SCIENTIFIC CULTURE
www.sci-cult.com

SCIENTIFIC CULTURE, Vol. 12, No. 4, (2026), pp. 6021-6030
Open Access. Online & Print

DOI: 10.5281/zenodo.12426629

ADVANCING HIGH RELIABILITY ORGANIZATION MATURITY IN INDONESIAN HOSPITALS: LEADERSHIP, SAFETY CULTURE, AND PROCESS IMPROVEMENT INSIGHTS FROM BOGOR CITY

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Received: 17/10/2025
Accepted: 05/03/2026

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ABSTRACT

High Reliability Organizations (HROs) represent a gold standard for safety and quality in complex, high-risk environments such as healthcare. Hospitals, particularly in developing countries, face unique challenges in achieving HRO maturity due to variations in resources, governance, and organizational culture. This study investigates the influence of leadership, safety culture, and robust process improvement (RPI) on HRO maturity across four hospitals in Bogor City, Indonesia, representing classifications from Type A to Type D. Employing a quantitative explanatory research design, data were collected from 286 hospital staff members using a validated HRO maturity questionnaire adapted from the Chassin and Loeb model. Partial Least Squares Structural Equation Modelling (PLS-SEM) was used to test hypotheses and assess the relationships between variables. The results reveal that leadership exerts the strongest influence on HRO maturity, followed by safety culture and RPI. Type A and Type B hospitals demonstrated Advancing maturity levels, while Type C and Type D hospitals remained at the Developing stage. These findings are consistent with international literature, underscoring the universal importance of leadership and safety culture in driving high reliability, while also highlighting the challenges of institutionalizing process improvement methodologies in resource-limited contexts. This study contributes to the growing body of literature on HRO in developing healthcare systems by providing empirical evidence from Indonesia. A strategic roadmap is proposed for advancing HRO maturity, emphasizing leadership development, strengthening safety culture, expanding RPI adoption, and fostering collaborative resource-sharing initiatives. The findings have significant implications for hospital management, policymakers, and accreditation bodies aiming to enhance patient safety and organizational resilience.

KEYWORDS: High Reliability Organization, leadership, safety culture, process improvement, hospital maturity, patient safety, Indonesia.

INTRODUCTION

Ensuring patient safety and delivering high-quality care in hospitals require robust systems capable of minimizing errors in inherently complex and high-risk environments. The concept of High Reliability Organizations (HROs) originated in industries such as nuclear power, aviation, and the military, fields where failure can result in catastrophic consequences (Weick & Sutcliffe, 2015). In healthcare, HRO principles have been increasingly applied to address systemic vulnerabilities and enhance operational resilience (Chassin & Loeb, 2013).

While high-income countries have made considerable progress in adopting HRO principles, the healthcare systems of developing nations continue to face structural and operational constraints that limit their capacity to achieve HRO maturity. In Indonesia, hospitals vary significantly in size, resources, governance models, and quality improvement capabilities, resulting in heterogeneous levels of safety culture and process standardization (Ben-Ner et al., 2021). These variations present challenges in creating consistent and reliable care delivery systems across hospital types.

Patient safety incidents remain a global concern, with the World Health Organization (WHO) estimating that approximately 134 million adverse events occur annually in hospitals in low- and middle-income countries, contributing to around 2.6 million deaths (WHO, 2019). In Indonesia, national hospital patient safety reports indicate persistent issues related to medication errors, falls, surgical incidents, and delayed diagnoses (Ministry of Health, 2022). Addressing these challenges requires a systemic approach that integrates leadership commitment, a culture of safety, and continuous process improvement, core pillars of the HRO model.

This study focuses on understanding the determinants of HRO maturity in Indonesian hospitals by examining three primary dimensions identified in the Chassin and Loeb (2013) framework: Leadership, Safety Culture, and Robust Process Improvement (RPI). The research is conducted in four hospitals in Bogor City, representing different classifications: Type A (largest and most resource-rich), Type B, Type C, and Type D (smallest and least resourced). This classification allows for comparative insights into how hospital size, capacity, and governance influence HRO maturity.

Table 1. *Summary of Previous HRO Maturity Studies in Healthcare.*

No	Author(s)	Year	Country	Setting / Sample Size	Key Findings
1	Chassin & Loeb	2013	USA	Multiple hospitals (n > 200)	Proposed four-stage maturity model; leadership and safety culture are critical.
2	Roberts et al.	2016	USA	Nuclear power & healthcare	Identified five core principles; application to healthcare improves safety outcomes.
3	Pronovost et al.	2017	USA	Large academic medical centers	Maturity linked to reduced harm rates; robust process improvement is essential.
4	Heskett et al.	2021	UK	NHS hospitals	High maturity hospitals show lower patient harm and higher staff engagement.
5	Ben-Ner et al.	2021	Israel	Mixed hospital types	Safety culture mediates leadership's effect on maturity.

Hypothesis:

Hypothesis 1: Leadership significantly and positively influences Safety Culture.
Hypothesis 2: Leadership significantly and positively affects Robust Process Improvement (RPI).
Hypothesis 3: Safety Culture significantly and positively impacts RPI.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

Concept of High Reliability Organizations (HRO)

High Reliability Organizations (HROs) are entities that operate in complex, high-risk environments while maintaining exceptionally low error rates over extended periods (Weick & Sutcliffe, 2015). Originally studied in industries such as aviation, nuclear power, and military operations, the HRO concept has been progressively adapted to healthcare, particularly in hospital settings (Roberts et al., 2016). The transition of HRO principles into healthcare aims to address the inherent variability of clinical processes and to build resilience against adverse events.

In the healthcare context, the adoption of HRO principles is intended to ensure consistent delivery of safe, high-quality care despite the unpredictability and complexity of medical practice. Chassin and Loeb (2013) proposed a widely recognized framework for HRO maturity in hospitals, identifying three critical domains: **Leadership**, **Safety Culture**, and **Robust Process Improvement (RPI)**. These domains are interconnected, collectively

driving organizational reliability.

HRO Maturity Models

Several models have been developed to conceptualize and measure HRO maturity in healthcare. While they share common principles, differences exist in their structure, emphasis, and assessment methodologies. The Chassin and Loeb (2013) model, for example, outlines four stages of maturity—*Beginning*, *Developing*, *Advancing*, and *Approaching*—with detailed indicators for each stage. The Sullivan et al. (2016) framework integrates leadership, safety culture, and technological capabilities, emphasizing the role of data transparency in improvement. The Joint Commission International's ORO® 2.0 model offers a diagnostic tool that provides hospitals with tailored action plans.

Table 2. Comparison of Selected HRO Maturity Models

No	Author(s) & Year	Model	Key Dimensions	Stages / Levels	Distinctive Features
1	Chassin & Loeb (2013)	HRHCM (*High Reliability Health Care Maturity)*	Leadership, Safety Culture, RPI	Beginning, Developing, Advancing, Approaching	Widely used in hospitals; detailed indicators for each stage.
2	Sullivan et al. (2016)	HRHCM (*High Reliability Health Care Maturity)*	Leadership, Safety Culture, Technology & Analytics	Beginning, Developing, Advancing, Approaching	Strong emphasis on measurement transparency and technology.
3	Joint Commission (ORO® 2.0, 2020)	HRMA (*High Reliability Maturity Assessment)*	Leadership, Safety Culture, RPI	Score-based assessment	Interactive online tool; customized action plans for hospitals.

Leadership in HRO

Leadership in HROs extends beyond administrative oversight; it involves setting a clear vision for safety, aligning resources with improvement goals, and personally engaging with staff to address concerns (Chassin & Loeb, 2022). Leaders in high-reliability healthcare systems actively participate in safety walk rounds, foster psychological safety for staff, and ensure that patient safety is prioritized in strategic decisions. The literature consistently emphasizes that leadership commitment is the most significant driver of organizational reliability (Ben-Ner et al., 2021; Pronovost et al., 2017).

Safety Culture

Safety culture encompasses the shared values, beliefs, and norms that shape behaviour regarding safety within an organization (Reason, 2016). In an HRO, safety culture promotes transparency, learning from errors, and non-punitive responses to incident reporting. A strong safety culture facilitates cross-disciplinary collaboration, enhances communication, and builds trust among staff members (Roberts et al., 2016). Evidence from multiple healthcare settings indicates that safety culture mediates the relationship between leadership and reliability outcomes (Ben-Ner et al., 2021).

Robust Process Improvement (RPI)

Robust Process Improvement refers to the systematic application of quality improvement methodologies, such as Lean, Six Sigma, and change management, to redesign processes and reduce variability (Pronovost et al., 2017). In the HRO framework, RPI ensures that process changes are evidence-based, sustainable, and scalable. Hospitals with high maturity in RPI demonstrate better performance in reducing medical errors, improving efficiency, and enhancing patient satisfaction.

Gaps in the Literature

While significant literature exists on HRO implementation in developed countries, studies from low- and middle-income countries remain limited. The contextual differences—such as resource constraints, regulatory environments, and organizational culture—may influence how HRO principles are adopted and sustained. This study addresses this gap by examining HRO maturity determinants in Indonesian hospitals, providing comparative insights across different hospital classifications.

RESEARCH METHODOLOGY

Research Design

This study employed a quantitative explanatory research design to investigate the influence of leadership, safety culture, and robust process improvement (RPI) on the maturity level of High Reliability Organizations (HRO) in hospitals. The explanatory approach was chosen to examine causal relationships between variables and to quantify the strength of these relationships using statistical modelling techniques.

Data were collected through a structured survey instrument adapted from the Chassin and Loeb

(2013) HRO maturity framework. The instrument was translated into Bahasa Indonesia, validated for content and construct equivalence, and pilot-tested before distribution to the study population.

Study Setting and Population

The research was conducted in four hospitals located in Bogor City, Indonesia, each representing a different classification as determined by the Ministry of Health:

- Type A: Large, highly specialized hospital with the most extensive resources.
- Type B: Medium-sized hospital with a mix of specialized and general services.
- Type C: Smaller district hospital with limited specialties.
- Type D: Basic-level hospital with minimal infrastructure and resources.

The study population consisted of healthcare professionals: including physicians, nurses, allied health staff, and administrative personnel, who had been employed at their respective hospitals for at least one year. This inclusion criterion ensured that participants had sufficient exposure to organizational practices and culture.

Sampling Technique and Sample Size

A proportionate stratified random sampling method was applied to ensure adequate representation from each hospital type. The final sample consisted of **286 respondents** distributed proportionally according to hospital size and staffing.

Table 3. Sample Distribution by Hospital Type and Profession

Hospital Type	Physicians	Nurses	Allied Health Staff	Administrative Staff	Total Respondents
Type A	25	60	20	15	120
Type B	20	45	15	10	90
Type C	10	25	5	5	45
Type D	5	15	5	6	31
Total	**60**	**145**	**45**	**36**	**286**

Research Variables

The study included one endogenous variable: HRO Maturity, and three exogenous variables: Leadership, Safety Culture, and Robust Process Improvement.

1. Leadership

Measured across domains such as executive engagement in safety, strategic alignment with patient safety goals, and leader visibility during safety initiatives.

2. Safety Culture

Assessed through indicators like trust in error reporting systems, non-punitive responses to mistakes, and cross-departmental teamwork.

3. Robust Process Improvement (RPI)

Evaluated based on the extent of Lean/Six Sigma implementation, data-driven problem solving, and process standardization.

4. HRO Maturity

Measured in alignment with the Chassin and Loeb (2013) maturity stages: *Beginning*, *Developing*, *Advancing*, and *Approaching*.

Instrumentation and Indicators

Table 4. Constructs, Dimensions, and Indicators

Construct	Dimensions	Indicators
Leadership	Board of Directors	Board quality focus, Involvement in quality, Involvement in quality planning, Commitment to HRO
	Management	Quality focus, Quality improvement planning, Development of quality agenda, Management of patient hazards
	Physicians	Role in quality improvement, Support for quality improvement, Participation in quality improvement, Leadership in clinical quality
	Quality Improvement Strategy	Quality as strategic priority, Strategic quality priorities, Key quality priorities, Quality as highest organizational priority
	Goals & Measurable Outcomes	Quality measurement, Reporting of quality, Routine reporting, Key quality metrics
	Information Technology (IT)	IT support in Quality Improvement, IT solutions for maintaining quality
Safety Culture	Safety Culture	Trust vs. intimidation, Code of conduct, Leadership and trust environment, Trust and code of conduct
	Accountability	Discipline and errors, Fair discipline, Safety Culture implementation, Accountability in Safety Culture
	Identifying Unsafe Conditions	Root Cause Analysis (RCA), Near Miss Reporting (KNC), Awareness of unsafe practices, Routine KNC reporting

	System Strengthening	System defenses, Identification of weaknesses, System improvement, Proactive system defense
	Measurement	Safety culture metrics, Measurement implementation, Safety culture strategies
Robust Process Improvement (RPI)	Methods	Adoption of quality management, Exploration of improvement tools, Commitment to RPI tools, Full adoption of tools
	Training	Personnel training, Recognition of training importance, RPI training, Training for all staff
	Deployment	Commitment to improvement methods, Pilot projects, Use of RPI across areas, Organization-wide tool deployment

Source: Chassin & Loeb, 2013; Berwick et al., 2013; Pronovost et al., 2017; Chassin & Loeb, 2016; Berwick, 2016; Miller et al., 2017; Reason, 2016

Validity and Reliability Testing

The insrument underwent **content validity** assessment by three healthcare management experts, achieving a Content Validity Index (CVI) score of 0.92. Construct validity was tested through Confirmatory Factor Analysis (CFA), with all factor loadings exceeding the recommended threshold of 0.70. Internal consistency reliability was confirmed with Cronbach's alpha values ranging from 0.85 to 0.94 for all constructs.

Data Collection Procedure

Following ethical clearance from the Faculty of Public Health, Hasanuddin University, and written permission from each hospital, questionnaires were distributed in both paper and digital formats. Respondents provided informed consent before participation. Data collection was conducted over six weeks, ensuring a high response rate through follow-up reminders.

Data Analysis

Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS software. This method was chosen for its suitability in analyzing complex models with multiple constructs and indicators, particularly in exploratory research settings. Bootstrapping with 5,000 resamples was performed to test the significance of path coefficients.

RESULTS

Descriptive Statistics

A total of 286 responses were analyzed. Table 5 presents the descriptive statistics for the main study variables: Leadership, Safety Culture, and Robust Process Improvement (RPI). All variables were measured on a five-point Likert scale, where higher scores indicate stronger perceptions of the construct.

Table 5. Descriptive Statistics of Study Variables

Variable	Minimum	Maximum	Mean	Standard Deviation
Leadership	1.000	5.000	3.693	3.750
Safety Culture	1.000	5.000	3.632	3.750
Robust Process Improvement (RPI)	1.000	5.000	3.600	3.833

Overall, Leadership received the highest mean score (M = 3,693), followed by Safety Culture (M = 3,632), and RPI (M = 3,600). These results suggest that while leadership and safety culture are relatively strong in the participating hospitals, process improvement remains a relatively underdeveloped area.

HRO Maturity Levels by Hospital Type

HRO maturity levels were determined according to the Chassin and Loeb (2013) four-stage model. Type A and Type B hospitals achieved **Advancing** stages, while Type C and Type D hospitals remained in the **Developing** stage.

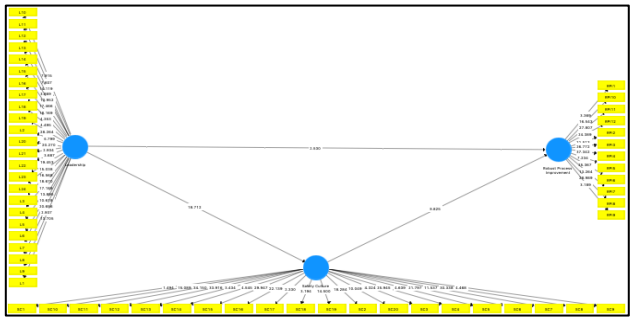

Figure 1. HRO Maturity Stages by Hospital Type

Structural Model Assessment

The PLS-SEM results confirmed that all three exogenous variables significantly influenced HRO maturity. The model achieved satisfactory fit indices, with **R^2 = 0.68**, indicating that 68% of the variance in HRO maturity can be explained by Leadership, Safety Culture, and RPI.

Table 6. Path Coefficients and Hypothesis Testing Results

	Original Sample (O)	***Sample Mean (M)***	***Standard Deviation (STDEV)***	***T Statistics (|O/STDEV|)***	***P Values***	***Result***
Leadership -> Safety Culture	0,769	0,773	0,041	18,712	0,000	Supported
Leadership -> Robust Process Improvement	0,184	0,186	0,073	2,530	0,012	Supported
Safety Culture -> Robust Process Improvement	0,689	0,689	0,070	9,825	0,000	Supported

Bootstrapping Analysis

Bootstrapping with 5,000 resamples further validated the significance of all hypothesized relationships. The confidence intervals did not include zero, providing strong evidence for the robustness of the results.

Tabel 7. Outer Loading Maturitas HRO pada RS di Kota Bogor

	Original Sample (O)	*Sample Mean (M)*	*Standard Deviation (STDEV)*	*T Statistics (|O/STDEV|)*	*P Values*	***Result***
L1 <- Leadership	0,655	0,649	0,048	13,705	0,000	Supported
L2 <- Leadership	0,461	0,456	0,068	6,799	0,000	Supported
L3 <- Leadership	0,695	0,693	0,042	16,568	0,000	Supported
L4 <- Leadership	0,700	0,699	0,037	18,670	0,000	Supported
L5 <- Leadership	0,708	0,705	0,041	17,189	0,000	Supported
L6 <- Leadership	0,671	0,667	0,048	13,895	0,000	Supported
L7 <- Leadership	0,656	0,659	0,062	10,618	0,000	Supported
L8 <- Leadership	0,750	0,750	0,036	20,656	0,000	Supported
L9 <- Leadership	0,303	0,291	0,103	2,937	0,003	Supported
L10 <- Leadership	0,559	0,550	0,071	7,915	0,000	Supported
L11 <- Leadership	0,531	0,524	0,070	7,607	0,000	Supported
L12 <- Leadership	0,642	0,640	0,045	14,119	0,000	Supported
L13 <- Leadership	0,357	0,341	0,092	3,869	0,000	Supported
L14 <- Leadership	0,621	0,620	0,045	13,952	0,000	Supported
L15 <- Leadership	0,691	0,690	0,040	17,466	0,000	Supported
L16 <- Leadership	0,669	0,671	0,037	18,169	0,000	Supported
L17 <- Leadership	0,391	0,384	0,090	4,353	0,000	Supported
L18 <- Leadership	0,401	0,393	0,089	4,495	0,000	Supported
L19 <- Leadership	0,753	0,752	0,027	28,264	0,000	Supported
L20 <- Leadership	0,723	0,720	0,036	20,270	0,000	Supported
L21 <- Leadership	0,284	0,275	0,097	2,934	0,003	Supported
L22 <- Leadership	0,365	0,356	0,099	3,687	0,000	Supported
L23 <- Leadership	0,703	0,704	0,036	19,453	0,000	Supported
L24 <- Leadership	0,648	0,650	0,043	15,038	0,000	Supported
RPI1 <- Robust Process Improvement	0,304	0,302	0,090	3,369	0,001	Supported
RPI2 <- Robust Process Improvement	0,786	0,786	0,037	21,513	0,000	Supported
RPI3 <- Robust Process Improvement	0,842	0,840	0,031	26,772	0,000	Supported
RPI4 <- Robust Process Improvement	0,836	0,837	0,022	37,342	0,000	Supported
RPI5 <- Robust Process Improvement	0,475	0,471	0,066	7,234	0,000	Supported
RPI6 <- Robust Process Improvement	0,795	0,795	0,031	25,367	0,000	Supported
RPI7 <- Robust Process Improvement	0,757	0,760	0,057	13,264	0,000	Supported
RPI8 <- Robust Process Improvement	0,784	0,785	0,027	28,989	0,000	Supported
RPI9 <- Robust Process Improvement	0,308	0,305	0,096	3,189	0,002	Supported
RPI10 <- Robust Process Improvement	0,772	0,771	0,047	16,543	0,000	Supported
RPI11 <- Robust Process Improvement	0,843	0,842	0,030	27,807	0,000	Supported
RPI12 <- Robust Process Improvement	0,805	0,806	0,033	24,389	0,000	Supported

SC1 <- Safety Culture	0,152	0,146	0,102	1,494	0,136	Not Supported
SC2 <- Safety Culture	0,705	0,703	0,039	18,284	0,000	Supported
SC3 <- Safety Culture	0,747	0,748	0,031	24,324	0,000	Supported
SC4 <- Safety Culture	0,769	0,769	0,030	25,945	0,000	Supported
SC5 <- Safety Culture	0,414	0,412	0,089	4,639	0,000	Supported
SC6 <- Safety Culture	0,758	0,757	0,035	21,797	0,000	Supported
SC7 <- Safety Culture	0,699	0,697	0,061	11,537	0,000	Supported
SC8 <- Safety Culture	0,808	0,807	0,027	30,338	0,000	Supported
SC9 <- Safety Culture	0,401	0,392	0,090	4,468	0,000	Supported
SC10 <- Safety Culture	0,767	0,768	0,051	15,089	0,000	Supported
SC11 <- Safety Culture	0,834	0,834	0,024	34,150	0,000	Supported
SC12 <- Safety Culture	0,834	0,835	0,025	33,916	0,000	Supported
SC13 <- Safety Culture	0,333	0,323	0,097	3,434	0,001	Supported
SC14 <- Safety Culture	0,424	0,416	0,093	4,545	0,000	Supported
SC15 <- Safety Culture	0,817	0,818	0,027	29,947	0,000	Supported
SC16 <- Safety Culture	0,765	0,766	0,035	22,139	0,000	Supported
SC17 <- Safety Culture	0,231	0,219	0,099	2,330	0,020	Supported
SC18 <- Safety Culture	0,317	0,306	0,099	3,194	0,001	Supported
SC19 <- Safety Culture	0,742	0,743	0,051	14,500	0,000	Supported
SC20 <- Safety Culture	0,708	0,711	0,070	10,049	0,000	Supported

RESEARCH RESULT

1. Hypothesis 1: Leadership has a significant effect on Safety Culture. Based on the analysis above, Ha is accepted. Leadership has a highly significant effect on Safety Culture with T Statistics = 18.712 and P Value = 0.000.
2. Hypothesis 5: Leadership has a significant effect on Robust Process Improvement (RPI). Based on the analysis above, Ha is accepted. Leadership has a significant effect on RPI with T Statistics = 2.530 and P Value = 0.012.
3. Hypothesis 6: Safety Culture has a significant effect on Robust Process Improvement (RPI)
   Based on the analysis above, Ha is accepted. Safety Culture has a highly significant effect on RPI with T Statistics = 9.825 and P Value = 0.000.
4. Leadership Dimension
   From 24 indicators:
- 22 indicators have a highly significant effect with P Values < 0.001.
- 2 indicators have a significant effect: L9 (T Statistics = 2.937, P Value = 0.003) and L21 (T Statistics = 2.934, P Value = 0.003).
- Leadership Dimension

5. Safety Culture Dimension
   From 20 indicators:
- 18 indicators have a highly significant effect with P Values < 0.001.
- 1 indicator has a significant effect: SC17 (T Statistics = 2.330, P Value = 0.020).
- 1 indicator has no significant effect: SC1 (T Statistics = 1.494, P Value = 0.136).

6. Robust Process Improvement (RPI) Dimension
   From 12 indicators:
- 11 indicators have a highly significant effect with P Values < 0.001.
- 1 indicator has a significant effect: RPI9 (T Statistics = 3.189, P Value = 0.002).

Summary of Findings

1. Leadership is the most influential determinant of HRO maturity in Bogor City hospitals.
2. Safety Culture has a substantial positive effect, reinforcing its mediating role between leadership and maturity.
3. RPI, although significant, remains the least developed among the three determinants, suggesting a need for capacity-building in systematic process improvement methods.
4. Hospital classification correlates with maturity levels, with higher-type hospitals achieving greater maturity.

DISCUSSION

Interpretation of Findings

The results of this study confirm that Leadership, Safety Culture, and Robust Process Improvement (RPI) are significant determinants of High Reliability Organization (HRO) maturity in hospitals, aligning with previous research conducted in various healthcare systems (Chassin & Loeb, 2013; Ben-Ner et al., 2021; Pronovost et al., 2017). The finding that leadership exerts the strongest influence suggests that in the Indonesian hospital context, visible and committed leadership is a critical driver for advancing reliability maturity. Leaders play an essential role in setting organizational priorities, securing resources, and fostering a culture of accountability and learning.

Safety Culture emerged as the second strongest determinant, which is consistent with studies showing its mediating role between leadership and performance outcomes (Roberts et al., 2016). Hospitals with strong safety cultures tend to exhibit open communication, collaborative problem-solving, and non-punitive approaches to incident reporting—conditions necessary for high reliability.

RPI, while still significant, ranked third in its influence, indicating that systematic process improvement methodologies are not yet fully embedded in hospital operations, particularly in lower-type hospitals. This is a notable gap because process improvement tools such as Lean and Six Sigma provide structured approaches to reducing variability, eliminating waste, and improving efficiency—key requirements for achieving sustained high reliability.

Comparison with International Studies

This comparative analysis shows that while the fundamental relationships between leadership, safety culture, and process improvement hold true globally, the relative strength of these factors can vary depending on local healthcare contexts.

Practical Implications

The findings provide actionable insights for hospital leaders, policymakers, and accreditation bodies aiming to enhance organizational reliability in Indonesia and similar contexts.

Table 8. Comparison of Study Findings with International Literature

Study / Author(s)	Years	Country	Key Findings	Consistency with Current Study
Chassin & Loeb	2013	USA	Leadership is the foundation of HRO maturity; RPI is critical for sustainability.	Consistent, leadership is most influential.
Roberts et al.	2016	USA	Safety culture mediates leadership's effect on reliability.	Consistent, safety culture ranked second.
Heskett et al.	2021	UK	High maturity hospitals have better patient outcomes and staff satisfaction.	Consistent, higher maturity in Type A/B hospitals.
Ben-Ner et al.	2021	Israel	Resource availability moderates maturity progression.	Consistent, lower maturity in resource-limited Type C/D hospitals.
Pronovost et al	2017	USA	RPI adoption is essential for long-term reliability gains.	Partially consistent, RPI is significant but less developed.

Table 9. Practical Implications Matrix

Determinant	Practical Action	Expected Outcome
Leadership	Executive leadership training on HRO principles; regular safety walkrounds; visible engagement in QI projects.	Increased alignment of strategic goals with patient safety objectives.
Safety Culture	Implement anonymous reporting systems; provide timely feedback on reported incidents; foster team-based safety dialogues.	Greater trust, higher incident reporting, and proactive risk mitigation.
RPI	Provide Lean/Six Sigma training for multidisciplinary teams; integrate improvement projects into daily operations.	Reduced process variability, improved efficiency, and sustained reliability.

Theoretical Contributions

This study extends the applicability of the Chassin and Loeb (2013) HRO maturity model to a developing country context. It highlights the interplay between leadership, safety culture, and process improvement within a healthcare system characterized by resource disparities. The results also underscore the mediating role of safety culture, suggesting that leadership's impact on maturity is partly channeled through the cultivation of a positive safety environment.

Limitations and Future Research

While this study provides valuable insights, several limitations should be acknowledged. First, the cross-sectional design limits causal inference; longitudinal studies would be useful to observe maturity progression over time. Second, the reliance on self-reported data may introduce bias, although validity and reliability measures were taken. Third, the focus on four hospitals in a single city limits generalizability; future research should expand to multiple regions and include a larger variety of hospital types.

Future studies could also explore the role of digital health technologies, regulatory environments, and inter-professional collaboration in influencing HRO maturity, as these factors are becoming increasingly relevant in the era of healthcare transformation.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study examined the influence of Leadership, Safety Culture, and Robust Process Improvement

(RPI) on the maturity of High Reliability Organizations (HRO) across four hospitals in Bogor City, Indonesia. The findings demonstrate that leadership is the most influential determinant, followed by safety culture and RPI. Hospitals classified as Type A and Type B exhibited higher maturity levels (*Advancing* stage), while Type C and Type D hospitals remained in the *Developing* stage.

These results reinforce the critical role of leadership in establishing a vision for patient safety, ensuring adequate resource allocation, and fostering accountability across all levels of the organization. Safety culture acts as both a direct contributor and a mediator, amplifying the impact of leadership on HRO maturity. RPI, while less developed in the studied hospitals, remains a vital component for sustaining improvements and ensuring process consistency.

Overall, the study confirms that the **Chassin and Loeb (2013) HRO maturity model** is applicable to the Indonesian context, although local adaptations may be necessary to address resource disparities and cultural differences in healthcare management.

Recommendations

Table 10. Strategic Roadmap for Advancing HRO Maturity in Indonesian Hospitals

Strategic Area	Recommended Action	Timeline	Responsible Party
Leadership Development	Implement formal HRO leadership training; establish safety governance committees.	Short-term	Hospital Board, Executive Team
Safety Culture Enhancement	Introduce anonymous incident reporting tools; schedule quarterly safety climate surveys.	Short to Medium	Quality & Safety Department
RPI Capacity Building	Train multidisciplinary teams in Lean/Six Sigma; create an internal improvement project database.	Medium-term	Quality Improvement Unit
Resource Optimization	Establish resource-sharing agreements between high- and low-type hospitals.	Medium-term	Regional Health Authorities
Policy and Regulation	Align hospital accreditation criteria with HRO maturity stages; provide incentives for progression.	Long-term	Ministry of Health, Accreditation Bodies

Policy Implications

Policymakers should integrate HRO principles into national hospital accreditation systems to ensure that leadership, safety culture, and process improvement are not treated as isolated initiatives but as interdependent drivers of patient safety and quality. Regional health authorities can also play a role in reducing disparities by facilitating knowledge and resource sharing between hospitals of different classifications.

Final Remarks

By adopting a structured, leadership-driven approach to safety culture and process improvement, Indonesian hospitals can advance toward becoming true High Reliability Organizations. This transformation requires a combination of **visionary leadership**, **staff empowerment**, **systematic process improvement**, and **policy support**. Such alignment will not only reduce patient harm but also strengthen public trust in the healthcare system, contributing to better health outcomes nationwide.

Declaration of Competing Interest

All authors have indicated they have no potential conflicts of interest to disclose.

Acknowledgement

The authors would like to express their sincere gratitude to the management and staff of the hospitals in Bogor City for their cooperation and support during the data collection process. We acknowledge the Faculty of Public Health, Hasanuddin University, for granting the necessary research permissions and ethical clearance. Special thanks are extended to all respondents who participated in this study, whose contributions were invaluable to the research. We also appreciate the guidance and feedback from our colleagues and mentors, which greatly enhanced the quality of this work.

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