



Review

Digital Fatigue and Performance Challenges in Smart Hospitals: A Workforce Resilience Perspective

Anton Nugroho^{1*}, Aris Sarjito¹, Deni Setiawati¹, Lusianah², Wenni Mustika¹

¹Faculty of Defense Management, Universitas Pertahanan Republik Indonesia, DKI Jakarta, Indonesia

²Faculty of Health Sciences, Institut Kesehatan dan Teknologi Pondok Karya Pembangunan, DKI Jakarta, Indonesia

*Corresponding Author anton.nugroho@idu.ac.id



ARTICLE INFO

Article History:

Received: 2025-11-03

Published: 2026-03-16

Keywords:

Digital fatigue; Smart hospitals; Performance paradox; Human resource resilience; Health governance.

ABSTRACT

Background: Digital transformation in hospital systems has accelerated globally, embedding electronic health records, clinical decision-support systems, interoperability platforms, and performance dashboards into governance architectures. Leading institutions, including the World Health Organization and the Organisation for Economic Co-operation and Development, position digital health as central to system resilience and efficiency. However, growing scholarship highlights unintended consequences, including documentation burden, alert overload, and clinician cognitive strain. This study develops a governance-oriented interpretive model linking digital work intensification, digital fatigue, performance paradox dynamics, and multilevel human resource (HR) resilience in smart hospitals. **Methods:** A qualitative secondary analysis was conducted on 28 documents (2020–2026), comprising peer-reviewed articles, international policy reports, and institutional governance frameworks. Reflexive thematic analysis, informed by socio-technical systems theory, performance paradox theory, and workforce resilience theory, was applied to examine documents as institutional artifacts shaping accountability regimes, workload structures, and adaptive capacities. **Results:** Four governance-mediated dynamics were identified. First, digital work intensification emerged through expanded documentation mandates, dense alert systems, and interoperability-driven coordination complexity. Second, digital fatigue was framed as an institutional risk marked by cumulative cognitive load and relational strain. Third, a performance paradox was evident, with efficiency gains coexisting alongside workforce strain. Fourth, HR resilience, through individual coping, team buffering, and participatory IT governance, functioned as an adaptive moderator but did not eliminate structural workload misalignment. **Conclusion:** Workforce sustainability in digitally intensive hospitals depends less on technological sophistication than on governance alignment among accountability systems, digital infrastructure, and human capacity.



©2026 by the authors. Submitted for possible open-access publication under the terms and conditions of the Creative Commons Attribution (CC BY SA) license (<https://creativecommons.org/licenses/by-sa/4.0/>)

INTRODUCTION

The global health sector is undergoing accelerated digital transformation, marked by the widespread integration of electronic health records (EHRs), clinical decision support systems, artificial intelligence (AI), interoperability infrastructures, and advanced analytics platforms. In this study, a smart hospital is defined as a digitally intensive healthcare organization that

systematically integrates interoperable information systems into clinical, administrative, and managerial workflows to enhance coordination, monitoring, and performance accountability (OECD, 2023; World Health Organization, 2023). This definition focuses specifically on governance-embedded digital infrastructures and excludes broader community-based or telehealth-only settings.

International policy frameworks position digital health as a strategic pillar for strengthening system resilience, efficiency, and post-pandemic reform agendas (WHO, 2020; OECD, 2023). However, alongside measurable gains in data integration and operational reporting, emerging empirical evidence indicates uneven workforce consequences. Clinicians increasingly report documentation expansion, alert overload, workflow fragmentation, and escalating cognitive workload associated with digitally mediated practice (Yan et al., 2021; Moy et al., 2023; Kremer et al., 2022). These findings suggest that digital transformation reshapes not only technological infrastructure but also the organization, pacing, and cognitive architecture of clinical work.

Within digitally dense environments, healthcare professionals have become a vulnerable occupational group. We define digital fatigue as cumulative cognitive and emotional depletion arising specifically from sustained engagement with digital interfaces, automated alerts, and performance-monitoring systems. This construct is analytically distinct from general occupational burnout because it is rooted in socio technical interaction patterns rather than solely in workload volume (Muhamad et al., 2025; Nisafani et al., 2020). Digital fatigue, as conceptualized here, refers exclusively to fatigue mechanisms mediated by digital infrastructures and governance design.

At the organizational level, workforce strain often coexists with reported improvements in measurable efficiency indicators such as throughput, reporting compliance, and documentation completeness. This coexistence reflects what we conceptualize as a performance paradox in smart hospital governance systems. The performance paradox refers to a governance-level misalignment in which expansion of quantifiable efficiency metrics occurs alongside persistent or emerging concerns regarding workforce sustainability, relational care quality, or safety culture (OECD, 2023; Schlicht et al., 2025). This definition excludes purely financial performance debates and instead focuses on tensions between metric-driven accountability systems and the socio-technical realities of clinical practice.

In response to intensified digital strain, healthcare organizations mobilize adaptive capacities that we conceptualize as human resource (HR) resilience. In this study, HR resilience refers to multilevel institutional adaptive capacities, spanning individual, team, and organizational levels, that enable sustained functioning under digitally intensified governance conditions (Yu et al., 2024; Ren et al., 2008). Importantly, resilience is treated not as an individual personality trait but as a governance-embedded capability shaped by staffing models, workflow architecture, accountability systems, and participatory IT oversight mechanisms.

Although prior studies have examined technostress, documentation burden, EHR-related burnout, and resilience interventions, these strands remain fragmented across disciplinary silos. Most analyses focus on individual-level outcomes or specific technological implementations. Less attention has been given to how institutional governance arrangements configure digital work intensification, shape fatigue dynamics, and structure performance tensions within an integrated analytical framework.

To address this gap, this study advances an institutional governance perspective that integrates digital work intensification, digital fatigue, performance paradox dynamics, and HR resilience mechanisms within a unified conceptual model. Rather than testing causal relationships or conducting a systematic review of outcomes, this study employs qualitative secondary document analysis to develop a governance-oriented interpretive framework.

Specifically, this study addresses three research questions:

1. RQ1: How do institutional and policy documents construct and frame digital work intensification in smart hospital environments?
2. RQ2: How is digital fatigue represented as a governance-related risk, and how is it associated with narratives of performance tension or paradox?

3. RQ3: How are multilevel HR resilience mechanisms articulated as adaptive governance responses within digitally intensified hospital systems?

The intended contribution of this study is the development of a governance-level interpretive model linking digital work intensification → digital fatigue → performance paradox dynamics, moderated by multilevel HR resilience capacities. By conceptualizing these relationships within governance and work-design architectures, the study moves beyond descriptive accounts of digital strain and offers a structured analytical lens for understanding how socio-technical design choices shape workforce sustainability and institutional performance.

Through this document-based qualitative analysis, the study contributes to global health governance scholarship by:

1. Tightening conceptual boundaries between digital fatigue and general burnout;
2. Reframing the performance paradox as a governance misalignment rather than a technological failure;
3. Positioning HR resilience as a system-level adaptive capability embedded in institutional design.

These contributions extend existing research by providing a multi-level governance mechanism model rather than a narrative synthesis of prior findings.

METHODS

Study Design and Qualitative Orientation

This study employed a qualitative research design using qualitative secondary data analysis (QSA) to examine institutional governance dynamics in smart hospital systems. QSA is an established interpretive methodology that re-analyzes existing textual materials to generate new conceptual insights while remaining grounded in their original contexts (Connor & Cba, 2020; Colorafi & Evans, 2016).

The study was explicitly exploratory and interpretive. It did not aim to conduct a systematic review, meta-analysis, or quantitative evidence synthesis. Instead, documents were treated as social and institutional artifacts that construct governance logics, policy priorities, accountability regimes, and socio-technical arrangements embedded within digital health transformation (Braun & Clarke, 2021).

This design was selected because governance structures, regulatory logics, and institutional workload mechanisms are frequently articulated in formal policy documents, institutional reports, and academic analyses rather than solely in interview-based accounts.

Data Sources and Study Context

The study adopted an international and multi-contextual scope to reflect the global nature of digital health transformation. The analytical corpus consisted of 28 documents published between January 2020 and April 2026.

Three categories of documents were included:

1. Peer-reviewed journal articles addressing digital transformation, digital workload, technostress, performance dynamics, and workforce resilience.
2. International organizational reports (e.g., World Health Organization; OECD) on digital governance, workforce sustainability, and system resilience (World Health Organization, 2020, 2023; OECD, 2023).
3. National and institutional policy documents, including digital health strategies, hospital IT governance frameworks, and patient safety reports.

A detailed summary of corpus characteristics (document type, year, regional scope, stakeholder perspective, and rationale for inclusion) is provided in Appendix Table A1 to enhance transparency and auditability.

Document Selection Strategy and Audit Trail

Document identification followed purposive and theoretically informed sampling consistent with qualitative interpretive methodology (Colorafi & Evans, 2016). Searches were

conducted between January and March 2026 using Scopus, PubMed, and Web of Science. These were supplemented by targeted searches of official WHO and OECD repositories.

Search strings combined terms related to digital transformation and governance, including: “smart hospital,” “digital hospital,” “electronic health records,” “technostress,” “digital workload,” “burnout,” “performance paradox,” “health governance,” and “resilience.” The searches were iterative rather than exhaustive. Newly identified documents were assessed for their theoretical contribution to understanding governance fatigue performance dynamics.

Inclusion criteria required that documents:

1. Address digital technologies in hospital or institutional healthcare settings
2. Discuss governance, workload intensification, digital fatigue/technostress, performance, or resilience
3. Provide substantive conceptual, analytical, or policy discussion
4. Be published between 2020–2026
5. Be publicly accessible and attributable

The documents were excluded if they focused solely on technical software development without governance implications, addressed non-clinical digital health contexts, lacked analytical depth, or were purely opinion-based without institutional relevance. Conceptual saturation was considered achieved when additional documents no longer contributed novel governance dimensions or fatigue performance linkages, consistent with reflexive qualitative standards of analytic sufficiency (Braun & Clarke, 2021).

Analytical Framework and Units of Analysis

The analytical integrated three complementary theoretical perspectives:

1. Socio technical systems theory
2. Performance paradox theory
3. Workforce resilience theory

These frameworks enabled examination of how digital infrastructures interact with governance architectures across institutional levels. The primary units of analysis were institutional processes and governance mechanisms rather than individual actors. Analysis was structured across three levels:

1. Individual level (cognitive load, emotional strain, professional agency)
2. Team level (coordination buffering, informal adaptation, communication practices)
3. Organizational level (governance structures, accountability systems, staffing models, digital oversight mechanisms)

Coding Procedure and Reflexive Thematic Analysis

The data were analyzed using reflexive thematic analysis as articulated by Braun and Clarke (2021). The analytic process involved six phases, namely:

1. Familiarization and reflexive memoring
2. Open inductive coding
3. Code clustering
4. Preliminary theme development
5. Iterative theme refinement
6. Theoretical integration

Coding was conducted manually in Microsoft Excel to enable detailed engagement with textual nuances. An evolving analytic codebook was maintained, including code labels, operational definitions, inclusion/exclusion criteria, and illustrative excerpts. To enhance interpretive rigor, two researchers independently coded an initial subset of documents (n=15) to establish conceptual alignment. Differences were resolved through reflexive dialogue rather than statistical reliability testing, consistent with the epistemological stance of reflexive thematic analysis (Braun & Clarke, 2021).

Trustworthiness, Reflexivity, and Ethical Considerations

The trustworthiness was strengthened through triangulation across academic, policy, and institutional documents; transparent documentation of search and inclusion procedures; maintenance of an analytic codebook; and reflexive memoing throughout theme development. The research team, with backgrounds in health governance and organizational studies, approached the corpus with sensitivity to institutional design mechanisms. Reflexive documentation was maintained to critically examine how disciplinary positioning shaped interpretation. The study relied exclusively on publicly available documents and did not involve human participants; therefore, formal ethical approval was not required. All materials were accessed through official databases or institutional repositories to ensure source authenticity and compliance with copyright standards.

RESULTS

Institutional Reconfiguration of Clinical Work Under Digital Governance

Analysis of the 28-document corpus (2020–2026) demonstrates that digital transformation in smart hospital systems constitutes a structural reconfiguration of institutional work rather than a purely technological upgrade. Across diverse geographic contexts, four interdependent governance-mediated dynamics were identified: digital work intensification, digital fatigue as systemic risk, performance paradox dynamics, and adaptive human resource resilience. These themes do not operate independently. Instead, they form a sequential and reinforcing institutional cycle through which digital infrastructures reshape labor distribution, accountability structures, and adaptive responses within hospital systems. To enhance analytical transparency, Table 1 below summarizes the thematic architecture, core mechanisms, and cross-document prevalence:

Table 1. Thematic Architecture of Digital Governance Dynamics

Major Theme	Core Institutional Mechanism	Representative Governance Expression	Documents Referencing (n)	Pattern Classification
Digital Work Intensification	Expansion of documentation mandates; alert density; coordination interdependence	Compliance-driven EHR documentation; high override alert environments; interoperability without workflow redesign	18	Dominant
Digital Fatigue as Institutional Risk	Cumulative cognitive load; emotional detachment; safety vulnerability	Task-switching strain; screen-mediated relational erosion; fatigue-linked error susceptibility	16	Dominant–Recurrent
Performance Paradox Dynamics	Metric optimization vs experiential strain	Improved reporting compliance alongside professional overload; emergence of shadow systems	14	Recurrent
Human Resource Resilience	Individual coping; team buffering; participatory governance adaptation	Digital self-regulation; workload redistribution; alert customization and feedback loops	12	Recurrent

*notes:

Pattern definitions:

Dominant = present in >50% of corpus

Recurrent = present in 30–50% of the corpus

Frequency counts reflect qualitative coding prevalence and do not represent statistical measurement.

Theme 1: Digital Work Intensification as Governance-Induced Expansion

Digital work intensification emerged as the most consistently represented institutional dynamic. Importantly, intensification was not framed primarily as a technological malfunction but as a consequence of governance architecture. Across hospital systems, documentation requirements were described as extending beyond clinical necessity into compliance-oriented traceability regimes (Moy et al., 2023; Schlicht et al., 2025). Digital systems institutionalized metric visibility, embedding accountability expectations directly into everyday clinical workflows. This restructuring expanded the volume and fragmentation of clinical documentation.

Alert proliferation represented a parallel intensification pathway. High-frequency clinical decision-support prompts—particularly in medication and diagnostic environments—were associated with cognitive interruption and normalization of override behavior (Rotenstein et al., 2024; WHO, 2022). Safety infrastructures thus simultaneously functioned as workload amplifiers.

Coordination complexity further illustrated governance-mediated restructuring. Interoperability initiatives increased digital handoffs and cross-unit dependencies. OECD (2023) emphasized that integration without aligned decision authority may generate coordination latency rather than efficiency. Collectively, these mechanisms demonstrate that digital intensification reflects institutional embedding of accountability systems rather than isolated software inefficiencies.

Theme 2: Digital Fatigue as Systemic Institutional Risk

Digital fatigue was widely conceptualized as a structural risk rather than individual vulnerability. Cognitive exhaustion associated with persistent task-switching and fragmented workflows was recurrent across the corpus (Moy et al., 2023; Muhamad et al., 2025). Fatigue emerged as cumulative and embedded in digital system design. Beyond cognitive depletion, emotional detachment associated with screen-mediated care signaled erosion of relational engagement (Kaptanoğlu, 2025; Schlicht et al., 2025). This indicates that digital governance reshapes not only workload intensity but also affective dimensions of professional practice.

Importantly, multiple documents reframed fatigue as a patient safety issue. High-alert and high-documentation environments were linked to increased error susceptibility (WHO, 2022). This shifts analytic attention from individual burnout to governance-level workload configuration. The findings extend technostress literature by situating fatigue within institutional accountability design rather than individual coping failure.

Theme 3: Performance Paradox, Metric Visibility and Experiential Strain

A recurrent cross-document narrative involved the coexistence of measurable efficiency gains and workforce strain. Digitally advanced systems demonstrated improved documentation completeness and reporting timeliness (OECD, 2023). However, these gains frequently coincided with professional overload and workflow fragmentation (Preko et al., 2022). This divergence constitutes a performance paradox: metric rationalization enhances institutional visibility while redistributing labor intensity downward to frontline professionals.

Informal workarounds—such as parallel communication channels and delayed system entry (Siddiqi, 2024)—emerged as adaptive responses to digital misalignment. While these practices enhance short-term functionality, they signal structural tension between formal governance systems and situated clinical realities. The performance paradox thus reflects a governance-level conflict between accountability optimization and sustainable professional practice.

Theme 4: Human Resource Resilience as Adaptive Layer

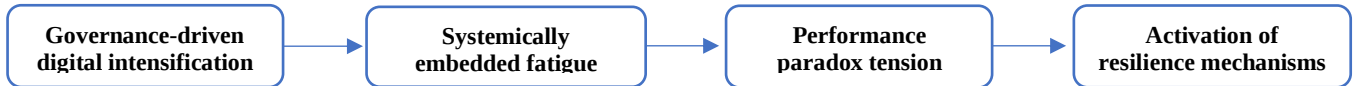
Resilience mechanisms functioned as adaptive responses within digitally intensified systems. At the individual level, digital self-regulation strategies were documented in nursing and physician contexts (Yu et al., 2024). At the team level, workload redistribution buffered interruption density, echoing coordination research in complex systems (Ren et al., 2008).

At the organizational level, participatory IT governance, alert customization, and structured feedback loops were identified as resilience-enabling mechanisms (WHO, 2022; OECD, 2023).

Systems embedding user participation into digital oversight structures demonstrated greater adaptive capacity. However, resilience operated primarily as a buffering layer. Without governance redesign, resilience mechanisms mitigated but did not eliminate systemic misalignment.

Integrated Institutional Dynamics

Across geographic contexts, a consistent institutional sequence was observable:



This sequence reframes digital transformation in hospital systems as an institutional governance process that redistributes labor, restructures accountability, and generates adaptive compensation. Outcomes depend less on technological sophistication alone and more on the alignment between digital infrastructure and governance architecture.

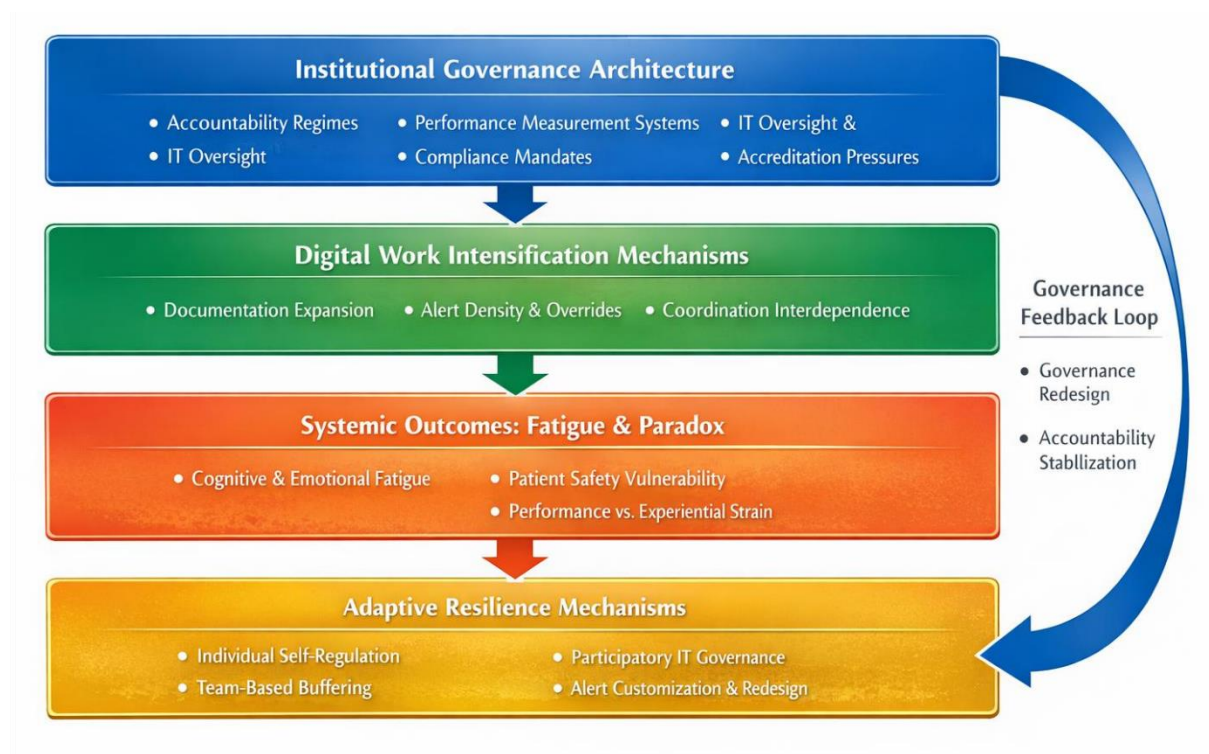


Figure 1. Multi-level governance model of digital strain dynamics in smart hospital systems

DISCUSSION

Overview of Interpretive Findings

This study explored how digital transformation in hospital systems is institutionally framed within a corpus of 28 documents published between 2020 and 2026. Through qualitative secondary analysis, four interrelated patterns were identified: digital work intensification, digital fatigue as institutional risk, performance tension dynamics, and multilevel human resource resilience mechanisms.

The purpose of this discussion is not to establish causal relationships between digitalization and workforce outcomes. Rather, it is to interpret recurring thematic patterns observed across diverse governance contexts and to situate them within broader socio-technical and institutional frameworks. The findings suggest that digital infrastructures do not operate independently; instead, their effects are mediated through regulatory, organizational, and performance governance arrangements.

Digital Work Intensification as a Governance-Embedded Process

Across the corpus, digital transformation is consistently associated with expanded documentation architectures, high-density alert systems, and increasingly complex coordination requirements. Importantly, these developments are not presented as technical anomalies. Instead, they are embedded within institutional logics emphasizing accountability, safety compliance, interoperability, and performance measurement (OECD, 2023; WHO, 2022).

Documentation expansion is frequently described as extending beyond direct clinical communication toward auditability and reporting traceability (Moy et al., 2023; Schlicht et al., 2025). Similarly, alert proliferation reflects precautionary regulatory frameworks that prioritize risk minimization. While such systems are designed to enhance safety and standardization, they may simultaneously increase interruption frequency and cognitive switching demands (Rotenstein et al., 2024).

Interoperability initiatives further illustrate this governance-embedded intensification. Efforts to digitally integrate departments and services may increase cross-unit dependencies and digital handoffs, thereby reshaping coordination structures (El Arab et al., 2025). Taken together, digital work intensification appears not merely as a technological outcome but as a structural feature of governance systems prioritizing transparency, compliance, and measurable outputs.

Institutional Fatigue Risk as an Emergent Condition

Within the analyzed documents, fatigue-related phenomena are predominantly framed at an institutional level rather than solely as individual psychological responses. Cognitive exhaustion, attentional fragmentation, and emotional detachment are described in relation to sustained exposure to digitally mediated workflows characterized by interruptions and documentation density (Moy et al., 2023; Muhamad et al., 2025).

Importantly, the study does not assert that digital systems directly cause burnout or patient safety failures. Instead, the recurring co-occurrence of digital intensification and fatigue-related indicators suggests a patterned vulnerability. Fatigue, in this interpretive framing, emerges as a systemic risk condition under cumulative digital load rather than as an isolated outcome attributable to individual resilience deficits. In several governance-oriented documents, fatigue is explicitly framed as a potential institutional safety concern (WHO, 2022; Verhagen et al., 2022). This framing shifts attention from personal coping capacity toward structural design features and workload architectures.

Performance Tensions and Measurement Architecture

One of the central interpretive insights of this study concerns the coexistence of efficiency gains and workforce strain. Multiple documents report improvements in documentation completeness, digital traceability, and process standardization within performance measurement systems (OECD, 2023). At the same time, empirical studies describe increased documentation time, after-hours digital work, and cognitive load indicators (Kremer et al., 2022; Moy et al., 2023).

This pattern suggests the presence of performance tensions. Rather than indicating technological failure, these tensions may reflect asymmetry within measurement architectures. Quantifiable compliance and throughput indicators are frequently prioritized, whereas workforce sustainability metrics receive less systematic integration. Such dynamics do not imply that digitalization reduces quality of care. Instead, they indicate that institutional performance regimes may emphasize measurable outputs without fully capturing relational, cognitive, and sustainability dimensions of clinical work.

Multilevel Human Resource Resilience

The corpus also documents adaptive responses across individual, team, and organizational levels. At the individual level, clinicians employ self-regulation strategies to manage interruption density and documentation burden (Yu et al., 2024). At the team level, workload redistribution and informal coordination practices function as buffering mechanisms under digitally intensive conditions (Ren et al., 2008).

At the organizational level, participatory IT governance structures, structured alert calibration processes, and workflow redesign initiatives are described as mechanisms that moderate digital strain (WHO, 2022; OECD, 2023). These governance adaptations suggest that resilience is not solely an individual attribute but may constitute an institutional capability shaped by leadership and regulatory design. Importantly, resilience mechanisms appear to mitigate rather than eliminate structural intensification. Where governance redesign is limited, adaptive practices may stabilize systems temporarily without addressing underlying workload architecture.

Integrative Interpretation of Institutional Pathways

Synthesizing these findings, the relationship between digital transformation and workforce experience can be interpreted as an interconnected institutional process. Digital work intensification constitutes the structural condition shaped by governance priorities. Under sustained intensification, institutional fatigue risk may become more visible as a cumulative vulnerability. Where fatigue risk coexists with performance regimes emphasizing measurable efficiency, tensions may surface between output indicators and workforce sustainability.

However, these dynamics are not deterministic. Multilevel resilience mechanisms—particularly those embedded in participatory governance and workflow redesign—may moderate how digital intensification translates into strain. These linkages represent analytically derived pathways grounded in thematic recurrence across the 28 documents corpus. They should not be interpreted as empirically validated causal chains but as theoretically informed interpretive propositions. The explanatory relevance of this governance-based interpretation appears strongest in digitally mature hospital systems characterized by advanced EHR integration and structured accountability frameworks. In settings with limited digital infrastructure or early-stage implementation, digital fatigue may not manifest as prominently. Variation in staffing ratios, regulatory regimes, and participatory governance models likely moderates how digital intensification is experienced. These contextual differences underscore the importance of avoiding universal generalization.

This study contributes to socio-technical systems scholarship by explicitly situating digital workload effects within governance architectures. Rather than attributing workforce strain to individual adaptation capacity or technological design alone, the analysis emphasizes institutional mediation through regulatory priorities and performance measurement structures. By integrating technostress perspectives, governance theory, and performance measurement analysis, the study advances a multi-level interpretive framework that conceptualizes digital fatigue and performance tensions as governance-conditioned phenomena.

Limitations

The findings are based on qualitative secondary analysis and therefore cannot establish causal inference or prevalence estimates. Thematic frequency reflects recurrence within the 28-document corpus rather than population-level magnitude. Publication bias and heterogeneous reporting standards across countries further constrain generalizability. Accordingly, the results should be interpreted as conceptual pattern identification within institutional discourse.

Future Research Direction

Future research should prioritize primary qualitative studies capturing frontline experiences, longitudinal analyses of governance adaptation, and mixed-method designs linking digital workload metrics with workforce and safety outcomes. Comparative studies across varying levels of digital maturity would further clarify boundary conditions and test the proposed interpretive pathways.

CONCLUSION

This qualitative secondary analysis of 28 documents examined how digital transformation in hospital systems is institutionally framed in relation to workforce sustainability and

organizational performance. Four interrelated themes were identified: digital work intensification, digital fatigue as an institutional risk, performance tension dynamics, and multilevel human resource resilience mechanisms.

Across the corpus, digital infrastructures—particularly expanded documentation regimes, alert-dense decision support systems, and interoperability driven coordination structures were recurrently described as reshaping clinical workflows. These shifts were frequently situated within governance environments emphasizing accountability, compliance, safety, and measurable efficiency. Rather than depicting digital technologies as inherently detrimental, the findings suggest that their workforce implications are mediated through institutional design and performance architectures.

The analysis indicates that digital fatigue is most coherently understood as a governance-sensitive condition emerging under sustained digital intensification. In parallel, performance tensions become visible where efficiency and reporting gains coexist with indicators of workforce strain or relational care challenges. These dynamics do not imply technological failure; rather, they highlight potential misalignment between digital capability, measurement systems, and human sustainability indicators.

Human resource resilience emerges across individual, team, and organizational levels as a moderating capacity. However, reliance on adaptive coping mechanisms without corresponding governance redesign may stabilize systems temporarily while leaving structural workload configurations intact.

From a policy perspective, the findings underscore the importance of embedding workforce centered indicators within digital performance frameworks. Governance levers such as structured alert calibration, documentation rationalization, participatory IT oversight, and staffing realignment may help recalibrate the relationship between digital expansion and workforce capacity. Incorporating measurable indicators, including documentation time, after-hours digital work, and alert burden, into institutional dashboards may strengthen alignment between technological advancement and organizational sustainability.

Future research should empirically examine the proposed institutional pathways through longitudinal, comparative, and mixed-method designs across varying levels of digital maturity. Testing governance interventions in real-world settings would further clarify how digital workload structures interact with resilience mechanisms over time. Ultimately, the sustainability of digitally intensive hospital systems depends not solely on technological sophistication but on governance architectures capable of balancing accountability, efficiency, and human capacity. Aligning digital transformation strategies with workforce sustainability principles remains central to achieving resilient and high quality health systems in the digital era.

Author's Contribution (Credit): Anton Nugroho: Conceptualization, Methodology, Formal analysis, Data curation, Investigation, Writing (Original Draft, Visualization); Aris Sarjito: Methodology, Validation, Writing (Review & Editing, Supervision); Deni Setiawati: Literature review, Data curation, Writing (Review & Editing); Lusianah: Theoretical framing, Interpretation of findings, Writing (Review & Editing); Wenni Mustika: Supervision, Project administration, Critical revision of the manuscript.

Conflicts of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Source of Funding Statements: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. The funding body had no role in the study design, data analysis, interpretation, or manuscript preparation.

Acknowledgments: The authors acknowledge the contributions of international health institutions and scholars whose publicly available reports and peer-reviewed publications informed this analysis. Appreciation is also extended to colleagues who provided constructive academic feedback during manuscript development.

BIBLIOGRAPHY

- AlMarri, M., Al-Ali, M., Alzarooni, M., AlTeneiji, A., Al-Ali, K., & Bahroun, Z. (2025). Enterprise resource planning systems for health, safety, and environment management: Analyzing critical success factors. *Sustainability*, 17(7), 2947. <https://www.mdpi.com/2071-1050/17/7/2947>
- Braithwaite, J. (2024). Peaceful independence for Bougainville: In the interests of the United Nations, United States, China, Australia, New Zealand, Papua New Guinea and the People of Bougainville? *United States, China, Australia, New Zealand, Papua New Guinea and the People of Bougainville*. <https://papers.ssrn.com/sol3/Delivery.cfm?abstractid=4946205>
- Braun, V., & Clarke, V. (2021). One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qualitative Research in Psychology*, 18(3), 328–352. <https://doi.org/10.1080/14780887.2020.1769238>
- Colorafi, K. J., & Evans, B. (2016). Qualitative Descriptive Methods in Health Science Research. 1–11. <https://doi.org/10.1177/1937586715614171>
- Connor, S. O., & Cba, C. (2020). Secondary Data Analysis in Nursing Research : A Contemporary Discussion. <https://doi.org/10.1177/1054773820927144>
- El Arab, R. A., Abu-Mahfouz, M. S., Abuadas, F. H., Alzghoul, H., Almari, M., Ghannam, A., & Seweid, M. M. (2025). Bridging the gap: From AI Success in clinical trials to real-world healthcare implementation—A narrative review. In *Healthcare (Switzerland)* (Vol. 13, Number 7). Multidisciplinary Digital Publishing Institute (MDPI). <https://doi.org/10.3390/healthcare13070701>
- Kaptanoğlu, R. Ö. (2025). The Human face of digitalization in healthcare: A mixed-methods study on the relationship between emotional intelligence and burnout. *Behavioral Sciences*, 15(11), 1505. <https://doi.org/10.3390/bs15111505>
- Kremer, L., Lipprandt, M., Röhrig, R., & Breil, B. (2022). Examining mental workload relating to digital health technologies in health care: Systematic review. *J Med Internet Res*, 24(10), e40946. <https://doi.org/10.2196/40946>
- Lewis, R., Yarker, J., Donaldson-Feilder, E., Flaxman, P., & Munir, F. (2010). Using a competency-based approach to identify the management behaviours required to manage workplace stress in nursing: A critical incident study. *International Journal of Nursing Studies*, 47(3), 307–313. <https://doi.org/10.1016/j.ijnurstu.2009.07.004>
- Melnick, E. R., Moser, F. P., & Loza, A. J. (2025). Accuracy without compromise: A programming-inspired solution for EHR workflow redesign in the generative AI era. *Discover Artificial Intelligence*, 5(1), 338. <https://doi.org/10.1007/s44163-025-00662-6>
- Merriweather Curtis A., Jr., Lyytinen, K., Aron, D., & Cauley, M. R. (2026). When better data meets better design: How EHR data usability and system usability shape physicians' cognitive load. *Npj Digital Medicine*. <https://doi.org/10.1038/s41746-025-02243-4>
- Moy, A. J., Hobensack, M., Marshall, K., Vawdrey, D. K., Kim, E. Y., Cato, K. D., & Rossetti, S. C. (2023). Understanding the perceived role of electronic health records and workflow fragmentation on clinician documentation burden in emergency departments. *Journal of the American Medical Informatics Association*, 30(5), 797–808. <https://doi.org/10.1093/jamia/ocad038>
- Muhamad, N. A., Ma'amor, N. H., Jamalluddin, N. H., Rosli, I. A., Leman, F. N., Shah, T. P. N. T. B., Misnan, N. S., Abdullah, N., Johari, M. Z., Chami, N., Ibrahim, N., Isa, M. F. M., Sabri, M. A. R., Azmi, A. F., Hussian, R. L. A. R., Heng, C. J., Hao, L. Y., Zakaria, Z. I., Najid, S. N., ... Wei, O. H. (2025). Technostress and its associated factors: Burnout and fatigue among Malaysian healthcare workers (HCWs) in state hospitals. *PLoS ONE*, 20(3 March). <https://doi.org/10.1371/journal.pone.0319506>
- Nisafani, A. S., Kiely, G., & Mahony, C. (2020). Workers' technostress : a review of its causes strains , inhibitors , and impacts. *Journal of Decision Systems*, 00(00), 1–16. <https://doi.org/10.1080/12460125.2020.1796286>
- OECD. (2023). *Health at a glance 2023: OECD indicators*. Paris: OECD Publishing. https://www.oecd.org/en/publications/health-at-a-glance-2019_4dd50c09-en.html

- Preko, M., Shabaya, P., & Anim-Yeboah, S. (2022). Dealing with the unexpected: Exploring the Unintended Negative Consequences of Digitalisation in Africa's Healthcare Industry. In R. Boateng, S. L. Boateng, T. Anning-Dorson, & L. Olumide Babatope (Eds.), *Digital innovations, business and society in Africa: New frontiers and a shared strategic vision* (pp. 115–136). Springer International Publishing. https://doi.org/10.1007/978-3-030-77987-0_6
- Ren, Y., Kiesler, S., & Fussell, S. R. (2008). Multiple group coordination in complex and dynamic task environments: interruptions, coping mechanisms, and technology recommendations. *Journal of Management Information Systems*, 25(1), 105–130. <https://doi.org/10.2753/MIS0742-1222250105>
- Rotenstein, L. S., Hendrix, N., Phillips, R. L., & Adler-Milstein, J. (2024). Team and electronic health record features and burnout among family physicians. *JAMA Network Open*, 7(11), e2442687–e2442687. <https://doi.org/10.1001/jamanetworkopen.2024.42687>
- Schlicht, L., Wendsche, J., Melzer, M., Tschetsche, L., & Rösler, U. (2025). Digital technologies in nursing: An umbrella review. *International Journal of Nursing Studies*, 161, 104950. <https://doi.org/10.1016/j.ijnurstu.2024.104950>
- Siddiqi, K. O. (2024). Impact of technostress and work-family conflict on turnover intention among nurses in Bangladesh: a moderation effect of perceived supervisor support. *Journal of Computational Social Science*, 7(2), 2005–2028. <https://doi.org/10.1007/s42001-024-00296-1>
- Tromp, J., Jindal, D., Redfern, J., Bhatt, A., Séverin, T., Banerjee, A., Ge, J., Itchhaporia, D., Jaarsma, T., & Lanas, F. (2022). World Heart Federation roadmap for digital health in cardiology. *Global Heart*, 17(1), 61. <https://doi.org/10.5334/gh.1141>
- Verhagen, M. J., de Vos, M. S., Smaggus, A., & Hamming, J. F. (2022). Measuring what matters at morbidity and mortality conferences: A scoping review of effectiveness measures. *Journal of Patient Safety*, 18(4). https://journals.lww.com/journalpatientsafety/fulltext/2022/06000/measuring_what_matters_at_morbidity_and_mortality.24.aspx
- WHO. (2020). *Operational framework for primary health care: transforming vision into action*. WHO.
- WHO. (2022, February 28). *Primary health care measurement framework and indicators: monitoring health systems through a primary health care lens*. WHO. <https://www.who.int/publications/i/item/9789240044210>
- World Health Organization. (2023). *A WHO global public health good to support building and strengthening of sustainable health systems resilience in countries with various contexts*. *Health systems resilience toolkit*. <https://iris.who.int/server/api/core/bitstreams/5dee789f-c197-4d45-b1aa-391da7b8bcf8/content>
- Yan, Q., Jiang, Z., Harbin, Z., Tolbert, P. H., & Davies, M. G. (2021). Review Exploring the relationship between electronic health records and provider burnout: A systematic review. 28(February), 1009–1021. <https://doi.org/10.1093/jamia/ocab009>
- Yu, F., Chu, G., Yeh, T., & Fernandez, R. (2024). Effects of interventions to promote resilience in nurses: A systematic review. *International Journal of Nursing Studies*, 157, 104825. <https://doi.org/10.1016/j.ijnurstu.2024.104825>
- Zavaleta-Monestel, E., Söderlund, L.-Å., Guiu-Segura, J. M., Mora-Jiménez, J., & Arguedas-Chacón, S. (2026). Pharmacist burnout: From coping to system accountability in the medication-use process. *Frontiers in Public Health*, Volume 13-2025. <https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2025.1749332>