysis of risk estimates shows that hospitals using a manual queuing system have a medium-to-high risk level that is 0.2 times that of hospitals using a semi-integrated system. However, the 95% confidence interval, which ranges from 0.035 to 1.154, includes the number 1. This means the difference isn't statistically significant. This outcome is probably because the sample size is small, with only 10 hospitals included.

Regarding the risk estimate analysis presented in Table 7, it should be noted that the findings did not reach statistical significance, as evidenced by confidence intervals exceeding 1. We acknowledge that this is a primary limitation of the study, largely attributable to the small sample size (N=10). While the sample was sufficient to demonstrate qualitative trends in risk profiling across different hospital classifications, the limited number of observations restricts the statistical power to generalize the risk estimates to a broader national population. Future research with a larger, multi-regional sample is recommended to enhance the precision and confidence level of these risk estimations.

Discussion

This study introduces a novel approach to evaluating outpatient waiting time risks through a risk assessment framework that combines likelihood and impact dimensions, alongside applying a risk matrix-based quantitative risk assessment—a method still rarely

utilized in hospital management studies. Queue system maturity—specifically its integration level—acts as a primary determinant of risk levels, superseding factors such as hospital type (B, C, D) or ownership status (public or private) [8], [9].

Physical, individual handling of patient registration triggers inconsistent waiting times, potential violations of Indonesian Ministry of Health standards, and heightened risks of administrative errors and overcrowding [10], [11], [12], [13]. The implementation of electronic modules, web-based registration, or integration with HIMS (SIMRS) accelerates administrative procedures, eliminates bottlenecks, aligns waiting times closer to national standards, and reduces patient-to-patient variance [14], [15], [16], [17].

Certain hospitals maintaining manual systems preserve 'Low' risk profiles not due to technology, but owing to optimized patient volume management, efficient staff coordination, and high situational awareness. Human-centric flexibility and communication effectively compensate for the absence of digital tools (healthcare resilience). Manual systems really keep risk levels low; our study shows this isn’t because they’re better with technology, but because they have stable operations and good control over workloads. Based on what we've seen, two main reasons explain this. Hospitals that use manual systems and record low risk levels usually have more managed and steady patient numbers than hospitals that use partially integrated digital systems. In places where people handle things by hand, the workers have a good sense of how much they can do each day. When the number of patients increases, staff take active steps to adjust how things run, like setting up more service desks or doing quick, on-the-spot patient sorting. These actions can't be easily done with strict or separate digital systems. Staff efficiency and flexibility, or the ability to adapt, in these hospitals rely on a work culture that emphasizes communication between staff members. In situations where people wait in line manually, there's a type of flexibility that lets medical and administrative workers talk to each other quickly and speak out loud to handle any problems that come up. This is different from hospitals that use some digital systems, where workers often depend too much on not-so-good system processes; as a result, when there are problems with the digital systems, they don’t have good enough backup plans (like manual alternatives) to handle the situation.

That's because the low risk comes from how efficient the staff is, not from how efficient the systems are. The people working at these places have become very skilled in managing how patients move through the system, which helps them handle sudden increases in patients without putting their safety at risk. These results show that when digitalization is not paired with strong system efficiency, it can actually reduce the flexibility that healthcare workers have depended on for a long time. Our study shows a key problem: hospitals that use queueing systems with some digital parts but aren't fully connected tend to have greater risks than those

using only manual systems. This situation shows there's a 'blind spot' in how hospitals are moving towards digital systems.

There are many reasons why this "partial digitalization" can really be risky. First, in systems that aren't fully connected, patient data in the waiting list is usually separate from the units that provide medical care, like diagnosis and treatment. This makes it seem like things are running smoothly during registration, but it hides problems in the medical service areas that aren't noticed. Because medical staff don't have real-time information about how patients are moving through the system, delays in diagnosis are more likely to happen. Second, the difference between what people expect and what actually happens in practice is that when systems are purely manual, both patients and staff end up having low expectations about how quickly things will go, which results in a usual and careful way of managing the line. On the other hand, separate digital systems give a wrong idea about how fast services can be. If the system doesn't match up registration with medical care, it creates an "operational gap," which leads to staff getting too tired and patients becoming more upset.

Third, illusion of Security versus Real Risk Management: according to STARKES standards, when digital transformation is not fully done, it usually misses the part about managing clinical risks. Hospitals often focus on making digital registration easier but don't set up plans to handle problems like system crashes or long waits for patients. Because of this, when there are problems with digital systems, the staff don't have strong backup plans, which causes delays in providing medical care. These findings are a clear message to hospital leaders: just because something is digital doesn't mean it will automatically solve problems. Digitalization can make things more complicated and raise risks in healthcare if the whole service process, from signing up to getting medical help, isn't fully connected. It can mess up the usual steps and make things less safe than using old, familiar methods that work the same every time.

Queue system risk variations directly affect patient satisfaction [18], hospital operational efficiency (staff workload), and clinical-administrative risks (appointment cancellations or medical examination errors) [19]. Queue digitization is not merely an administrative efficiency tool, but a critical patient safety intervention component [20].

The Indonesian Ministry of Health and the Commission for Hospital Accreditation are urged to mandate digital integrated queuing systems within outpatient service standards and accreditation frameworks [21], [22], [23]. Hospital administrators must invest in fully integrated queue systems connected with HIMS, online registration, and electronic medical records to ensure service tracking and transparency [24], [25]. Hospitals can incorporate waiting time risk matrices into continuous quality improvement programs to prioritize data-backed interventions rather than relying solely on patient grievances [26], [27]. Central and

local governments should formulate digitalization assistance programs, funding models, or public-private partnerships tailored for type B and C hospitals still operating non-integrated systems [28], [29].

Conclusion

This study successfully addresses its research objectives by introducing a risk-based assessment framework—utilizing the Risk Grading Matrix—to evaluate outpatient waiting time risks across hospitals in East Java. The empirical findings demonstrate a statistically significant difference in total risk scores, likelihood, and impact between hospital queuing systems ($p<0.05$). Specifically, while certain manual systems maintain low risk profiles due to high staff adaptability and workload control, non-integrated digital systems create "clinical blind spots" and operational gaps that elevate risks to diagnosis and treatment delays.

Future policy and managerial strategies must move beyond generic digital adoption. Hospital administrators and policymakers should prioritize fully integrating queuing systems with Electronic Medical Records (EMR) in strict accordance with the latest Indonesian Ministry of Health and STARKES clinical governance standards. Furthermore, addressing the primary limitation of this study—specifically the small sample size (N=10), which restricted statistical power in risk estimations—future research should incorporate a longitudinal pre-post study design alongside a larger, multi-regional sample to comprehensively examine and validate the impact of digital integration before and after implementation.

Limitation and Suggestions

One main thing that limits this study is that there weren't enough hospitals included (only 10), which made the results less certain and some parts not significant. The study was also cross-sectional, so it can't show cause and effect clearly. As expected, hospitals with systems that weren't well connected had higher risk levels. But something unexpected was found: some hospitals that used simple, manual systems still had low risk levels. This suggests that other factors, like how many patients come in and how smooth the process is, can make a difference in how risky the waiting times are. Future research should include more hospitals from different parts of the country, use long-term studies, and look at other factors such as how many staff there are, the types of patients, and how services are redesigned to help make waiting times better.

Conflict of Interest

The authors should declare that there is no conflict of interest.

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