



A sustainable public healthcare model: Transformative resilience and crisis management in a State University hospital during the coronavirus pandemic

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ABSTRACT

Background: This study addresses the governance challenges faced by State University Hospitals operating within rigid administrative structures while responding to the rapidly escalating pressures of the coronavirus pandemic. These conditions created severe resource scarcity, threatening critical disruptions in hospital operations. This research evaluates surge capacity adaptation strategies (4S), measures functional preparedness parameters, and analyzes multisectoral coordination (5C) in fostering organizational resilience. **Methods:** A descriptive qualitative case study design was employed at the Universitas Indonesia Hospital, combining in-depth interviews, field observations, and document audits. Quantitative functional preparedness was evaluated using an adapted multi-criteria scoring rubric, complemented by After-Action Review (AAR) and Pattern Matching analytical methods. **Findings:** The hospital adapted its resource allocation system across four core pillars (Space, Staff, Supplies, Systems). Although initial logistical vulnerabilities were identified, management expanded its decision space through an Emergency Budget Plan initiative and fast-track procurement. Furthermore, multisectoral coordination among government authorities, the university ecosystem, and hospital management reduced functional silos, facilitating flexible operational adjustments. **Conclusion:** The hospital progressed toward a transformative resilience phase by institutionalizing emergency adaptations into permanent policies within its 2024–2029 Strategic Plan. While limited as a single-case study, the findings suggest that expanding managerial decision space and fostering multisectoral synergy can mitigate resource constraints during biological health emergencies. **Novelty/Originality of this article:** This study integrates the 4S surge capacity framework, the 5C multisectoral coordination model, and standardized preparedness measurement to provide an empirical resilience blueprint for university hospitals in developing nations.

KEYWORDS: COVID-19 response; disaster preparedness; hospital resilience; organizational resilience; surge capacity.

1. Introduction

Recent decades have witnessed a profound paradigm shift in how healthcare facilities are conceptualized and managed. Hospital organizations are no longer adequately explicated through reductionistic perspectives that construe them as mechanistic bureaucratic apparatuses. The prevailing theoretical orientation now posits that hospitals function as Complex Adaptive Systems (CAS), in which intricate networks of autonomous agents continuously interact and dynamically recalibrate their behaviors in response to multifaceted perturbations (Ratnapalan & Lang, 2020). Sahin et al. (2020) demonstrated

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during the coronavirus pandemic how biological shocks create multidimensional disruptions that inevitably overwhelm rigid public administrative structures. Within the global paradigm of Disaster Risk Reduction (DRR) under the Sendai Framework 2015–2030, pandemics are formally classified as systemic biological hazards requiring a shift from reactive responses to proactive preparedness (Seddiky et al., 2020). For a State University Hospital operating as a CAS, this transition requires mainstreaming DRR principles directly into everyday institutional governance, such as those outlined in the Universitas Indonesia Hospital/*Rumah Sakit Universitas Indonesia* (RSUI) 2024–2029 Strategic Plan, rather than relying on isolated ad-hoc responses (Seddiky et al., 2020).

Without proactive DRR and preparedness measures, severe biological disturbances can trigger acute scarcities of vital medical resources, leading to rapid cascading failures across interconnected healthcare infrastructures (Haley et al., 2021). By integrating proactive DRR strategies into daily operations, healthcare facilities build sustainable, process-oriented resilience to mitigate these systemic risks and maintain operational continuity during extreme patient surges (Seddiky et al., 2020). Hospital resilience must be developed as a dynamic capability to adapt clinical protocols and transform organizational structures, rather than relying solely on static physical asset reserves. Furthermore, Kraus et al. (2025) argue that building this adaptive capacity requires standardized operational modifications that allow facilities to absorb escalating emergency waves smoothly. Ultimately, these findings suggest that operational resilience during crises is not determined solely by rigid hierarchical commands but also depends on the agility of governance mechanisms and the capacity for self-organization (Barasa et al., 2017).

Confronted with the pressure of an exponential surge in infectious patients, healthcare facilities were compelled to implement surge capacity adaptation. Theoretically, surge capacity denotes a system's ability to expand its operations beyond standard thresholds through the management of four core pillars: space, staff, supplies, and systems (Bonnett et al., 2007). According to the clinical guidelines of the Institute of Medicine (2009), this operational adaptation must be implemented dynamically across a continuum transitioning clinical standards from conventional and contingency levels to crisis standards of care. Successfully navigating this continuum requires rapid spatial layout re-engineering and flexible nurse-to-patient staffing ratio modifications to prevent localized system saturation. Phattharapornjaroen et al. (2023) established that flexible surge capacity must serve as a core pillar of modern emergency medical systems to ensure long-term resilience under prolonged biological threats. To operationalize these 4S adaptations under severe resource constraints, hospital managers require adequate administrative latitude. Bossert (1998) established the decision space framework to analyze how the degree of decentralized authority given to local managers directly determines their capacity for administrative and operational innovation. Bower (2016) further asserted that an organization's realized strategy is ultimately defined by real-time resource-commitment choices made by frontline managers under rigid financial constraints. When decision-making autonomy is expanded, local managers gain the flexibility to execute 4S adaptations swiftly without being paralyzed by risk-averse bureaucratic protocols (Bossert, 1998; Bower, 2016).

The problem context becomes increasingly specific and complex within facilities operating as Academic Health Centers (AHCs) or State University Hospitals, such as the Universitas Indonesia Hospital (RSUI), which was situated at the epicenter of an urban agglomeration outbreak. Operational pressures in state university hospitals are intensified by a unique governance paradox, wherein rigid public administrative rules collide with real-time clinical necessities. This creates what Kusumayati (2021) terms a double burden, compelling these institutions simultaneously scale up emergency clinical responses and sustain their core missions of medical instruction and scholarly research. To address this paradox, Phattharapornjaroen et al. (2022) proposed the 5C framework, illustrating how the orchestration of Command, Control, Communication, Coordination, and Collaboration can reduce functional silos during public health emergencies. The effectiveness of these systemic mitigation measures can subsequently be evaluated through multi-criteria decision-making models (Ortiz-Barrios et al., 2020) to measure functional hospital

preparedness across infrastructure, logistics, and human resource dimensions. The ultimate objective of such preparedness is the attainment of transformative resilience, in which an institution uses crisis experiences to bounce forward toward a more robust and adaptive operational architecture (Malléjac & Or, 2025).

Although the challenges of healthcare crises have been widely studied, a significant literature gap persists regarding micro-level operational implementation in developing nations. Prior studies have predominantly examined macro-level policy containment or national-scale administrative accountability (Nguyen et al., 2021). Consequently, limited empirical evidence exists regarding how a hybrid institution, such as a state university hospital in Indonesia, navigates a circumscribed decision space to adapt its resource-allocation capacity during an acute crisis. This study addresses this gap by integrating three theoretical perspectives: The 4S surge management strategy, the 5C multisectoral coordination framework, and a dual quantitative-qualitative preparedness assessment, to formulate an empirical blueprint for a sustainable public healthcare model.

Grounded in this theoretical background, this study tests a directional hypothesis: if a state university hospital expands its managerial decision space and flexibly operationalizes the 4S allocation framework through 5C multisectoral collaboration, its capacity to mitigate resource scarcity will improve, enabling the transition toward transformative resilience (Kusumayati, 2021; Lubis, 2021). To examine this hypothesis, the study addresses three research questions How did RSUI implement its surge capacity adaptation strategies (4S) during the COVID-19 pandemic? How effective was the orchestration of multisectoral coordination (5C) among university leadership, government authorities, and hospital management in responding to the crisis? What is the resulting level of RSUI's functional preparedness in mitigating future public health emergencies?

2. Methods

2.1 Research design and setting

This study adopted a descriptive qualitative single-case study design, complemented by a quantitative functional preparedness assessment, to investigate organizational adaptation and resilience mechanisms at the Universitas Indonesia Hospital (RSUI). The qualitative component examined organizational decision-making and adaptive processes, while the quantitative component assessed functional preparedness using standardized criteria. RSUI is a state university hospital located in Depok, West Java, serving as a secondary referral center within the Greater Jakarta urban agglomeration. The hospital operates under shared governance involving university authorities and the Ministry of Health while balancing clinical services and academic responsibilities.

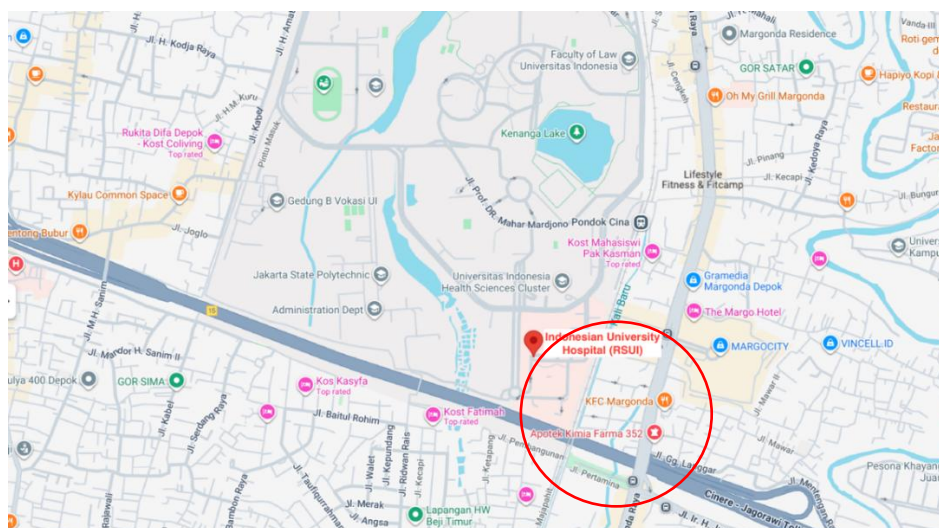


Fig. 1 Research location

To evaluate institutional resilience accurately, this study drew an explicit distinction between two operational timeframes: the retrospective crisis period (2020–2022), during which emergency adaptations were implemented, and the current observation period (2025–2026), during which field observations and follow-up interviews were conducted to assess the permanent institutionalization of these measures into the hospital's strategic plan. The geographic position and referral catchment area of RSUI within the urban outbreak epicenter are illustrated in Figure 1.

2.2 Informants and data collection

To select key informants possessing deep operational knowledge and formal decision-making authority during the pandemic, this study employed purposive sampling based on predefined inclusion criteria active leadership in the RSUI COVID-19 Task Force or university-level emergency committees during 2020–2022, holding formal administrative or clinical management positions and direct responsibility for executing 4S surge capacity adaptations or 5C multisectoral coordination. Five key informants were selected across strategic, operational, and regulatory levels (Table 1).

Table 1. Demographic profiles and specific operational roles of key informants

Informant code	Affiliated unit	Authority level	Pandemic-era operational role	Qualitative data extracted
INF-01	UI Rectorate Leadership	Strategic (Key)	Authorized university asset re-allocation and coordinated high-level regional political alignments.	University-hospital synergy, approval for State University Operational Assistance (BOPTN) budget redirection, and administrative liability protection.
INF-02	RSUI Board of Directors	Strategic (Key)	Formulated a three-month emergency budget plan (RAB), bypassed conventional procurement protocols, and legalized emergency Standard Operating Procedures (SOPs).	Decision-space expansion, financial autonomy, fast-track Cito Purchase Order via Type-2 Swakelola (Self-Management Procurement), and audit protection.
INF-03	Medical Management/ Taskforce Head	Operational (Main)	Orchestrated clinical department transitions, cross-functional staff rosters, and led interdisciplinary engineering projects.	Clinical governance adaptations, team dynamics, local task force command, and Biosafety Level 2 (BSL-2) laboratory establishment.
INF-04	Heads of Clinical Units (Intensive Care Unit/Emergency Department)	Operational (Main)	Managed bedside clinical operations, implemented the color-coded triage protocols, and supervised volunteer integration.	Bed-occupancy management, staff burnout mitigation, Occupational Health and Safety compliance, Infection Prevention and Control Committee protocols, and physical zoning.

INF-05	Government Health Authorities	External (Addition)	Coordinated epidemiological data sync with national platforms and managed municipal emergency grants.	National reporting compliance, public resource-pooling, and disbursement of Emergency Local Government Grants.
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Note: Informant codes are utilized throughout this paper to protect participant privacy in accordance with qualitative research ethics

Primary data collection integrated semi-structured in-depth interviews, direct field observations, and a comprehensive document audit. Fieldwork conducted between 2025 and 2026 involved direct observation of permanent architectural and mechanical layouts, such as the Biosafety Level 2 (BSL-2) molecular laboratory and active negative-pressure Heating, Ventilation, and Air Conditioning (HVAC) systems on the 13th and 14th floors. For temporary emergency physical structures decommissioned prior to fieldwork, such as external National Disaster Management Authority/*Badan Nasional Penanggulangan Bencana* (BNPB) triage tents and early emergency zoning layouts, spatial configurations were reconstructed retrospectively. Methodologically, cross-referencing current physical observations with contemporaneous institutional archives (architectural blueprints, internal facility maps, and official photographic records from hospital evaluation reports) mitigated potential recall bias and ensured empirical accuracy (Creswell & Poth, 2018; Miles et al., 2019; Lubis, 2021). Concurrently, document audits examined key institutional regulatory decrees, including Director Regulation (Perdirut) No. 035/2020 on clinical triage, Director Decree (Keputdirut) No. 043A/2020 regarding pressure isolation rooms, occupational health and safety (OHS) tracing protocols, and the RSUI 2024–2029 Strategic Plan.

This study examines four core research variables: Surge Capacity (4S: Space, Staff, Supplies, Systems), Crisis Governance (5C: Command, Control, Communication, Coordination, Collaboration), Functional Preparedness, and Transformative Resilience. To evaluate the functional preparedness of RSUI quantitatively while maintaining qualitative depth, we adapted the multi-criteria parameters from Ortiz-Barrios et al. (2020). To reduce subjectivity in the assessment, a standardized evaluation rubric was established to determine scoring on a 1-to-5 Likert scale, where Score 1 represents a highly unprepared state (no written procedures exist and physical infrastructure is entirely absent), Score 3 represents a moderately prepared state (SOPs are formalized but lack system redundancy), and Score 5 represents a highly prepared state (systems are optimized across multisectoral networks with verified high-load flexibility).

2.3 Data analysis

Qualitative data condensation and analysis followed the three-stage systematic coding approach described by Creswell & Poth (2018) and the matrix-based procedures outlined by Miles et al. (2019): (1) Open Coding, where verbatim transcripts were broken down line-by-line to identify raw operational concepts; (2) Axial Coding, where codes were grouped into larger functional categories to map the interactions among the 4S surge adaptations and the 5C multisectoral dynamics; and (3) Selective Coding, where core themes were integrated to construct the final model of sustainable healthcare resilience. To identify functional critical weaknesses (Scrit) across the evaluated parameters, a scoring average threshold of ≤ 2.5 was applied using Equation 1:

$$\text{Scrit} = \frac{\sum_{i=1}^n si}{n} \leq 2.5 \quad (\text{Eq. 1})$$

Where *si* represents the individual score of the sub-criteria, and *n* represents the total number of functional sub-criteria evaluated within each main parameter. The final data

interpretation utilized the Pattern Matching technique to compare emerging empirical patterns from the field with the study's pre-formulated directional hypotheses.

2.4 Data triangulation

To establish scientific rigor and reduce potential researcher bias in the qualitative findings, this study implemented a strict qualitative data trustworthiness protocol grounded in qualitative research standards. Credibility (internal validity) was achieved through extensive source and method triangulation, cross-verifying accounts between strategic leaders and operational clinical heads, and checking interview verbatims against spatial field observations and official policy documents. Dependability (reliability) was guaranteed by establishing a transparent, chronological audit trail, archiving raw audio recordings, transcripts, field notes, and coding trees in a secure database to permit process audits. Confirmability was addressed through reflexive journaling to identify and mitigate researcher bias, ensuring that conclusions remain grounded in empirical field data and established theoretical parameters. Overall trustworthiness was further strengthened through source, method, and time triangulation. Source triangulation involved cross-verifying accounts between strategic leaders and operational clinical heads, while method triangulation compared interview verbatims with spatial field observations and official policy documents. Finally, time triangulation contextualized evidence across different phases of the crisis and subsequent institutional development.

3. Results and Discussion

3.1 Overview of RSUI operational emergency in facing the COVID-19 pandemic

The Universitas Indonesia Hospital (RSUI) was positioned at the epicenter of the initial COVID-19 transmission in Depok City, an agglomeration area characterized by high commuter mobility (Novarita, 2021). In response to these regional conditions, RSUI was designated as an infectious disease management facility through a series of regulations at the national, provincial, and municipal levels. These included the Ministry of Health Circular Letter Number HK.02.02/I/0883/2020 as part of the National Service Network, the West Java Gubernatorial Decree Number 445/Kep.224-Dinkes/2020 as a Referral Hospital for Emerging Infectious Diseases, and the Depok Mayoral Decree Number 440/140/Kpts/Dinkes/Huk/2020 as a Dedicated Hospital (*Rumah Sakit Universitas Indonesia*, 2021). This multi-layered designation placed RSUI under a dual operational burden arising from its state university hospital status. Consequently, the institution confronted, wherein the fulfillment of frontline emergency clinical services had to proceed concurrently with compliance with university bureaucratic procedures and the mandate to protect the campus academic community.

These external environmental pressures triggered severe internal operational vulnerabilities. Based on the Hazard Vulnerability Assessment (HVA) conducted by the RSUI Occupational Health and Safety Unit in early 2020, an infectious disease outbreak was categorized as a high-probability threat with maximum severity (Rahmadani, 2021). This vulnerability manifested tangibly when RSUI's baseline infrastructure capacity was confronted with an exponential surge in patient admissions. At the onset of the crisis in March 2020, the newly operational hospital operated only 34 active inpatient beds, with critical care capacity constrained to just 3 Intensive Care Unit (ICU) beds and 2 High Care Unit (HCU) beds (Ramlan, 2021). This severe discrepancy between the influx of critical patients from the Depok epicenter and the scarce intensive care capacity triggered severe overcrowding and operational bottlenecks in the Emergency Department (ED). To map these baseline pressures systematically, Table 2 summarizes the multi-dimensional emergency conditions faced by RSUI at the onset of the pandemic.

Table 2. Dimensions of RSUI operational emergency at the onset of the pandemic

Emergency dimension	Baseline capacity (Pre-pandemic)	Pandemic-induced challenges
Physical Infrastructure & Space	Operating 34 inpatient beds, with a maximum threshold of 3 ICU beds and 2 HCU beds.	High risk of cross-contamination due to the absence of extreme negative pressure HVAC systems; severe patient bottlenecks occurred in the ED.
Supply Chain (Logistics)	Supply dependency on vendors utilizing standard deferred payment terms.	Vendors shifted schemes to mandatory cash-only payments; unprecedented spikes in cash-only payments; Polymerase chain reaction (PCR) diagnostic devices required pre-ordering (indent).
Human Resources	Staffed by 151 nursing personnel, predominantly comprised of 99 junior associate nurses.	An urgent need to modify staff rosters modifications to mitigate staff burnout arising from intensive workloads and dehydration from prolonged hazmat suit usage.
Financial Stability	Revenue stream primarily supported by regular outpatient clinics and elective (scheduled) surgical procedures.	A sharp decline in regular service revenues, coupled with a 33% increase in indirect operational expenditures.

Note: Data compiled from RSUI Annual Reports and internal crisis documentation

3.2 Surge capacity adaptation strategy (4S) in maintaining critical services

Confronted with the accumulation of operational pressures during the initial phase of the pandemic, RSUI's management recognized that standard protocols were no longer sufficient to address escalating operational pressures and maintain service continuity. In response, RSUI activated a surge capacity strategy—defined as the ability of a healthcare facility to safely expand its operations to manage an influx of critical patients that exceeds standard operational thresholds (Bonnett et al., 2007). This adaptation was executed systematically across the four core pillars of resource allocation: Space, Staff, Supplies, and Systems/Standards of Care (4S).

On the Space pillar, RSUI scaled up physical capacity from an initial 34 regular beds to a total of 68 negative-pressure isolation and intensive care beds. Externally, RSUI erected National Disaster Management Authority (BNPB) triage tents to serve as a physical buffer zone and repurposed the ground floor of the parking structure into the Melati Outpatient Clinic, dedicated specifically to infectious cases (Nursasi, 2021). Within the main building, RSUI centralized a 17-bed Intensive Care Unit (ICU) on the 3rd floor, an 8-bed Pediatric and Neonatal Intensive Care Unit (PICU/NICU) on the 6th floor, and renovated VIP wards on the 13th and 14th floors to accommodate 41 negative-pressure isolation beds (Ramlan, 2021) equipped with High-Efficiency Particulate Air (HEPA) filters achieving 12 Air Changes per Hour (ACH) circulation. To confirm this operational reality, the Head of Clinical Units (INF-04) stated:

"We had to convert the VIP rooms on the 13th and 14th floors into negative-pressure isolation wards almost overnight. Setting up HEPA filters and adjusting the exhaust systems to maintain negative pressure was a massive operational feat, but it prevented cross-contamination" (INF-04, 2026).

This spatial strategy provides empirical support for the cohorting area framework postulated by Carenzo et al. (2020). On the Staff pillar, RSUI implemented a comprehensive workforce-support strategy to mitigate acute nurse shortages and prevent physical collapse. RSUI expanded its workforce by recruiting 123 healthcare volunteers to support the existing 151 nurses (Fajariani, 2021). Consistent with contingency capacity principles (Institute of Medicine, 2012), management also introduced measures to support staff working under intensive conditions (Institute of Medicine [IOM], 2012), management

introduced strict measures to protect personnel operating inside high-risk red zones using Level 3 Personal Protective Equipment (PPE) by limiting duty shifts to a maximum of 4 hours. As recalled by the Medical Management Representative (INF-03):

“Our clinical staffs were on the verge of physical collapse due to wearing hazmat suits for over six hours. Limiting the red-zone duty to a strict four-hour shift, combined with setting up Wisma Makara UI as a safe dormitory, was vital to sustain our frontline clinical workforce” (INF-03, 2026).

Occupational protection was further reinforced by providing sterile lodging at Wisma Makara UI and the UI Japanese Studies Center (PSJ), conducting routine Polymerase Chain Reaction (PCR) swab screenings reaching 87.7% staff coverage, and monitoring psychological well-being every three months using the World Health Organization’s Self-Reporting Questionnaire (SRQ) mental health tool (Dahlia, 2021). On the Supplies pillar, RSUI addressed global supply chain disruptions—characterized by N95 mask prices surging to IDR 50,000 per unit and cash-on-delivery vendor mandates (Hidayat, 2021)—by establishing an Emergency Procurement Taskforce utilizing Type-2 Self-Management (*Swakelola Tipe 2*). Management formulated a 3-month Emergency Budget Plan/*Rencana Anggaran Biaya Darurat* (RAB Darurat) and applied fast-track Purchase Orders (PO Cito) to acquire critical stocks directly. As explained by the RSUI Board Representative (INF-02):

“In the first three months, we faced absolute cash-only demands from PPE vendors. We immediately established an emergency budget (RAB Darurat) and utilized the PO Cito swakelola mechanism. This saved us from bureaucratic paralyzation and allowed us to purchase PPE directly without waiting for normal tender approvals” (INF-02, 2026).

To absorb external humanitarian donations transparently, RSUI established a zero-value PO Cito accounting mechanism within the Hospital Management Information System/*Sistem Informasi Manajemen Rumah Sakit* (SIMRS) (Pujiyanti, 2021), synchronizing inventory and bed availability in real time with national SIRS Online (*Sistem Informasi Rumah Sakit Online*) and *Bersatu Lawan COVID-19* (BLC) dashboards. On the Systems/Standards of Care pillar, RSUI shifted from conventional patient-centered care toward population-centered crisis standards of care (IOM, 2012). Hospital leadership legalized internal COVID-19 Clinical Practice Guidelines/*Pedoman Praktik Klinis* (PPK) via Director Regulation (Perdirut) No. 035/2020 to establish a formal legal framework for therapeutic protocols. To pool resources, RSUI suspended Medical Check-Up (MCU) services, deferred elective surgeries, transitioned routine outpatient clinics to telemedicine platforms (Dewi, 2021), and deployed mobile X-ray units directly inside the Emergency Department (ED) to protect permanent Computed Tomography (CT) Scan and Magnetic Resonance Imaging (MRI) facilities from airborne contamination risks (Dewi, 2021). Furthermore, cost controls were stringently monitored by Case Managers using Executive Decree (*Surat Edaran*) No. 229/2020 to ensure that high-cost pharmaceutical utilization aligned with Cost Per Days evaluation metrics.

3.3 Multisectoral orchestration in the crisis management ecosystem

The implementation of RSUI's 4S surge capacity adaptations also depended on support from actors beyond the hospital. During the pandemic, RSUI coordinated with four main stakeholder groups: internal hospital actors, the Universitas Indonesia (UI) ecosystem, government authorities, and community and private-sector actors. To harmonize these diverse entities, RSUI operationalized the 5C framework (Command, Control, Communication, Coordination, and Collaboration) to facilitate multi-sectoral orchestration. This framework served as an operational mechanism to transform fragmented inter-institutional efforts into a synchronized emergency response system, as detailed in Table 3.

Table 3. Mapping of multisectoral actors within the COVID-19 management ecosystem at RSUI

Authority level	Specific actor entities	Role focus
Internal (Micro-Operational)	RSUI Board of Directors, COVID-19 Taskforce, Infection Prevention Control Committee, Occupational Health and Safety Unit (OHS), Casemix Team, & Hospital Management Information System Unit (SIMRS).	Executing spatial restructuring (4S), enforcing tracking and tracing compliance (3T), and anchoring the rationality of cost metrics (Cost Per Days).
UI Ecosystem (Macro-Innovation & Assets)	UI Rectorate Leadership, Directorate of Partnerships, Alumni Network (ILUNI UI), & Inter-faculty Departments (Faculty of Medicine, Faculty of Nursing, Faculty of Engineering, and Faculty of Mathematics and Natural Sciences).	Mobilizing campus assets (Wisma Makara UI and Japanese Studies Center [PS] - <i>Pusat Studi Jepang</i>) for staff lodging and supporting the development of translational medical device innovations (COVENT-20 portable ventilator, sterile swab booths, and DSS-CovidNet AI diagnostics).
Government Authorities (Regulatory & Extrinsic)	Governor of West Java, Depok Municipal Government, Ministry of Health, Directorate General of Higher Education, National Taskforce/BNPB, BPJS Kesehatan.	Providing legal referral legitimacy, disbursing emergency financing (IDR 17.2 billion BTT and IDR 38 billion BOPTN grants), and supplying emergency logistical aid.
Community & Private Sectors (Philanthropy)	SOE (BUMN)/Private Consortia, Humanitarian NGOs, and Mass Media Networks.	Mobilizing trust-based humanitarian solidarity to supply critical medical equipment donations.

Note: 4S = Space, Staff, Supplies, Systems; 3T = Testing, Tracing, Treatment; BTT = *Biaya Belanja Tidak Terduga* (Unexpected Assistance Funds); BOPTN = *Bantuan Operasional Perguruan Tinggi Negeri* (State University Operational Assistance)

These diverse actors and jurisdictions shown in Table 3 were systematically orchestrated through the 5C framework, which encompasses Command, Control, Communication, Coordination, and Collaboration. The first dimension, Command, served as the primary source of legal legitimacy and liability protection. Regional authorities from West Java Province and the Depok Municipal Government established referral mandates, while the Universitas Indonesia Rectorate granted specialized administrative autonomy. This strategic command protection was highlighted by the UI Rectorate Leadership (INF-01), who stated:

“As a state university hospital, RSUI was bound by rigid public sector accounting, which risked operational paralysis during the initial cash-only market disruptions. We issued emergency rectorial decrees to relocate state funding (BOPTN) of IDR 38 billion, providing both the vital liquidity buffer and the administrative protection required for the directors' fast-track procurement actions” (INF-01, 2026).

This vertical command was dynamically balanced by the Control element. The UI Rectorate managed transmission risks outside the hospital facilities by restricting activities within the broader campus ecosystem, while the RSUI COVID-19 Taskforce and OHS Unit acted as internal safety nets to enforce safety compliance through Perdirut No. 035/2020 on clinical triage, Keputdirut No. 043A/2020 regarding pressure isolation rooms, and various OHS tracing procedures (Standard Operating Procedure No. 28, 29, and 33). Regarding the financial and operational control mechanisms, the RSUI Board Representative (INF-02) explained:

“We had to enforce strict Cost Per Days controls through our Case Managers using SE No. 229/2020. This financial control ensured that our emergency procurement via swakelola

Tipe 2 stayed highly rational and auditable, even when bypassing standard public tender processes” (INF-02, 2026).

The efficacy of these command-and-control elements relied heavily on real-time data transparency processed through the Communication element. RSUI reduced the bottlenecks associated with conventional paper-based information flows by digitally integrating its local Hospital Management Information System (SIMRS) with the national-level Bersatu Lawan Covid-19 (BLC) and SIRS Online dashboards. This digital transparency facilitated the fourth element, Coordination, which focused on resource-pooling (Phattharapornjaroen et al., 2022). Through robust cross-sectoral coordination, RSUI successfully mobilized substantial external resources (Sesuai Style Edits: Mengganti kata hiperbolis), including an injection of IDR 17.2 billion in Emergency Local Government Grants (BTT) from the Depok Municipal Government, and the deployment of university assets like Wisma Makara UI and the Japanese Studies Center (PSJ - *Pusat Studi Jepang*) as dedicated dormitories for healthcare personnel. The Government Health Authority Representative (INF-05) described this communication and coordination process, stating:

“RSUI’s capability to feed real-time bed occupancy and laboratory data directly into our regional dashboards allowed us to make instant decisions. We immediately approved and disbursed the IDR 17.2 billion BTT grant to cover their volunteer recruitment and subsidize free PCR testing for Depok citizens without bureaucratic delay” (INF-05, 2026).

When macro-level public resource-pooling schemes fell short of keeping pace with extreme global supply chain shortages, the fifth element, Collaboration, assumed greater operational importance. Collaborative orchestration triggered innovative self-organization, wherein internal RSUI actors and various university faculties worked across conventional boundaries to establish the “Gerakan UI Melawan Covid-19” coalition. Regarding this interdisciplinary academic synergy, the Medical Management Representative (INF-03) recalled:

“The crisis forced us to dissolve academic silos. We brought together medical specialists from Faculty of Medicine, fluid mechanics engineers from Faculty of Engineering, and computer scientists from Faculty of Mathematics and Natural Sciences. Within weeks, this collaborative team was testing the COVENT-20 portable ventilator prototype and designing the DSS-CovidNet AI diagnostics right in our wards” (INF-03, 2026).

This grassroots collaboration also mobilized over 1,000 senior healthcare students as clinical volunteers. To capture the bedside reality of this collaboration, the Head of Clinical Units (INF-04) remarked:

“Integrating student volunteers under our senior nurses was a complex coordination task. We set up an adaptive team-based nursing model and limited red-zone duty to four hours, which successfully absorbed our massive patient workloads while keeping staffs infection rates extremely low” (INF-04, 2026).

Theoretically, this 5C orchestration demonstrates the structural transformation of RSUI from a rigid, mechanistic public bureaucracy into an agile Complex Adaptive System (CAS) (Ratnapalan & Lang, 2020). Conversely, the 5C framework served as a set of dynamic interaction rules that enabled local actors to coordinate and adapt through self-organization (Barasa et al., 2017). This transition was solidly anchored by a Three-Pillar Synergy comprising government authorities (providing legal and financial legitimacy), the university ecosystem (supplying assets and intellectual capital), and hospital management (executing frontline operational agility). Synergy among these three pillars provided an important organizational mechanism for limiting the propagation of operational disruptions and maintaining overall healthcare delivery capacity.

3.4 Preparedness evaluation and critical weakness mapping

In modern crisis management paradigms, hospital preparedness is measured not merely by the routine accumulation of physical assets, but by an integrated operational planning capacity to absorb shock burdens. To evaluate RSUI's functional readiness comprehensively following the implementation of 4S adaptations and 5C multisectoral orchestration, a multi-criteria evaluation was conducted using a standardized disaster assessment matrix. This quantitative assessment measured performance across key disaster preparedness parameters, comparing baseline vulnerabilities against post-adaptation operational states as detailed in Table 4.

Table 4. Evaluation criteria for hospital preparedness at RSUI

Main criteria	Sub-criteria indicator	Pre-adaptation score	Post-adaptation score	Strategic intervention
Building (C1)	Physical infrastructure (SC01)	2.0 (Unprepared)	4.09 (Prepared)	Segregated Red, Yellow, and Green zones to isolate infectious areas.
	Localization (SC02)	2.0 (Unprepared)	3.54 (Moderately Prepared)	Restricted campus area access and controlled emergency movement routes.
	Number of storeys (SC03)	2.0 (Unprepared)	4.09 (Prepared)	Managed vertical transit using dedicated clean and dirty elevators.
	Installed capacity (SC04)	2.0 (Unprepared)	3.74 (Moderately Prepared)	Converted 13th-14th floors into 41 isolation beds & 3rd floor into ICU (17 beds).
	Disaster meeting point (SC05)	2.0 (Unprepared)	4.17 (Prepared)	Erected external BNPB triage tents as physical buffer zones.
	Isolation (SC06)	1.0 (Highly Unprepared)	3.94 (Moderately Prepared)	Built negative-pressure isolation wards (-15 Pa room, -5 Pa airlock).
	Ventilation (SC07)	2.0 (Unprepared)	4.03 (Prepared)	Installed HEPA filters and exhaust fans achieving 12 ACH circulation.
Equipment & Supplies (C2)	Medicaments (SC08)	1.0 (Highly Unprepared)	3.97 (Moderately Prepared)	Emergency procurement via fast-track PO Cito, Dikti & BTT Depok funds.
	Safety supply management (SC09)	1.0 (Highly Unprepared)	4.03 (Prepared)	Restricted Level 3 PPE to red zones & absorbed external donations.
	Medical equipment (ECS) (SC10)	2.0 (Unprepared)	3.97 (Moderately Prepared)	Bypassed import limits via COVENT-20 ventilator, swab booths & DSS-CovidNet.

Main criteria	Sub-criteria indicator	Pre-adaptation score	Post-adaptation score	Strategic intervention
	Electric generator (SC11)	2.0 (Unprepared)	4.06 (Prepared)	Enhanced backup generator capacity to secure continuous life-support power.
	Potable Water Supply (SC12)	2.0 (Unprepared)	4.20 (Prepared)	Secured independent clean water supply and emergency buffer capacity.
	Tent availability (SC13)	2.0 (Unprepared)	3.97 (Moderately Prepared)	Deployed semi-permanent outdoor tents for initial screening and swab tests.
	Food services (SC14)	2.0 (Unprepared)	4.06 (Prepared)	Provided extra high-nutrition meals for isolation red-zone medical staff.
	Hospital beds (SC15)	2.0 (Unprepared)	3.89 (Moderately Prepared)	Expanded active beds from initial 34 regular beds to dozens of isolation beds.
	Triage label (SC16)	2.0 (Unprepared)	3.97 (Moderately Prepared)	Standardized clinical triage pathways via Director Decree No. 035/2020.
	Financial resources (SC17)	2.0 (Unprepared)	3.77 (Moderately Prepared)	Expanded budget space via Self-Management, emergency RAB & BTT Depok funds.
	Supply Source (SC18)	2.0 (Unprepared)	3.94 (Moderately Prepared)	Used fast-track purchasing (PO Cito) from stock-ready vendors.
Communication (C3)	Emergency service network (SC19)	2.0 (Unprepared)	4.00 (Prepared)	Integrated RSUI as a regional and national PCR testing network hub.
	Communications platforms (SC20)	2.0 (Unprepared)	3.91 (Moderately Prepared)	Digitalized screening forms via SIMRS to eliminate paper transmission.
	Information Quality (SC21)	2.0 (Unprepared)	3.89 (Moderately Prepared)	Synchronized real-time SIMRS data with SIRS Online & BNPB BLC dashboards.
Transportation (C4)	Number of ambulances (SC22)	2.0 (Unprepared)	3.60 (Moderately Prepared)	Dedicated specialized ambulance fleet for infectious patient transfer.

Main criteria	Sub-criteria indicator	Pre-adaptation score	Post-adaptation score	Strategic intervention
Human Resources (C5)	Heliport area (SC23)	2.0 (Unprepared)	3.14 (Moderately Prepared)	Maintained heliport area, though response relied heavily on ground transport.
	Safety (SC24)	2.0 (Unprepared)	3.91 (Moderately Prepared)	Enforced security controls over clean vs. dirty vertical transit paths.
	Road accessibility (SC25)	2.0 (Unprepared)	4.06 (Prepared)	Optimized main access roads leading to emergency triage and buffer areas.
	Education and training (SC26)	2.0 (Unprepared)	3.86 (Moderately Prepared)	Trained swabbers and hosted preparedness webinars for >1,000 health workers.
	Disaster drill (SC27)	2.0 (Unprepared)	4.00 (Prepared)	Mandated pre-deployment Occupational Health and Safety and Infection Prevention and Control orientations for all staff and volunteers.
	Emergency response team (SC28)	2.0 (Unprepared)	4.11 (Prepared)	Formed Task Force, screened 87.7% staff via PCR & monitored mental health.
	Integration & coordination (SC29)	2.0 (Unprepared)	3.86 (Moderately Prepared)	Suspended non-essential services (MCU, Home Care) to redeploy staff.
	Number of emergency staff (SC30)	2.0 (Unprepared)	3.97 (Moderately Prepared)	Recruited 123 volunteers and deployed >1,000 UI medical/nursing students.
	Working time (SC31)	2.0 (Unprepared)	3.20 (Moderately Prepared)	Restricted red-zone shifts to max 4 hours & provided Wisma Makara UI lodging.
	Flexibility in facility use (SC32)	2.0 (Unprepared)	4.14 (Prepared)	Repurposed ground-floor parking into Polyclinic Melati for outpatient screening.
Adaptability (C6)	Contingency staff (SC33)	2.0 (Unprepared)	3.94 (Moderately Prepared)	Applied functional team nursing and cross-departmental staff backups.
	Blood bank (SC34)	2.0 (Unprepared)	3.97 (Moderately Prepared)	Strengthened blood supply coordination

Main criteria	Sub-criteria indicator	Pre-adaptation score	Post-adaptation score	Strategic intervention
	Flexible supply chains (SC35)	2.0 (Unprepared)	3.97 (Moderately Prepared)	with PMI and health networks. Used zero-value PO Cito accounting to absorb external donations instantly.

Based on Table 4, RSUI's preparedness architecture experienced substantial operational improvements across all main parameters. Prior to crisis adaptations, RSUI operated at an unprepared baseline status across multiple dimensions, with several indicators recording initial baseline weaknesses between 1.0 and 2.0 (such as logistics supply recording a critical baseline score of 2.4). Following the execution of 4S adaptations and 5C multisectoral orchestration, post-adaptation evaluations demonstrated aggregate scores reaching between 3.14 and 4.20, led by Adaptability (4.00), Equipment & Supplies (3.98), Building (3.94), Communication (3.93), and Human Resources (3.83).

Within the structural infrastructure dimension (C1), RSUI's initial disaster-resistant design permitted substantial modifications, such as converting upper-floor VIP rooms into 41 isolation beds and installing negative-pressure HVAC systems (-15 Pa room, -5 Pa airlock) with HEPA filters, without compromising the integrity of the main building. In the human resources dimension (C5), burnout risks were actively mitigated through a 4-hour red-zone shift cap and dedicated isolation housing at Wisma Makara UI, supported by an 87.7% PCR screening rate for frontline emergency response teams. The strength of the communication parameter (C3) was demonstrated by real-time digital integration of SIMRS data with the national SIRS Online and BNPB BLC dashboards, ensuring more efficient referral flows.

Crucially, the recalculated post-adaptation scores reveal that initial vulnerabilities in Equipment & Supplies (C2) were substantially reduced, reaching a robust average of 3.98. Sub-criteria including medicaments (3.97) and safety supply management (4.03) achieved moderate to high preparedness levels. Early market shortages of PCR reagents and N95 masks were substantially mitigated via Type 2 Self-Management procurement, fast-track PO Cito zero-value donor absorption, and in-house interdisciplinary innovations such as the Faculty of Engineering COVENT-20 ventilator and swab booths. However, the post-adaptation evaluation also identified remaining relative operational bottlenecks—particularly in staff working times (SC31; score 3.20) due to nurse burnout, and the underutilized heliport area (SC23; score 3.14) resulting from regional aviation regulatory constraints. This empirical evidence suggests that expanded managerial decision space and agile supply-chain mechanisms contributed to reducing frontline logistical bottlenecks and strengthening organizational resilience.

3.5 Reflective transformative resilience toward sustainability

Drawing upon contemporary organizational resilience models in healthcare, an institution's robustness during crises is no longer measured passively by its mechanistic capacity to merely return to its baseline state (bounce back) after exposure to a shock, but is conceptualized as a dynamic, systemic capacity to move beyond the baseline state (bounce forward) to develop improved system capabilities (Malléjac & Or, 2025). To achieve this sustainable resilience, RSUI adapted its organizational architecture across three hierarchical dimensions of capacity: Absorptive, Adaptive, and Transformative Capacity (Malléjac & Or, 2025). The foundational level involved the development of Absorptive Capacity, which was demonstrated when RSUI absorbed the initial wave of critical patients without experiencing functional collapse of its clinical services (Malléjac & Or, 2025). This capacity manifested through the rapid spatial engineering of the 13th and

14th floors into isolation compartments under negative pressure reaching -15 Pa, which acted as a physical buffer for the main hospital building (Malléjac & Or, 2025; Marmo et al., 2022). This structural adaptation minimized cross-contamination and helped prevent the cascading failure of regular healthcare services during the peak patient influx (Malléjac & Or, 2025).

The secondary level was attained through the activation of Adaptive Capacity, which provided empirical support for the study's first assumption using the Pattern Matching method. This initial assumption posited that resource scarcity constraints could be minimized if the 4S allocation strategy was underpinned by self-organization mechanisms and an expanded decision space (Barasa et al., 2017). While field realities largely substantiated this assumption, the empirical findings also exposed critical tensions that challenged the ideal model of absolute preparedness, highlighting a phenomenon of asymmetric resilience where adaptive capacity did not develop homogeneously across all parameters. On one hand, internal spatial adaptations achieved high agility; on the other hand, human resource sustainability faced severe constraints, as evidenced by the low score of the working time indicator (SC31; mean score of 3.20, std dev of 0.76) due to substantial nurse burnout and prolonged shifts in high-risk zones, consistent with the workforce vulnerability patterns identified by Adams & Walls (2020). Furthermore, the hospital's heliport area (SC23) remained largely underutilized (mean score of 3.14, std dev of 1.33) due to rigid regional aviation regulations and a lack of integrated air-ambulance coordination with external municipal agencies (Ortiz-Barrios et al., 2020). This demonstrates that while local decision-space expansion can resolve immediate internal bottlenecks (Bossert, 1998), its operational utility remains heavily constrained by broader, more rigid socio-ecological and bureaucratic systems. Consequently, decentralizing administrative authority alone is insufficient to guarantee long-term institutional adaptation without parallel reforms at the macro-governance level. Operating as a State University Hospital (RS-PTN), RSUI confronted a severe governance paradox wherein rigid state financial regulations heavily impeded the procurement of essential logistics. According to Resource Allocation Theory, managers constrained by rigid procedures tend to exhibit risk-averse behavior due to the fear of subsequent financial audit sanctions (Bower, 2016). However, RSUI's leadership addressed this bureaucratic constraint by broadening its *de facto* decision space (Barasa et al., 2017; Bossert, 1998). This expansion of authority was operationalized through the self-managed formulation of an Emergency Budget Plan (RAB), supporting Bower's (2016) argument that an organization's realized strategy is shaped not only by normative planning documents but also by the real-time decisions of managers responding to operational constraints.

The highest and most critical tier was realized through Transformative Capacity, which provided empirical support for the study's second assumption. This assumption asserted that long-term resilience (*bounce forward*) is achieved when management patterns from the emergency response phase are successfully converted into organizational learning (Malléjac & Or, 2025). Evidence of this process was reflected in RSUI management's response to the critical weaknesses discovered (a score of 2.4) within the equipment and logistics sector (Ortiz-Barrios et al., 2020). Rather than allowing these gaps to persist, RSUI utilized an After-Action Review (AAR) evaluation to transform past logistical scarcities into a catalyst for technological innovation (Institute of Medicine, 2012). Empirical evidence of this organizational learning includes the rapid construction of a Biosafety Level 2 (BSL-2) Laboratory as a direct outcome of AAR crisis evaluations to achieve diagnostic independence, alongside the institutionalization of a buffer stock logistics system (Sukarman, 2021). The strongest evidence of this transformative capacity lies in the formal institutionalization of these tactical innovations as permanent policies within the RSUI 2024–2029 Strategic Plan (Renstra) (*Rumah Sakit Universitas Indonesia*, 2023).

The culmination of the disaster management synthesis at RSUI demonstrates the institution's transformation from a mechanistic bureaucracy into a Complex Adaptive System (CAS) (Ratnapalan & Lang, 2020). Under rapidly changing and uncertain conditions, the 5C leadership orchestration successfully reduced functional silos and facilitated the

emergence of interdisciplinary innovations, such as the DSS-CovidNet artificial intelligence software, swab test chambers, and the COVENT-20 portable ventilator prototype. The sustainability of hospital operations during a catastrophic situation depends substantially on a Three-Pillar Synergy. The legal legitimacy and substantial emergency funding provided by government authorities, combined with the asset mobility and intellectual capital of the university ecosystem and the operational agility of hospital management, converged to form an integrated organizational response. This macro- and micro-orchestration supported the organization against cascading failures (Haley et al., 2021; Institute of Medicine, 2012), demonstrating that RSUI successfully transformed past vulnerabilities into a resilient ecosystem for future healthcare delivery.

To further enrich the theoretical discussion, RSUI's adaptive responses can be compared to various international hospital resilience experiences during biological crises. In Lombardy, Italy, high-technology tertiary hospitals faced immediate system saturation because they lacked pre-existing, flexible cohorting protocols, and rigid boundaries prevented rapid spatial repurposing under the sudden influx of critical patients (Carenzo et al., 2020; Nacoti et al., 2020). Conversely, RSUI's ability to quickly scale up its space by converting VIP wards and setting up external triage tents mirrors the spatial re-engineering witnessed at New York-Presbyterian Hospital in the United States, which utilized mechanical ventilation adjustments and HEPA filters to prevent cross-contamination. In terms of human resource constraints, RSUI's model of recruiting and training over 1,000 healthcare students as volunteers aligns with the mobilization patterns utilized by various NHS Trusts in the United Kingdom, where medical students were integrated under complex adaptive conditions to absorb clinical workloads. This comparative alignment is consistent with the findings of the French national study by Malléjac & Or (2025), which concluded that long-term hospital recovery and resilience are not determined by baseline physical assets, but by the quality and flexibility of the clinical governance standards of care implemented during peak crisis periods. Furthermore, experiences in Singapore and Hong Kong highlight the critical role of coordinated health system resilience, while the preventive-focused governance in Vietnam and Wuhan's response to severe critical care crises demonstrate how multi-actor alignment can prevent curative system paralysis (Nguyen et al., 2021; Xie et al., 2020).

The RSUI sustainable healthcare model can also be considered for adaptation by other medical institutions, such as regional public hospitals (RSUD) and private hospitals, that may lack similar institutional privileges. While RSUI's status as a state university hospital provided distinct advantages in academic intellectual capital and asset mobilization, the underlying principles of three-pillar synergy and decision-space expansion are broadly transferable across diverse healthcare settings. The process of converting physical parking spaces into outpatient clinics, establishing localized procurement taskforces, and creating negative-pressure ventilation modifications can be replicated by any public or regional hospital facing severe resource scarcity under biological threats. To ensure successful replication, external policymakers must proactively establish a protective command framework that legally protects local hospital directors, thereby reducing the administrative fear of financial audit sanctions during emergency procurement maneuvers (Bower, 2016). Furthermore, the transferability of this model to non-academic healthcare facilities relies on formalizing cross-sectoral resilience networks before a crisis manifests (Comfort et al., 2010). Non-academic hospitals can achieve a functionally equivalent buffer by establishing pre-signed Memorandums of Understanding (MoUs) with local technical colleges for rapid medical device engineering and local hotels for staff housing. Replicating RSUI's digital integration, specifically connecting local SIMRS data directly to regional public health dashboards, is also vital for non-academic facilities to ensure transparency and facilitate external resource-pooling. By transforming reactive, temporary emergency procedures into permanent, standardized Contingency Plans, any public healthcare facility can successfully build everyday resilience and transition from a rigid bureaucracy into an agile complex adaptive system capable of surviving future health disasters (Kraus et al., 2025). To ensure the trustworthiness of these qualitative findings, data validation through

source, method, and time triangulation was executed in accordance with qualitative research standards (Arianto, 2024; Creswell & Poth, 2018).

4. Conclusions

The COVID-19 pandemic severely tested the operational systems of the Universitas Indonesia Hospital (RSUI), which were previously constrained by standard public governance structures. Within the global paradigm of Disaster Risk Reduction (DRR) under the Sendai Framework 2015–2030, this study demonstrates how a state university hospital adapted its operational model during a biological crisis. First, regarding the operational execution of surge capacity, RSUI expanded its capabilities beyond conventional limits through systematic re-engineering of the four core pillars: Space, Staff, Supplies, and Systems (4S). These included repurposing hospital spaces, recruiting additional personnel, introducing flexible emergency procurement, and adapting clinical protocols. The findings suggest that expanded local decision space supported RSUI's ability to adjust operations and maintain healthcare services during periods of increased demand.

Second, regarding the efficacy of multisectoral orchestration, the study demonstrates that the 5C coordination framework (Command, Control, Communication, Coordination, and Collaboration) supported organizational resilience through a robust Three-Pillar Synergy. Vertical command provided legal legitimacy and administrative protection, facilitating resource allocations such as BOPTN and BTT grants. This framework enabled horizontal communication and coordination, synchronizing hospital data with emergency dashboards. Furthermore, collaboration among university faculties, government bodies, and civil philanthropy networks supported student volunteer mobilization and the development of medical device innovations like COVENT-20 and DSS-CovidNet, helping to limit cascading operational disruptions.

Third, concerning long-term functional preparedness, the multi-criteria evaluation indicates that RSUI achieved an improved adaptive state across core parameters. Post-adaptation evaluations show substantial progress from baseline vulnerabilities through fast-track emergency procurement and external donor integration. However, the findings reveal remaining relative operational bottlenecks, particularly in staff working times due to nurse burnout and the underutilized heliport area constrained by regional aviation regulations. To support ongoing readiness, emergency response practices were integrated as organizational lessons within the RSUI 2024–2029 Strategic Plan (Renstra), suggesting a pathway toward sustained disaster preparedness.

Fourth, despite these contributions, this study is subject to methodological limitations. As a single-case study focused on an academic healthcare institution with specific university privileges, the findings may not be directly generalizable to other public healthcare facilities operating under different institutional arrangements. Additionally, retrospective key informant interviews introduce potential recall bias, which was mitigated through data triangulation with official hospital evaluation reports and documentation. Future research should pursue multi-center comparative studies involving regional public hospitals (RSUD) and non-academic clinical facilities, as well as examine this resilience model under non-biological disaster contexts to evaluate its broader applicability.

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Author Contribution

Conceptualization, A.S.; Methodology, A.S., R.P., and T.E.B.S.; Formal Analysis, A.S.; Investigation, A.S.; Resources, A.S.; Data Curation, A.S.; Writing – Original Draft Preparation,

A.S.; Writing – Review & Editing, A.S., R.P., and T.E.B.S.; Supervision, R.P., and T.E.B.S. All authors have read and agreed to the published version of the manuscript.

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Ethical Review Board Statement

The study was conducted in accordance with the applicable ethical research guidelines and approved by the Ethics Committee of Rumah Sakit Pendidikan Universitas Indonesia (protocol code 2026-06-127 and date of approval 16 June 2026).

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The datasets presented in this article are not readily available in the public domain due to privacy, confidentiality, and ethical restrictions imposed by the hospital management. Requests to access the datasets should be directed to the corresponding author.

Conflicts of Interest

The authors declare no conflict of interest.

Declaration of Generative AI Use

During the preparation of this work, the author used generative artificial intelligence (AI) tools to assist in summarizing, extracting, and analyzing secondary data. After using this tool, the author reviewed and edited the content as needed and took full responsibility for the content of the publication.

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